

# OAKLAND ENERGY



## ENERGY STATEMENT

Client: ABDS LTD

Project: Development at, Meaver Road  
Mullion, HELSTON, TR12 7DP

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EXCELLENCE  
IN ENERGY  
ASSESSMENT

## INTRODUCTION

This report has been prepared by Oakland Energy LTD, under instruction from ABDS to accompany the planning application for 6no. New dwellings at Meaver Road, Mullion.

Cornwall Council has set an ambitious target of becoming net zero by 2030. Policy SEC1 of the Climate Emergency Development Plan Document requires the highest standards of sustainable construction with energy hierarchy as its core principle. This means improving fabric standards, energy efficiency and minimising space heating requirements, before installing renewable energy and then offsetting residual energy if required.

Policy extract showing requirement

### **2b) New Development – Residential**

Residential development proposals will be required to achieve Net Zero Carbon and submit an 'Energy Statement' that demonstrates how the proposal will achieve:

- Space heating demand less than 30kWh/m<sup>2</sup>/annum;
- Total energy consumption less than 40kWh/m<sup>2</sup>/annum; and
- On-site renewable generation to match the total energy consumption, with a preference for roof-mounted solar PV.

Where the use of onsite renewables to match total energy consumption is demonstrated to be not technically feasible (for example with apartments) or economically viable renewable energy generation should be maximised as much as possible; and/or connection to an existing or proposed low carbon district energy network; or where this is not possible the residual energy (the amount by which total energy demand exceeds the renewable energy generation) is to be offset by a contribution to Cornwall Council's Offset Fund.

Where economic viability or technical constraints prevent policy compliance, proposals should first and foremost strive to meet the space heating and total energy consumption thresholds. Proposals must then benefit as much as possible from renewable energy generation and/or connection to an existing or proposed low carbon district energy network. As a last resort, any residual energy is to be offset by a contribution to Cornwall Council's Offset Fund, as far as economic viability allows.

### **5 Water**

All dwellings (including conversions, reversions and change of use) should achieve an estimated water consumption of no more than 110 litres/person/day through the incorporation of water saving measures where feasible.

Requirements of section 6 of the policy SEC1 will be covered in the Design & Access Statement.

## RENEWABLE & LOW CARBON TECHNOLOGIES

**Decentralised Energy** – Energy generated off the main grid and produced close to where it will be used rather than at a large plant and sent through the national grid. It can include micro renewables, heating and cooling.

**District Heating** – is a system for distributing heat generated in a centralised location through a system of insulated pipes for residential and commercial heating requirements.

There are no networks near to the site.

**Electricity generating technologies** – solar pv, wind turbines, hydroelectricity and micro-CHP.

**Solar PV** – These modules convert sunlight into electricity for use in the home or to export to the grid. This is one of the simplest technologies to install and provides a reasonable payback (if roof orientation is suitable).

**Wind Turbines** – These are an effective renewable energy option in terms of energy output but the best sites require an average annual winds speed of at least 5metres per second with an unobstructed flow of wind thus making it inefficient for the most developments.

**Micro-CHP** - is a heating technology which generates heat and electricity simultaneously from the same energy source. This is a low carbon technology.

Hydroelectricity generate electricity from running water, usually a stream. Very site specific and impossible for most sites.

**Heat generating technologies** – solar water heating, biomass heating systems and heat pumps.

**Solar Water Heating** – solar collectors use free heat from the suns rays to warm domestic water which is stored in a hot water cylinder. Low maintenance option subject to the correct roof orientation.

**Biomass heating** – This is considered renewable as the co2 emitted during combustion is offset by that absorbed during growth. It is typically a boiler fired by wood pellets or chips and is a good option for developments that have no access to natural gas as a fuel. It does however require sufficient space on site for the boiler and fuel storage.

**Heat Pumps** - This moves heat energy from one place to another – such as from the ground or air to your central heating system and from a lower to a high temperature. Heat pumps use some electricity but they generate more heat energy than the electrical energy they use. These are a good option when there is no access to gas.

## FIGURES EXPLAINED

The energy consumption figures are taken from SAP 10.2.

The **TER** is the figure required to comply with SAP & Building Regulations.

The **DER** shows the actual heating demand and co2 emissions produced by the proposed dwelling.

### NEW DWELLINGS

- Plot 1 – 76.72m<sup>2</sup>
- Plot 2 – 76.72m<sup>2</sup>
- Plot 3 – 76.72m<sup>2</sup>
- Plot 4 – 76.72m<sup>2</sup>
- Plot 5 – 149.90m<sup>2</sup>
- Plot 6 – 149.90m<sup>2</sup>

### FABRIC FIRST STRATEGY

- Wall U Value – 0.15W/m<sup>2</sup>K
- Roof U Value – 0.10W/m<sup>2</sup>K
- Floor U Value – 0.12W/m<sup>2</sup>K
- Glazing U Value – 1.20W/m<sup>2</sup>K
- Air permeability of 1.5 or lower.

### HEATING & VENTILATION STRATEGY

- Air Source Heat Pump
- Mechanical ventilation with heat recovery

### OVERHEATING MITIGATION

- Low g values

### RENEWABLE ENERGY

- Plot 1 – 4.0kW peak
- Plot 2 – 4.0kW peak
- Plot 3 – 4.0kW peak
- Plot 4 – 4.0kW peak
- Plot 5 – 5.1kW peak
- Plot 6 – 5.1kW peak

## WATER EFFICIENCY

The requirement of **110l/person/day** will be met by using the following:

WC – 6/3 dual flush

Shower – 8l/min

Bath - 180l to overflow

Basin taps 4l/ min

Sink taps – 6l/min

Dishwasher – 1.25l/ per place setting

Washing machine – 8.17l/kg

## CONCLUSION

The thresholds of the Climate Emergency DPD Policy have been met.  
See Energy Summary Spreadsheet for results.

**Report completed on 3<sup>rd</sup> January 2024.**

**By Sophie Oakland - Accredited Assessor EES/011881.**

# Full SAP Calculation Printout



Property Reference	_23.SAP.144 ABDS Mullion p1/3		Issued on Date	03/01/2024	
Assessment Reference	AS DESIGNED	Prop Type Ref			
Property	Development at, Meaver Road, HELSTON, TR12 7DP				
SAP Rating	97 A	DER	-1.11	TER	11.05
Environmental	101 A	% DER < TER			110.05
CO <sub>2</sub> Emissions (t/year)	-0.2	DFEE	39.47	TFEE	48.64
Compliance Check	See BREL	% DFEE < TFEE			18.86
% DPER < TPER	83.29	DPER	9.90	TPER	59.24
Assessor Details	Mrs. Sophie Oakland			Assessor ID	F859-0001
Client	ABDS, ABDS				

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	76.7200 (1b)	2.5000 (2b)	191.8000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	76.7200		191.8000 (4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 191.8000 (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		1.5000 (17)
Infiltration rate		0.0750 (18)
Number of sides sheltered		2 (19)

Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.0638 (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	0.0813	0.0797	0.0781	0.0701	0.0685	0.0606	0.0606	0.0590	0.0638	0.0685	0.0717	0.0749 (22b)
Balanced mechanical ventilation with heat recovery												0.5000 (23a)
If mechanical ventilation												0.5000 (23b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												84.6000 (23c)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												
Effective ac	0.1583	0.1567	0.1551	0.1471	0.1455	0.1376	0.1376	0.1360	0.1407	0.1455	0.1487	0.1519 (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
NEW OPENINGS (Uw = 1.20)			9.2600	1.1450	10.6031		(27)
DOOR			2.2100	1.2000	2.6520		(26)
PAT DOORS (Uw = 1.20)			3.7800	1.1450	4.3282		(27)
Heat Loss Floor 1			76.7200	0.1200	9.2064	75.0000	5754.0000 (28a)
External Wall 1	90.4250	15.2500	75.1750	0.1800	13.5315	60.0000	4510.5000 (29a)
PLANE	76.7200		76.7200	0.1000	7.6720	9.0000	690.4800 (30)
Total net area of external elements Aum (A, m <sup>2</sup> )			243.8650				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	47.9932		(33)
Party Wall 1			8.7300	0.0000	0.0000	110.0000	960.3000 (32)
Internal Wall 2			144.5000			75.0000	10837.5000 (32c)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 22752.7800 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							296.5691 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value		Total



# Full SAP Calculation Printout



E1 Steel lintel with perforated steel base plate	20.5800	0.0650	1.3377
E3 Sill	19.5300	0.0250	0.4883
E4 Jamb	35.4000	0.0200	0.7080
E5 Ground floor (normal)	36.1700	0.0230	0.8319
E10 Eaves (insulation at ceiling level)	16.3200	0.0370	0.6038
E12 Gable (insulation at ceiling level)	19.8500	0.0390	0.7742
E16 Corner (normal)	15.0000	0.0350	0.5250
E17 Corner (inverted - internal area greater than external area)	10.0000	-0.0780	-0.7800
E18 Party wall between dwellings	5.0000	0.0550	0.2750
P1 Party wall - Ground floor	3.4900	0.0580	0.2024
P4 Party wall - Roof (insulation at ceiling level)	3.4900	0.0810	0.2827
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			5.2490 (36)
Point Thermal bridges			0.0000 (36a) =
Total fabric heat loss			53.2422 (37) (33) + (36) + (36a) =

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	10.0183	9.9174	9.8165	9.3121	9.2113	8.7069	8.7069	8.6060	8.9086	9.2113	9.4130	9.6148 (38)
Average = Sum(39)m / 12 =	63.2604	63.1595	63.0587	62.5543	62.4534	61.9490	61.9490	61.8482	62.1508	62.4534	62.6552	62.8569 (39)

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	0.8246	0.8232	0.8219	0.8154	0.8140	0.8075	0.8075	0.8062	0.8101	0.8140	0.8167	0.8193 (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 2.3977 (42)

Hot water usage for mixer showers	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hot water usage for baths	64.4209	63.4528	62.0420	59.3428	57.3509	55.1295	53.8669	55.2669	56.8017	59.1868	61.9439	64.1741 (42a)
Hot water usage for other uses	27.8263	27.4131	26.8311	25.7581	24.9546	24.0637	23.5825	24.1604	24.7896	25.7429	26.8380	27.7323 (42b)
Average daily hot water use (litres/day)	39.1846	37.7597	36.3349	34.9100	33.4851	32.0602	32.0602	33.4851	34.9100	36.3349	37.7597	39.1846 (42c)

Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	131.4319	128.6256	125.2080	120.0109	115.7906	111.2534	109.5095	112.9123	116.5012	121.2645	126.5417	131.0910 (44)
Energy content (annual)	208.1560	183.1611	192.4400	164.2889	155.8764	136.7990	132.4422	139.8091	143.6576	164.5548	180.2818	205.2568 (45)
Distribution loss (46)m = 0.15 x (45)m	31.2234	27.4742	28.8660	24.6433	23.3815	20.5198	19.8663	20.9714	21.5486	24.6832	27.0423	30.7885 (46)

Water storage loss:

Store volume 180.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 1.3200 (48)

Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 0.7128 (55)

Total storage loss

22.0968	19.9584	22.0968	21.3840	22.0968	21.3840	22.0968	22.0968	21.3840	22.0968	21.3840	22.0968	22.0968 (56)
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If cylinder contains dedicated solar storage

22.0968	19.9584	22.0968	21.3840	22.0968	21.3840	22.0968	22.0968	21.3840	22.0968	21.3840	22.0968	22.0968 (57)
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Primary loss 23.2624 21.0112 23.2624 22.5120 23.2624 22.5120 23.2624 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 0.0000 (61)

Total heat required for water heating calculated for each month

253.5152	224.1307	237.7992	208.1849	201.2356	180.6950	177.8014	185.1683	187.5536	209.9140	224.1778	250.6160 (62)
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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

253.5152	224.1307	237.7992	208.1849	201.2356	180.6950	177.8014	185.1683	187.5536	209.9140	224.1778	250.6160 (64)
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Total per year (kWh/year) = Sum(64)m = 2540.7917 (64)

Electric shower(s)

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

Heat gains from water heating, kWh/month

105.4992	93.6768	100.2737	89.7429	88.1163	80.6025	80.3244	82.7739	82.8830	91.0018	95.0605	104.5352 (65)
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#### 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	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608 (66)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	26.2358	23.3024	18.9508	14.3470	10.7245	9.0541	9.7833	12.7167	17.0683	21.6721	25.2946	26.9650 (67)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	317.0883	320.3787	312.0870	294.4350	272.1526	251.2103	237.2195	233.9291	242.2208	259.8727	282.1552	303.0975 (68)
Pumps, fans	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838 (69)
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 (70)
Water heating gains (Table 5)	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072 (71)
Total internal gains	141.8000	139.3999	134.7764	124.6429	118.4358	111.9479	107.9629	111.2552	115.1152	122.3143	132.0285	140.5044 (72)
FGHRS	584.8615	582.8184	565.5516	533.1623	501.0503	471.9496	454.7030	457.6384	474.1417	503.5965	539.2156	570.3043 (73)

#### 6. Solar gains

[Jan]	Area	Solar flux	g	FF	Access	Gains
	m2	Table 6a	Specific data	Specific data	factor	W
		W/m2	or Table 6b	or Table 6c	Table 6d	
Northeast	3.1500	11.2829	0.6300	0.7000	0.7700	10.8619 (75)
Southwest	3.1500	36.7938	0.6300	0.7000	0.7700	35.4207 (79)
Northwest	2.9600	11.2829	0.6300	0.7000	0.7700	10.2067 (81)
Northeast	3.7800	11.2829	0.6300	0.7000	0.7700	13.0342 (75)

# Full SAP Calculation Printout



Solar gains	69.5236	129.7519	207.6203	307.6839	390.6638	408.0867	385.0129	320.0106	241.7840	151.5160	85.3360	58.1628 (83)
Total gains	654.3851	712.5703	773.1720	840.8461	891.7141	880.0363	839.7159	777.6489	715.9257	655.1125	624.5517	628.4671 (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	99.9079	100.0675	100.2276	101.0357	101.1989	102.0228	102.0228	102.1892	101.6917	101.1989	100.8730	100.5493	
alpha	7.6605	7.6712	7.6818	7.7357	7.7466	7.8015	7.8015	7.8126	7.7794	7.7466	7.7249	7.7033	
util living area	0.9901	0.9795	0.9445	0.8339	0.6429	0.4500	0.3246	0.3658	0.5945	0.8818	0.9771	0.9925 (86)	
Living	20.5659	20.6522	20.7821	20.9060	20.9526	20.9597	20.9601	20.9601	20.9569	20.8905	20.7083	20.5429	
Non living	19.7325	19.8411	19.9991	20.1408	20.1846	20.1955	20.1957	20.1969	20.1916	20.1295	19.9171	19.7075	
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	20.7779	20.6522	20.7821	20.9060	20.9526	20.9597	20.9601	20.9601	20.9569	20.8905	20.7083	20.6068 (87)	
Th 2	20.2321	20.2332	20.2344	20.2400	20.2412	20.2469	20.2469	20.2480	20.2446	20.2412	20.2389	20.2366 (88)	
util rest of house	0.9869	0.9730	0.9284	0.7979	0.5937	0.3973	0.2690	0.3060	0.5315	0.8450	0.9686	0.9899 (89)	
MIT 2	20.0329	19.8411	19.9991	20.1408	20.1846	20.1955	20.1957	20.1969	20.1916	20.1295	19.9171	19.8028 (90)	
Living area fraction									FLA = Living area / (4) =			0.2793 (91)	
MIT	20.2410	20.0677	20.2178	20.3545	20.3991	20.4089	20.4092	20.4101	20.4054	20.3421	20.1381	20.0274 (92)	
Temperature adjustment												0.0000	
adjusted MIT	20.2410	20.0677	20.2178	20.3545	20.3991	20.4089	20.4092	20.4101	20.4054	20.3421	20.1381	20.0274 (93)	

## 8. Space heating requirement

Utilisation	0.9869	0.9713	0.9280	0.8036	0.6041	0.4087	0.2810	0.3189	0.5451	0.8503	0.9673	0.9891 (94)
Useful gains	645.8171	692.1478	717.5067	675.7109	538.6601	359.6598	235.9670	247.9922	390.2416	557.0734	604.1047	621.6144 (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	1008.4350	957.9819	865.0249	716.5301	543.2906	359.8584	235.9755	248.0146	391.8827	608.4261	816.9031	994.8617 (97)
Space heating kWh	269.7877	178.6405	109.7535	29.3898	3.4451	0.0000	0.0000	0.0000	0.0000	38.2064	153.2149	277.6960 (98a)
Space heating requirement - total per year (kWh/year)												1060.1339
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	269.7877	178.6405	109.7535	29.3898	3.4451	0.0000	0.0000	0.0000	0.0000	38.2064	153.2149	277.6960 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1060.1339
Space heating per m2										(98c) / (4) =		13.8182 (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 %)												264.8630 (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	269.7877	178.6405	109.7535	29.3898	3.4451	0.0000	0.0000	0.0000	0.0000	38.2064	153.2149	277.6960 (98)
Space heating efficiency (main heating system 1)	264.8630	264.8630	264.8630	264.8630	264.8630	0.0000	0.0000	0.0000	0.0000	264.8630	264.8630	264.8630 (210)
Space heating fuel (main heating system)	101.8593	67.4464	41.4379	11.0962	1.3007	0.0000	0.0000	0.0000	0.0000	14.4250	57.8469	104.8452 (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	253.5152	224.1307	237.7992	208.1849	201.2356	180.6950	177.8014	185.1683	187.5536	209.9140	224.1778	250.6160 (64)
Efficiency of water heater (217)m	167.5316	167.5316	167.5316	167.5316	167.5316	167.5316	167.5316	167.5316	167.5316	167.5316	167.5316	167.5316 (216)
Fuel for water heating, kWh/month	151.3238	133.7842	141.9429	124.2661	120.1180	107.8573	106.1301	110.5274	111.9512	125.2982	133.8123	149.5933 (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	14.1600	12.7896	14.1600	13.7032	14.1600	13.7032	14.1600	14.1600	13.7032	14.1600	13.7032	14.1600 (231)
Lighting	22.9641	18.4226	16.5875	12.1527	9.3871	7.6694	8.5633	11.1308	14.4579	18.9695	21.4260	23.6023 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-58.7758	-84.6737	-122.8627	-135.6123	-144.7669	-134.8134	-132.9626	-126.4143	-112.3368	-94.5082	-64.5078	-50.4721 (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	-29.3871	-66.4642	-143.4792	-231.4729	-315.4406	-319.8702	-314.8099	-260.7407	-184.1055	-101.3006	-40.9003	-22.7196 (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												400.2575 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												167.5316



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Water heating fuel used	1516.6047	(219)
Space cooling fuel	0.0000	(221)
Electricity for pumps and fans: (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7125) mechanical ventilation fans (SFP = 0.7125)	166.7221	(230a)
Total electricity for the above, kWh/year	166.7221	(231)
Electricity for lighting (calculated in Appendix L)	185.3332	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-3293.3975	(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	-1024.4799	(238)

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10a. Fuel costs - using Table 12 prices  
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	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	400.2575	16.4900	66.0025 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1516.6047	16.4900	250.0881 (247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000 (247a)
Pumps, fans and electric keep-hot	166.7221	16.4900	27.4925 (249)
Energy for lighting	185.3332	16.4900	30.5615 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1262.7067	16.4900	-208.2203
PV Unit electricity exported	-2030.6908	5.5900	-113.5156
Total			-321.7359 (252)
Total energy cost			52.4086 (255)

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

Energy cost deflator (Table 12):		0.3600 (256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	0.1550 (257)
SAP value		97.4874
SAP rating (Section 12)		97 (258)
SAP band		A

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	400.2575	0.1581	63.2794 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1516.6047	0.1410	213.8045 (264)
Space and water heating			277.0839 (265)
Pumps, fans and electric keep-hot	166.7221	0.1387	23.1264 (267)
Energy for lighting	185.3332	0.1443	26.7493 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1262.7067	0.1347	-170.0487
PV Unit electricity exported	-2030.6908	0.1243	-252.3408
Total			-422.3895 (269)
Total CO2, kg/year			-95.4299 (272)
CO2 emissions per m2			-1.2400 (273)
EI value			101.0506
EI rating			101 (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  
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	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	76.7200 (1b)	x 2.5000 (2b)	= 191.8000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	76.7200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 191.8000 (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)

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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 AF50 1.5000 (17)  
 Infiltration rate 0.0750 (18)  
 Number of sides sheltered 2 (19)  
 Shelter factor (20) = 1 - [0.075 x (19)] = 0.8500 (20)  
 Infiltration rate adjusted to include shelter factor (21) = (18) x (20) = 0.0638 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	8.0000	7.4000	7.1000	6.3000	6.3000	5.6000	5.4000	5.4000	6.2000	7.0000	7.4000	8.0000
Wind factor	2.0000	1.8500	1.7750	1.5750	1.5750	1.4000	1.3500	1.3500	1.5500	1.7500	1.8500	2.0000
Adj inflt rate	0.1275	0.1179	0.1132	0.1004	0.1004	0.0892	0.0861	0.0861	0.0988	0.1116	0.1179	0.1275
Balanced mechanical ventilation with heat recovery												
If mechanical ventilation												0.5000
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												84.6000
Effective ac	0.2045	0.1949	0.1902	0.1774	0.1774	0.1662	0.1631	0.1631	0.1758	0.1886	0.1949	0.2045

### 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
NEW OPENINGS (Uw = 1.20)			9.2600	1.1450	10.6031		(27)
DOOR			2.2100	1.2000	2.6520		(26)
PAT DOORS (Uw = 1.20)			3.7800	1.1450	4.3282		(27)
Heat Loss Floor 1			76.7200	0.1200	9.2064	75.0000	5754.0000 (28a)
External Wall 1	90.4250	15.2500	75.1750	0.1800	13.5315	60.0000	4510.5000 (29a)
PLANE	76.7200		76.7200	0.1000	7.6720	9.0000	690.4800 (30)
Total net area of external elements Aum(A, m2)			243.8650				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	47.9932		(33)
Party Wall 1			8.7300	0.0000	0.0000	110.0000	960.3000 (32)
Internal Wall 2			144.5000			75.0000	10837.5000 (32c)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 22752.7800 (34)  
 Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 296.5691 (35)

#### List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	20.5800	0.0650	1.3377
E3 Sill	19.5300	0.0250	0.4883
E4 Jamb	35.4000	0.0200	0.7080
E5 Ground floor (normal)	36.1700	0.0230	0.8319
E10 Eaves (insulation at ceiling level)	16.3200	0.0370	0.6038
E12 Gable (insulation at ceiling level)	19.8500	0.0390	0.7742
E16 Corner (normal)	15.0000	0.0350	0.5250
E17 Corner (inverted - internal area greater than external area)	10.0000	-0.0780	-0.7800
E18 Party wall between dwellings	5.0000	0.0550	0.2750
P1 Party wall - Ground floor	3.4900	0.0580	0.2024
P4 Party wall - Roof (insulation at ceiling level)	3.4900	0.0810	0.2827

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 5.2490 (36)  
 Point Thermal bridges 0.0000  
 Total fabric heat loss (33) + (36) + (36a) = 53.2422 (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	12.9436	12.3384	12.0357	11.2288	11.2288	10.5226	10.3209	10.3209	11.1279	11.9349	12.3384	12.9436
Heat transfer coeff	66.1858	65.5805	65.2779	64.4709	64.4709	63.7648	63.5630	63.5630	64.3700	65.1770	65.5805	66.1858
Average = Sum(39)m / 12 =												64.8492

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	0.8627	0.8548	0.8509	0.8403	0.8403	0.8311	0.8285	0.8285	0.8390	0.8495	0.8548	0.8627
HLP (average)												0.8453
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												2.3977 (42)
Hot water usage for mixer showers												
Hot water usage for baths												
Hot water usage for other uses												
Average daily hot water use (litres/day)												
Daily hot water use	131.4319	128.6256	125.2080	120.0109	115.7906	111.2534	109.5095	112.9123	116.5012	121.2645	126.5417	131.0910
Energy content (annual)	208.1560	183.1611	192.4400	164.2889	155.8764	136.7990	132.4422	139.8091	143.6576	164.5548	180.2818	205.2568
Distribution loss (46)m = 0.15 x (45)m												
Water storage loss:	31.2234	27.4742	28.8660	24.6433	23.3815	20.5198	19.8663	20.9714	21.5486	24.6832	27.0423	30.7885
Store volume												180.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3200 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.7128 (55)
Total storage loss	22.0968	19.9584	22.0968	21.3840	22.0968	21.3840	22.0968	22.0968	21.3840	22.0968	21.3840	22.0968
If cylinder contains dedicated solar storage												
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624
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

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Total heat required for water heating calculated for each month												
	253.5152	224.1307	237.7992	208.1849	201.2356	180.6950	177.8014	185.1683	187.5536	209.9140	224.1778	250.6160 (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	253.5152	224.1307	237.7992	208.1849	201.2356	180.6950	177.8014	185.1683	187.5536	209.9140	224.1778	250.6160 (64)
	Total per year (kWh/year) = Sum(64)m =											2540.7917 (64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (64a)
	Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =											0.0000 (64a)
Heat gains from water heating, kWh/month	105.4992	93.6768	100.2737	89.7429	88.1163	80.6025	80.3244	82.7739	82.8830	91.0018	95.0605	104.5352 (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
	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.2358	23.3024	18.9508	14.3470	10.7245	9.0541	9.7833	12.7167	17.0683	21.6721	25.2946	26.9650 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	317.0883	320.3787	312.0870	294.4350	272.1526	251.2103	237.2195	233.9291	242.2208	259.8727	282.1552	303.0975 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838 (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)	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072 (71)
Water heating gains (Table 5)	141.8000	139.3999	134.7764	124.6429	118.4358	111.9479	107.9629	111.2552	115.1152	122.3143	132.0285	140.5044 (72)
Total internal gains	584.8615	582.8184	565.5516	533.1623	501.0503	471.9496	454.7030	457.6384	474.1417	503.5965	539.2156	570.3043 (73)

## 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	g	FF Specific data or Table 6c	Access factor Table 6d	Gains W					
Northeast	3.1500	15.8605	0.6300	0.7000	0.7700	15.2686 (75)						
Southwest	3.1500	47.9418	0.6300	0.7000	0.7700	46.1527 (79)						
Northwest	2.9600	15.8605	0.6300	0.7000	0.7700	14.3476 (81)						
Northeast	3.7800	15.8605	0.6300	0.7000	0.7700	18.3223 (75)						
Solar gains	94.0912	152.4604	243.3079	369.0880	444.4790	508.1757	435.3808	390.6115	300.3626	186.5793	110.9872	76.1859 (83)
Total gains	678.9527	735.2788	808.8595	902.2503	945.5294	980.1253	890.0838	848.2499	774.5043	690.1758	650.2028	646.4902 (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	95.4921	96.3734	96.8201	98.0321	98.0321	99.1177	99.4323	99.4323	98.1857	96.9700	96.3734	95.4921
alpha	7.3661	7.4249	7.4547	7.5355	7.5355	7.6078	7.6288	7.6288	7.5457	7.4647	7.4249	7.3661
util living area	0.9708	0.9531	0.9077	0.7906	0.6265	0.4483	0.3712	0.3671	0.5298	0.7799	0.9277	0.9727 (86)
Living	20.7018	20.7561	20.8360	20.9194	20.9518	20.9586	20.9591	20.9591	20.9572	20.9307	20.8323	20.7045
Non living	19.8731	19.9435	20.0374	20.1321	20.1607	20.1737	20.1763	20.1763	20.1660	20.1372	20.0339	19.8770
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	20.8474	20.7561	20.8360	20.9194	20.9518	20.9586	20.9591	20.9591	20.9572	20.9307	20.8323	20.7458 (87)
Th 2	20.1993	20.2061	20.2095	20.2185	20.2185	20.2264	20.2287	20.2287	20.2196	20.2106	20.2061	20.1993 (88)
util rest of house	0.9604	0.9380	0.8824	0.7502	0.5767	0.3984	0.3162	0.3094	0.4663	0.7236	0.9015	0.9624 (89)
MIT 2	20.0693	19.9435	20.0374	20.1321	20.1607	20.1737	20.1763	20.1763	20.1660	20.1372	20.0339	19.9351 (90)
Living area fraction									flA = Living area / (4) =			0.2793 (91)
MIT	20.2866	20.1705	20.2604	20.3520	20.3817	20.3929	20.3950	20.3950	20.3870	20.3589	20.2569	20.1615 (92)
Temperature adjustment												0.0000
adjusted MIT	20.2866	20.1705	20.2604	20.3520	20.3817	20.3929	20.3950	20.3950	20.3870	20.3589	20.2569	20.1615 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9617	0.9372	0.8842	0.7574	0.5873	0.4091	0.3281	0.3218	0.4800	0.7348	0.9034	0.9619 (94)
Useful gains	652.9449	689.1257	715.1699	683.3474	555.2731	401.0013	292.0306	272.9697	371.7341	507.1074	587.3925	621.8267 (95)
Ext temp.	7.0000	7.1000	7.8000	9.3000	11.7000	14.1000	15.8000	16.1000	14.6000	12.3000	9.8000	7.5000 (96)
Heat loss rate W	879.3854	857.1699	813.3916	712.5340	559.7170	401.2669	292.0705	273.0021	372.5076	525.2535	685.7702	838.0144 (97)
Space heating kWh	168.4718	112.9257	73.0770	21.0143	3.3063	0.0000	0.0000	0.0000	0.0000	13.5006	70.8319	160.8437 (98a)
Space heating requirement - total per year (kWh/year)												623.9713
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	168.4718	112.9257	73.0770	21.0143	3.3063	0.0000	0.0000	0.0000	0.0000	13.5006	70.8319	160.8437 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												623.9713
Space heating per m2										(98c) / (4) =		8.1331 (99)

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

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Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)	
Fraction of space heat from main system(s)													1.0000 (202)	
Efficiency of main space heating system 1 (in %)													264.6897 (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	168.4718	112.9257	73.0770	21.0143	3.3063	0.0000	0.0000	0.0000	0.0000	13.5006	70.8319	160.8437	(98)	
Space heating efficiency (main heating system 1)	264.6897	264.6897	264.6897	264.6897	264.6897	0.0000	0.0000	0.0000	0.0000	264.6897	264.6897	264.6897	(210)	
Space heating fuel (main heating system)	63.6488	42.6634	27.6085	7.9392	1.2491	0.0000	0.0000	0.0000	0.0000	5.1006	26.7604	60.7669	(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)	
<b>Water heating</b>														
Water heating requirement	253.5152	224.1307	237.7992	208.1849	201.2356	180.6950	177.8014	185.1683	187.5536	209.9140	224.1778	250.6160	(64)	
Efficiency of water heater	167.5462	167.5462	167.5462	167.5462	167.5462	167.5462	167.5462	167.5462	167.5462	167.5462	167.5462	167.5462	(216)	
Fuel for water heating, kWh/month	151.3106	133.7725	141.9306	124.2552	120.1075	107.8479	106.1209	110.5177	111.9414	125.2872	133.8006	149.5802	(219)	
<b>Space cooling fuel requirement</b>														
(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	14.1600	12.7896	14.1600	13.7032	14.1600	13.7032	14.1600	14.1600	13.7032	14.1600	13.7032	14.1600	(231)	
Lighting	22.9641	18.4226	16.5875	12.1527	9.3871	7.6694	8.5633	11.1308	14.4579	18.9695	21.4260	23.6023	(232)	
Electricity generated by PVs (Appendix M) (negative quantity)	-73.5234	-93.1102	-132.4644	-145.8728	-151.1523	-144.5218	-138.0938	-135.9338	-123.8399	-106.0215	-76.9485	-61.9228	(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)	-46.9214	-84.8506	-176.9366	-287.1234	-362.7603	-411.4979	-358.9817	-328.1404	-239.7816	-134.6084	-61.1651	-35.0324	(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)	
<b>Annual totals kWh/year</b>														
Space heating fuel - main system 1													235.7368	(211)
Space heating fuel - main system 2													0.0000	(213)
Space heating fuel - secondary													0.0000	(215)
Efficiency of water heater													167.5462	(216)
Water heating fuel used													1516.4724	(219)
Space cooling fuel													0.0000	(221)
<b>Electricity for pumps and fans:</b>														
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7125)														
mechanical ventilation fans (SFP = 0.7125)														166.7221 (230a)
Total electricity for the above, kWh/year														166.7221 (231)
Electricity for lighting (calculated in Appendix L)														185.3332 (232)
<b>Energy saving/generation technologies (Appendices M ,N and Q)</b>														
PV generation														-3911.2049 (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														-1806.9403 (238)

## 10a. Fuel costs - using BEDF prices (533)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	235.7368	21.5100	50.7070	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1516.4724	21.5100	326.1932	(247)
Energy for instantaneous electric shower(s)	0.0000	21.5100	0.0000	(247a)
Pumps, fans and electric keep-hot	166.7221	21.5100	35.8619	(249)
Energy for lighting	185.3332	21.5100	39.8652	(250)
Additional standing charges			0.0000	(251)
<b>Energy saving/generation technologies</b>				
PV Unit electricity used in dwelling	-1383.4050	21.5100	-297.5704	
PV Unit electricity exported	-2527.7999	5.5900	-141.3040	
Total			-438.8744	(252)
Total energy cost			13.7529	(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	235.7368	0.1585	37.3647	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1516.4724	0.1410	213.7858	(264)
Space and water heating			251.1505	(265)
Pumps, fans and electric keep-hot	166.7221	0.1387	23.1264	(267)
Energy for lighting	185.3332	0.1443	26.7493	(268)
<b>Energy saving/generation technologies</b>				
PV Unit electricity used in dwelling	-1383.4050	0.1352	-187.0965	
PV Unit electricity exported	-2527.7999	0.1252	-316.3605	
Total			-503.4570	(269)
Total CO2, kg/year			-202.4307	(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	235.7368	1.5868	374.0567 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1516.4724	1.5213	2306.9807 (278)
Space and water heating			2681.0374 (279)
Pumps, fans and electric keep-hot	166.7221	1.5128	252.2173 (281)
Energy for lighting	185.3332	1.5338	284.2703 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1383.4050	1.4999	-2074.9147
PV Unit electricity exported	-2527.7999	0.4594	-1161.2288
Total			-3236.1435 (283)
Total Primary energy kWh/year			-18.6185 (286)

## SAP 10 EPC IMPROVEMENTS

### AS DESIGNED

Current energy efficiency rating: A 97  
 Current environmental impact rating: A 101

	Recommended
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	+ 2.2	-£ 73	-52 kg (25.9%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£73	0.68 kg/m <sup>2</sup>	A 100 A 101
<b>Total Savings</b>	<b>£73</b>	<b>0.68 kg/m<sup>2</sup></b>	

Potential energy efficiency rating: A 100  
 Potential environmental impact rating: A 101

Fuel prices for cost data on this page from database revision number 533 TEST (30 Nov 2023)  
 Recommendation texts revision number 6.1 (11 Jun 2019)

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

	Current	Potential	Saving
Electricity	£453	£362	£90
Space heating	£87	£104	-£17
Water heating	£326	£218	£108
Lighting	£40	£40	£0
Generated (PV)	-£439	-£422	-£17
Total cost of fuels	£14	-£60	£73
Total cost of uses	£14	-£60	£74
Delivered energy	-24 kWh/m <sup>2</sup>	-29 kWh/m <sup>2</sup>	5 kWh/m <sup>2</sup>
Carbon dioxide emissions	-0.2 tonnes	-0.3 tonnes	0.1 tonnes
CO2 emissions per m <sup>2</sup>	-3 kg/m <sup>2</sup>	-3 kg/m <sup>2</sup>	1 kg/m <sup>2</sup>
Primary energy	-0 kWh/m <sup>2</sup>	-7 kWh/m <sup>2</sup>	7 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	76.7200 (1b)	x 2.5000 (2b)	= 191.8000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	76.7200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 191.8000 (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)

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Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =											Air changes per hour	0.0000 / (5) =	0.0000 (8)
Pressure test												Yes		
Pressure Test Method												Blower Door		
Measured/design AP50												1.5000	(17)	
Infiltration rate												0.0750	(18)	
Number of sides sheltered												2	(19)	
Shelter factor												(20) = 1 - [0.075 x (19)] =	0.8500 (20)	
Infiltration rate adjusted to include shelter factor												(21) = (18) x (20) =	0.0638 (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	0.0813	0.0797	0.0781	0.0701	0.0685	0.0606	0.0606	0.0590	0.0638	0.0685	0.0717	0.0749	(22b)
Balanced mechanical ventilation with heat recovery													
If mechanical ventilation													0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)													0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =													84.6000 (23c)
Effective ac	0.1583	0.1567	0.1551	0.1471	0.1455	0.1376	0.1376	0.1360	0.1407	0.1455	0.1487	0.1519	(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	
NEW OPENINGS (Uw = 1.20)			9.2600	1.1450	10.6031			(27)
DOOR			2.2100	1.2000	2.6520			(26)
PAT DOORS (Uw = 1.20)			3.7800	1.1450	4.3282			(27)
Heat Loss Floor 1			76.7200	0.1200	9.2064	75.0000	5754.0000	(28a)
External Wall 1	90.4250	15.2500	75.1750	0.1800	13.5315	60.0000	4510.5000	(29a)
PLANE	76.7200		76.7200	0.1000	7.6720	9.0000	690.4800	(30)
Total net area of external elements Aum(A, m2)			243.8650					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	47.9932			(33)
Party Wall 1			8.7300	0.0000	0.0000	110.0000	960.3000	(32)
Internal Wall 2			144.5000			75.0000	10837.5000	(32c)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	22752.7800	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							296.5691	(35)

#### List of Thermal Bridges

K1 Element	Length	Psi-value	Total	
E1 Steel lintel with perforated steel base plate	20.5800	0.0650	1.3377	
E3 Sill	19.5300	0.0250	0.4883	
E4 Jamb	35.4000	0.0200	0.7080	
E5 Ground floor (normal)	36.1700	0.0230	0.8319	
E10 Eaves (insulation at ceiling level)	16.3200	0.0370	0.6038	
E12 Gable (insulation at ceiling level)	19.8500	0.0390	0.7742	
E16 Corner (normal)	15.0000	0.0350	0.5250	
E17 Corner (inverted - internal area greater than external area)	10.0000	-0.0780	-0.7800	
E18 Party wall between dwellings	5.0000	0.0550	0.2750	
P1 Party wall - Ground floor	3.4900	0.0580	0.2024	
P4 Party wall - Roof (insulation at ceiling level)	3.4900	0.0810	0.2827	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)				5.2490 (36)
Point Thermal bridges				(36a) = 0.0000
Total fabric heat loss				(33) + (36) + (36a) = 53.2422 (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	10.0183	9.9174	9.8165	9.3121	9.2113	8.7069	8.7069	8.6060	8.9086	9.2113	9.4130	9.6148	(38)
Heat transfer coeff	63.2604	63.1595	63.0587	62.5543	62.4534	61.9490	61.9490	61.8482	62.1508	62.4534	62.6552	62.8569	(39)
Average = Sum(39)m / 12 =													62.5291
HLP	0.8246	0.8232	0.8219	0.8154	0.8140	0.8075	0.8075	0.8062	0.8101	0.8140	0.8167	0.8193	(40)
HLP (average)													0.8150
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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

Assumed occupancy													2.3977 (42)
Hot water usage for mixer showers													64.4209
Hot water usage for baths													27.8263
Hot water usage for other uses													39.1846
Average daily hot water use (litres/day)													120.8157 (43)
Daily hot water use	131.4319	128.6256	125.2080	120.0109	115.7906	111.2534	109.5095	112.9123	116.5012	121.2645	126.5417	131.0910	(44)
Energy conte	208.1560	183.1611	192.4400	164.2889	155.8764	136.7990	132.4422	139.8091	143.6576	164.5548	180.2818	205.2568	(45)
Energy content (annual)													Total = Sum(45)m = 2006.7237
Distribution loss (46)m = 0.15 x (45)m													31.2234
Water storage loss:													180.0000 (47)
Store volume													1.3200 (48)
a) If manufacturer declared loss factor is known (kWh/day):													0.5400 (49)
Temperature factor from Table 2b													0.7128 (55)
Enter (49) or (54) in (55)													
Total storage loss	22.0968	19.9584	22.0968	21.3840	22.0968	21.3840	22.0968	22.0968	21.3840	22.0968	21.3840	22.0968	(56)
If cylinder contains dedicated solar storage	22.0968	19.9584	22.0968	21.3840	22.0968	21.3840	22.0968	22.0968	21.3840	22.0968	21.3840	22.0968	(57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	253.5152	224.1307	236.4035	201.4313	188.4413	168.0883	164.7745	173.0718	182.1507	208.5182	224.1778	250.6160	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)

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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													610.6804 (H24)
Heat delivered to space heating													0.0000 (H29)
Solar input													610.6804
Solar input	-0.0000	-16.2246	-57.8453	-79.0099	-102.3998	-94.1569	-93.3236	-82.0488	-57.0720	-28.5996	-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													
	253.5152	207.9061	178.5582	122.4214	86.0415	73.9313	71.4509	91.0231	125.0788	179.9187	224.1778		250.6160 (64)
													Total per year (kWh/year) = Sum(64)m = 1864.6390 (64)
Electric shower(s)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000 (64a)
													Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)
Heat gains from water heating, kWh/month													
	105.4992	93.6768	99.1571	84.3400	77.8808	70.5171	69.9029	73.0967	78.5607	89.8852	95.0605		104.5352 (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	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.2358	23.3024	18.9508	14.3470	10.7245	9.0541	9.7833	12.7167	17.0683	21.6721	25.2946	26.9650	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	317.0883	320.3787	312.0870	294.4350	272.1526	251.2103	237.2195	233.9291	242.2208	259.8727	282.1552	303.0975	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838	(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)													
	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	(71)
Water heating gains (Table 5)													
	141.8000	139.3999	133.2756	117.1389	104.6785	97.9404	93.9554	98.2483	109.1120	120.8135	132.0285	140.5044	(72)
Total internal gains	584.8615	582.8184	564.0508	525.6583	487.2930	457.9421	440.6956	444.6314	468.1385	502.0957	539.2156	570.3043	(73)

## 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W							
Northeast	3.1500	11.2829	0.6300	0.7000	0.7700	10.8619 (75)							
Southwest	3.1500	36.7938	0.6300	0.7000	0.7700	35.4207 (79)							
Northwest	2.9600	11.2829	0.6300	0.7000	0.7700	10.2067 (81)							
Northeast	3.7800	11.2829	0.6300	0.7000	0.7700	13.0342 (75)							
Solar gains	69.5236	129.7519	207.6203	307.6839	390.6638	408.0867	385.0129	320.0106	241.7840	151.5160	85.3360	58.1628	(83)
Total gains	654.3851	712.5703	771.6712	833.3421	877.9568	866.0289	825.7084	764.6420	709.9225	653.6117	624.5517	628.4671	(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	99.9079	100.0675	100.2276	101.0357	101.1989	102.0228	102.0228	102.1892	101.6917	101.1989	100.8730	100.5493	
alpha	7.6605	7.6712	7.6818	7.7357	7.7466	7.8015	7.8015	7.8126	7.7794	7.7466	7.7249	7.7033	
util living area	0.9901	0.9795	0.9450	0.8387	0.6522	0.4572	0.3301	0.3720	0.5993	0.8829	0.9771	0.9925	(86)
Living	20.5659	20.6522	20.7811	20.9038	20.9519	20.9596	20.9601	20.9601	20.9567	20.8899	20.7083	20.5429	
Non living	19.7325	19.8411	19.9979	20.1387	20.1841	20.1955	20.1957	20.1969	20.1915	20.1289	19.9171	19.7075	
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	20.7779	20.6522	20.7811	20.9038	20.9519	20.9596	20.9601	20.9601	20.9567	20.8899	20.7083	20.6068	(87)
Th 2	20.2321	20.2332	20.2344	20.2400	20.2412	20.2469	20.2469	20.2480	20.2446	20.2412	20.2389	20.2366	(88)
util rest of house													
	0.9869	0.9730	0.9290	0.8030	0.6025	0.4037	0.2736	0.3112	0.5359	0.8462	0.9686	0.9899	(89)
MIT 2	20.0329	19.8411	19.9979	20.1387	20.1841	20.1955	20.1957	20.1969	20.1915	20.1289	19.9171	19.8028	(90)
Living area fraction													
													FLA = Living area / (4) = 0.2793 (91)
MIT	20.2410	20.0677	20.2167	20.3524	20.3986	20.4089	20.4092	20.4101	20.4052	20.3415	20.1381	20.0274	(92)
Temperature adjustment													0.0000
adjusted MIT	20.2410	20.0677	20.2167	20.3524	20.3986	20.4089	20.4092	20.4101	20.4052	20.3415	20.1381	20.0274	(93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9869	0.9713	0.9286	0.8086	0.6130	0.4153	0.2858	0.3243	0.5496	0.8515	0.9673	0.9891	(94)
Useful gains	645.8171	692.1478	716.5812	673.8224	538.1518	359.6339	235.9658	247.9890	390.1407	556.5402	604.1047	621.6144	(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													
	1008.4350	957.9819	864.9566	716.3956	543.2548	359.8565	235.9754	248.0143	391.8754	608.3877	816.9031	994.8617	(97)
Space heating kWh													
	269.7877	178.6405	110.3913	30.6527	3.7967	0.0000	0.0000	0.0000	0.0000	38.5746	153.2149	277.6960	(98a)
Space heating requirement - total per year (kWh/year)													1062.7544
Solar heating kWh													



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Solar heating contribution - total per year (kWh/year)	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(98b)
Space heating kWh	269.7877	178.6405	110.3913	30.6527	3.7967	0.0000	0.0000	0.0000	0.0000	38.5746	153.2149	277.6960	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1062.7544	
Space heating per m2												13.8524	(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 %)													264.8630	(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	269.7877	178.6405	110.3913	30.6527	3.7967	0.0000	0.0000	0.0000	0.0000	38.5746	153.2149	277.6960	(98)	
Space heating efficiency (main heating system 1)	264.8630	264.8630	264.8630	264.8630	264.8630	0.0000	0.0000	0.0000	0.0000	264.8630	264.8630	264.8630	(210)	
Space heating fuel (main heating system)	101.8593	67.4464	41.6786	11.5730	1.4335	0.0000	0.0000	0.0000	0.0000	14.5640	57.8469	104.8452	(211)	
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)	
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)	
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)	
Water heating requirement	253.5152	207.9061	178.5582	122.4214	86.0415	73.9313	71.4509	91.0231	125.0788	179.9187	224.1778	250.6160	(64)	
Efficiency of water heater (217)m	167.5316	167.5316	167.5316	167.5316	167.5316	167.5316	167.5316	167.5316	167.5316	167.5316	167.5316	167.5316	(216)	
Fuel for water heating, kWh/month	151.3238	124.0996	106.5818	73.0736	51.3584	44.1298	42.6492	54.3319	74.6598	107.3939	133.8123	149.5933	(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	20.9545	18.9266	20.9545	20.2785	20.9545	20.2785	20.9545	20.2785	20.9545	20.2785	20.9545	20.2785	(231)	
Lighting	22.9641	18.4226	16.5875	12.1527	9.3871	7.6694	8.5633	11.1308	14.4579	18.9695	21.4260	23.6023	(232)	
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-58.9268	-84.4809	-119.7904	-127.3295	-129.0256	-118.9237	-117.2284	-114.6581	-106.9166	-93.4854	-64.7438	-50.5928	(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	-29.2362	-66.6570	-146.5515	-239.7556	-331.1819	-335.7600	-330.5441	-272.4969	-189.5257	-102.3233	-40.6643	-22.5989	(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													401.2469	(211)
Space heating fuel - main system 2													0.0000	(213)
Space heating fuel - secondary													0.0000	(215)
Efficiency of water heater													167.5316	
Water heating fuel used													1113.0075	(219)
Space cooling fuel													0.0000	(221)
Electricity for pumps and fans: (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7125) mechanical ventilation fans (SFP = 0.7125) pump for solar water heating													166.7221	(230a)
Total electricity for the above, kWh/year													80.0000	(230g)
Electricity for lighting (calculated in Appendix L)													246.7221	(231)
													185.3332	(232)
Energy saving/generation technologies (Appendices M ,N and Q)														
PV generation													-3293.3975	(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													-1347.0877	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	401.2469	16.4900	66.1656	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1113.0075	16.4900	183.5349	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	166.7221	16.4900	27.4925	(249)
Pump for solar water heating	80.0000	16.4900	13.1920	(249)
Energy for lighting	185.3332	16.4900	30.5615	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1186.1021	16.4900	-195.5882	
PV Unit electricity exported	-2107.2954	5.5900	-117.7978	
Total			-313.3860	(252)
Total energy cost			7.5604	(255)

## 11a. SAP rating - Individual heating systems

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Energy cost deflator (Table 12): 0.3600 (256)  
 Energy cost factor (ECF) 0.0224 (257)  $[(255) \times (256)] / [(4) + 45.0] =$   
 SAP value 99.6375  
 SAP rating (Section 12) 100 (258)  
 SAP band A

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	401.2469	0.1581	63.4208 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1113.0075	0.1460	162.4758 (264)
Space and water heating			225.8966 (265)
Pumps, fans and electric keep-hot	246.7221	0.1387	34.2234 (267)
Energy for lighting	185.3332	0.1443	26.7493 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1186.1021	0.1354	-160.5951
PV Unit electricity exported	-2107.2954	0.1239	-261.0822
Total			-421.6774 (269)
Total CO2, kg/year			-134.8080 (272)
CO2 emissions per m2			-1.7600 (273)
EI value			101.4841
EI rating			101 (274)
EI band			A

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

### 1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	76.7200 (1b)	x 2.5000 (2b)	= 191.8000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	76.7200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 191.8000 (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	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	1.5000	(17)
Infiltration rate	0.0750	(18)
Number of sides sheltered	2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.0638 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	8.0000	7.4000	7.1000	6.3000	6.3000	5.6000	5.4000	5.4000	6.2000	7.0000	7.4000	8.0000 (22)
Wind factor	2.0000	1.8500	1.7750	1.5750	1.5750	1.4000	1.3500	1.3500	1.5500	1.7500	1.8500	2.0000 (22a)
Adj infilt rate	0.1275	0.1179	0.1132	0.1004	0.1004	0.0892	0.0861	0.0861	0.0988	0.1116	0.1179	0.1275 (22b)
Balanced mechanical ventilation with heat recovery												
If mechanical ventilation												0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												84.6000 (23c)
Effective ac	0.2045	0.1949	0.1902	0.1774	0.1774	0.1662	0.1631	0.1631	0.1758	0.1886	0.1949	0.2045 (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
NEW OPENINGS (Uw = 1.20)			9.2600	1.1450	10.6031		(27)
DOOR			2.2100	1.2000	2.6520		(26)
PAT DOORS (Uw = 1.20)			3.7800	1.1450	4.3282		(27)
Heat Loss Floor 1			76.7200	0.1200	9.2064	75.0000	5754.0000 (28a)
External Wall 1	90.4250	15.2500	75.1750	0.1800	13.5315	60.0000	4510.5000 (29a)
PLANE	76.7200		76.7200	0.1000	7.6720	9.0000	690.4800 (30)
Total net area of external elements Aum(A, m2)			243.8650				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	47.9932		(33)
Party Wall 1			8.7300	0.0000	0.0000	110.0000	960.3000 (32)

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Internal Wall 2 144.5000 75.0000 10837.5000 (32c)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 22752.7800 (34)  
 Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 296.5691 (35)

List of Thermal Bridges	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	20.5800	0.0650	1.3377
E3 Sill	19.5300	0.0250	0.4883
E4 Jamb	35.4000	0.0200	0.7080
E5 Ground floor (normal)	36.1700	0.0230	0.8319
E10 Eaves (insulation at ceiling level)	16.3200	0.0370	0.6038
E12 Gable (insulation at ceiling level)	19.8500	0.0390	0.7742
E16 Corner (normal)	15.0000	0.0350	0.5250
E17 Corner (inverted - internal area greater than external area)	10.0000	-0.0780	-0.7800
E18 Party wall between dwellings	5.0000	0.0550	0.2750
P1 Party wall - Ground floor	3.4900	0.0580	0.2024
P4 Party wall - Roof (insulation at ceiling level)	3.4900	0.0810	0.2827
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			5.2490 (36)
Point Thermal bridges			0.0000
Total fabric heat loss			(33) + (36) + (36a) = 53.2422 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	12.9436	12.3384	12.0357	11.2288	11.2288	10.5226	10.3209	10.3209	11.1279	11.9349	12.3384	12.9436 (38)
Heat transfer coeff	66.1858	65.5805	65.2779	64.4709	64.4709	63.7648	63.5630	63.5630	64.3700	65.1770	65.5805	66.1858 (39)
Average = Sum(39)m / 12 =												64.8492
HLP	0.8627	0.8548	0.8509	0.8403	0.8403	0.8311	0.8285	0.8285	0.8390	0.8495	0.8548	0.8627 (40)
HLP (average)												0.8453
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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

Assumed occupancy	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hot water usage for mixer showers	64.4209	63.4528	62.0420	59.3428	57.3509	55.1295	53.8669	55.2669	56.8017	59.1868	61.9439	64.1741 (42a)
Hot water usage for baths	27.8263	27.4131	26.8311	25.7581	24.9546	24.0637	23.5825	24.1604	24.7896	25.7429	26.8380	27.7323 (42b)
Hot water usage for other uses	39.1846	37.7597	36.3349	34.9100	33.4851	32.0602	32.0602	33.4851	34.9100	36.3349	37.7597	39.1846 (42c)
Average daily hot water use (litres/day)												120.8157 (43)
Daily hot water use	131.4319	128.6256	125.2080	120.0109	115.7906	111.2534	109.5095	112.9123	116.5012	121.2645	126.5417	131.0910 (44)
Energy conte	208.1560	183.1611	192.4400	164.2889	155.8764	136.7990	132.4422	139.8091	143.6576	164.5548	180.2818	205.2568 (45)
Energy content (annual)										Total = Sum(45)m =		2006.7237
Distribution loss (46)m = 0.15 x (45)m	31.2234	27.4742	28.8660	24.6433	23.3815	20.5198	19.8663	20.9714	21.5486	24.6832	27.0423	30.7885 (46)
Water storage loss:												
Store volume												180.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3200 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.7128 (55)
Total storage loss	22.0968	19.9584	22.0968	21.3840	22.0968	21.3840	22.0968	22.0968	21.3840	22.0968	21.3840	22.0968 (56)
If cylinder contains dedicated solar storage	22.0968	19.9584	22.0968	21.3840	22.0968	21.3840	22.0968	22.0968	21.3840	22.0968	21.3840	22.0968 (57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624 (59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
Total heat required for water heating calculated for each month	253.5152	224.1307	236.4035	201.4313	188.4413	168.0883	164.7745	173.0718	182.1507	208.5182	224.1778	250.6160 (62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000 (63b)
Aperture area of solar collector												3.0000 (H1)
Zero-loss collector efficiency												0.8000 (H2)
Collector linear heat loss coefficient												1.8000 (H3)
Collector 2nd order heat loss coefficient												0.0000 (H4)
Collector loop efficiency												0.9000 (H5)
Incidence angle modifier												1.0000 (H6)
Overshading factor												0.8000 (H8)
Overall heat loss coefficient of system												6.5000 (H10)
Heat loss coefficient of collector loop												3.9667 (H11)
Dedicated solar storage volume												75.0000 (H12)
Effective solar volume												75.0000 (H14)
Reference volume												225.0000 (H15)
Storage tank correction coefficient												1.3161 (H16)
Heat delivered to hot water												774.6492 (H24)
Heat delivered to space heating												0.0000 (H29)
Solar input												774.6492
Solar input	-9.4168	-27.7002	-73.1721	-96.7884	-114.7526	-114.8389	-103.0405	-100.1530	-76.1166	-45.8236	-12.8465	-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	244.0984	196.4305	163.2314	104.6429	73.6887	53.2494	61.7340	72.9188	106.0341	162.6947	211.3314	250.6160 (64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												0.0000 (64a)
Heat gains from water heating, kWh/month	105.4992	93.6768	99.1571	84.3400	77.8808	70.5171	69.9029	73.0967	78.5607	89.8852	95.0605	104.5352 (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	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.2358	23.3024	18.9508	14.3470	10.7245	9.0541	9.7833	12.7167	17.0683	21.6721	25.2946	26.9650 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	317.0883	320.3787	312.0870	294.4350	272.1526	251.2103	237.2195	233.9291	242.2208	259.8727	282.1552	303.0975 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838 (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)	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072 (71)
Water heating gains (Table 5)	141.8000	139.3999	133.2756	117.1389	104.6785	97.9404	93.9554	98.2483	109.1120	120.8135	132.0285	140.5044 (72)
Total internal gains	584.8615	582.8184	564.0508	525.6583	487.2930	457.9421	440.6956	444.6314	468.1385	502.0957	539.2156	570.3043 (73)

## 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
Northeast	3.1500	15.8605	0.6300	0.7000	0.7700	15.2686 (75)
Southwest	3.1500	47.9418	0.6300	0.7000	0.7700	46.1527 (79)
Northwest	2.9600	15.8605	0.6300	0.7000	0.7700	14.3476 (81)
Northeast	3.7800	15.8605	0.6300	0.7000	0.7700	18.3223 (75)

Solar gains	94.0912	152.4604	243.3079	369.0880	444.4790	508.1757	435.3808	390.6115	300.3626	186.5793	110.9872	76.1859 (83)
Total gains	678.9527	735.2788	807.3587	894.7463	931.7720	966.1178	876.0764	835.2429	768.5011	688.6750	650.2028	646.4902 (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	95.4921	96.3734	96.8201	98.0321	98.0321	99.1177	99.4323	99.4323	98.1857	96.9700	96.3734	95.4921
alpha	7.3661	7.4249	7.4547	7.5355	7.5355	7.6078	7.6288	7.6288	7.5457	7.4647	7.4249	7.3661
util living area	0.9708	0.9531	0.9084	0.7954	0.6350	0.4548	0.3771	0.3728	0.5338	0.7811	0.9277	0.9727 (86)
Living	20.7018	20.7561	20.8352	20.9178	20.9511	20.9585	20.9591	20.9591	20.9571	20.9304	20.8323	20.7045
Non living	19.8731	19.9435	20.0365	20.1307	20.1603	20.1737	20.1763	20.1763	20.1659	20.1370	20.0339	19.8770
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	20.8474	20.7561	20.8352	20.9178	20.9511	20.9585	20.9591	20.9591	20.9571	20.9304	20.8323	20.7458 (87)
Th 2	20.1993	20.2061	20.2095	20.2185	20.2185	20.2264	20.2287	20.2287	20.2196	20.2106	20.2061	20.1993 (88)
util rest of house	0.9604	0.9380	0.8832	0.7551	0.5849	0.4041	0.3213	0.3142	0.4699	0.7249	0.9015	0.9624 (89)
MIT 2	20.0693	19.9435	20.0365	20.1307	20.1603	20.1737	20.1763	20.1763	20.1659	20.1370	20.0339	19.9351 (90)
Living area fraction									fLA = Living area / (4) =			0.2793 (91)
MIT	20.2866	20.1705	20.2596	20.3505	20.3812	20.3929	20.3950	20.3950	20.3869	20.3586	20.2569	20.1615 (92)
Temperature adjustment												0.0000
adjusted MIT	20.2866	20.1705	20.2596	20.3505	20.3812	20.3929	20.3950	20.3950	20.3869	20.3586	20.2569	20.1615 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9617	0.9372	0.8849	0.7622	0.5954	0.4150	0.3333	0.3268	0.4837	0.7360	0.9034	0.9619 (94)
Useful gains	652.9449	689.1257	714.4720	682.0127	554.8224	400.9713	292.0254	272.9655	371.6899	506.8880	587.3925	621.8267 (95)
Ext temp.	7.0000	7.1000	7.8000	9.3000	11.7000	14.1000	15.8000	16.1000	14.6000	12.3000	9.8000	7.5000 (96)
Heat loss rate W	879.3854	857.1699	813.3391	712.4372	559.6844	401.2647	292.0700	273.0018	372.5043	525.2373	685.7702	838.0144 (97)
Space heating kWh	168.4718	112.9257	73.5571	21.9056	3.6173	0.0000	0.0000	0.0000	0.0000	13.6519	70.8319	160.8437 (98a)
Space heating requirement - total per year (kWh/year)												625.8050
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	168.4718	112.9257	73.5571	21.9056	3.6173	0.0000	0.0000	0.0000	0.0000	13.6519	70.8319	160.8437 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												625.8050
Space heating per m2										(98c) / (4) =		8.1570 (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 %)												264.6897 (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	168.4718	112.9257	73.5571	21.9056	3.6173	0.0000	0.0000	0.0000	0.0000	13.6519	70.8319	160.8437 (98)
Space heating efficiency (main heating system 1)	264.6897	264.6897	264.6897	264.6897	264.6897	0.0000	0.0000	0.0000	0.0000	264.6897	264.6897	264.6897 (210)
Space heating fuel (main heating system)	63.6488	42.6634	27.7899	8.2760	1.3666	0.0000	0.0000	0.0000	0.0000	5.1577	26.7604	60.7669 (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	244.0984	196.4305	163.2314	104.6429	73.6887	53.2494	61.7340	72.9188	106.0341	162.6947	211.3314	250.6160 (64)
Efficiency of water heater (217)m	167.5462	167.5462	167.5462	167.5462	167.5462	167.5462	167.5462	167.5462	167.5462	167.5462	167.5462	167.5462 (216)
Fuel for water heating, kWh/month	145.6902	117.2396	97.4247	62.4561	43.9811	31.7819	36.8459	43.5216	63.2865	97.1044	126.1332	149.5802 (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	20.9545	18.9266	20.9545	20.2785	20.9545	20.9545	20.9545	20.9545	20.2785	20.9545	20.2785	20.9545 (231)

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Lighting	22.9641	18.4226	16.5875	12.1527	9.3871	7.6694	8.5633	11.1308	14.4579	18.9695	21.4260	23.6023	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-73.5664	-92.3694	-127.4472	-133.5217	-131.5506	-121.3223	-118.9953	-118.8381	-114.6156	-103.4091	-76.8880	-62.1174	(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	-46.8784	-85.5914	-181.9538	-299.4744	-382.3620	-434.6974	-378.0803	-345.2361	-249.0059	-137.2208	-61.2256	-34.8378	(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												236.4296	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												167.5462	
Water heating fuel used												1015.0456	(219)
Space cooling fuel												0.0000	(221)

Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7125)													
mechanical ventilation fans (SFP = 0.7125)												166.7221	(230a)
pump for solar water heating												80.0000	(230g)
Total electricity for the above, kWh/year												246.7221	(231)
Electricity for lighting (calculated in Appendix L)												185.3332	(232)

Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-3911.2049	(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												-2227.6743	(238)

## 10a. Fuel costs - using BEDF prices (533)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	236.4296	21.5100	50.8560	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1015.0456	21.5100	218.3363	(247)
Energy for instantaneous electric shower(s)	0.0000	21.5100	0.0000	(247a)
Pumps, fans and electric keep-hot	166.7221	21.5100	35.8619	(249)
Pump for solar water heating	80.0000	21.5100	17.2080	(249)
Energy for lighting	185.3332	21.5100	39.8652	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1274.6411	21.5100	-274.1753	
PV Unit electricity exported	-2636.5638	5.5900	-147.3839	
Total			-421.5592	(252)
Total energy cost			-59.4318	(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	236.4296	0.1585	37.4639	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1015.0456	0.1471	149.2815	(264)
Space and water heating			186.7454	(265)
Pumps, fans and electric keep-hot	246.7221	0.1387	34.2234	(267)
Energy for lighting	185.3332	0.1443	26.7493	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1274.6411	0.1362	-173.5871	
PV Unit electricity exported	-2636.5638	0.1248	-328.9423	
Total			-502.5294	(269)
Total CO2, kg/year			-254.8113	(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	236.4296	1.5866	375.1170	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1015.0456	1.5441	1567.3141	(278)
Space and water heating			1942.4311	(279)
Pumps, fans and electric keep-hot	246.7221	1.5128	373.2413	(281)
Energy for lighting	185.3332	1.5338	284.2703	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1274.6411	1.5034	-1916.2991	
PV Unit electricity exported	-2636.5638	0.4579	-1207.3683	
Total			-3123.6674	(283)
Total Primary energy kWh/year			-523.7247	(286)

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Property Reference	_23.SAP.144 ABDS Mullion p2/4		Issued on Date	03/01/2024	
Assessment Reference	AS DESIGNED	Prop Type Ref			
Property	Development at, Meaver Road, HELSTON, TR12 7DP				
SAP Rating	98 A	DER	-1.19	TER	10.69
Environmental	101 A	% DER < TER		111.13	
CO <sub>2</sub> Emissions (t/year)	-0.21	DFEE	37.89	TFEE	47.01
Compliance Check	See BREL	% DFEE < TFEE		19.39	
% DPER < TPER	84.02	DPER	9.16	TPER	57.32
Assessor Details	Mrs. Sophie Oakland			Assessor ID	F859-0001
Client	ABDS, ABDS				

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	76.7200 (1b)	2.5000 (2b)	191.8000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	76.7200		191.8000 (4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 191.8000 (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		1.5000 (17)
Infiltration rate		0.0750 (18)
Number of sides sheltered		2 (19)

Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.0638 (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	0.0813	0.0797	0.0781	0.0701	0.0685	0.0606	0.0606	0.0590	0.0638	0.0685	0.0717	0.0749 (22b)
Balanced mechanical ventilation with heat recovery												0.5000 (23a)
If mechanical ventilation												0.5000 (23b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												84.6000 (23c)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												
Effective ac	0.1583	0.1567	0.1551	0.1471	0.1455	0.1376	0.1376	0.1360	0.1407	0.1455	0.1487	0.1519 (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
NEW OPENINGS (Uw = 1.20)			9.2600	1.1450	10.6031		(27)
DOOR			2.2100	1.2000	2.6520		(26)
PAT DOORS (Uw = 1.20)			3.7800	1.1450	4.3282		(27)
Heat Loss Floor 1			76.7200	0.1200	9.2064	75.0000	5754.0000 (28a)
External Wall 1	90.4250	15.2500	75.1750	0.1800	13.5315	60.0000	4510.5000 (29a)
PLANE	76.7200		76.7200	0.1000	7.6720	9.0000	690.4800 (30)
Total net area of external elements Aum (A, m <sup>2</sup> )			243.8650				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	47.9932		(33)
Party Wall 1			8.7300	0.0000	0.0000	110.0000	960.3000 (32)
Internal Wall 2			144.5000			75.0000	10837.5000 (32c)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 22752.7800 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							296.5691 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value		Total

# Full SAP Calculation Printout



E1 Steel lintel with perforated steel base plate	20.5800	0.0650	1.3377
E3 Sill	19.5300	0.0250	0.4883
E4 Jamb	35.4000	0.0200	0.7080
E5 Ground floor (normal)	36.1700	0.0230	0.8319
E10 Baves (insulation at ceiling level)	16.3200	0.0370	0.6038
E12 Gable (insulation at ceiling level)	19.8500	0.0390	0.7742
E16 Corner (normal)	15.0000	0.0350	0.5250
E17 Corner (inverted - internal area greater than external area)	10.0000	-0.0780	-0.7800
E18 Party wall between dwellings	5.0000	0.0550	0.2750
P1 Party wall - Ground floor	3.4900	0.0580	0.2024
P4 Party wall - Roof (insulation at ceiling level)	3.4900	0.0810	0.2827
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			5.2490 (36)
Point Thermal bridges			0.0000 (36a) =
Total fabric heat loss			53.2422 (37) (33) + (36) + (36a) =

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	10.0183	9.9174	9.8165	9.3121	9.2113	8.7069	8.7069	8.6060	8.9086	9.2113	9.4130	9.6148 (38)
Average = Sum(39)m / 12 =	63.2604	63.1595	63.0587	62.5543	62.4534	61.9490	61.9490	61.8482	62.1508	62.4534	62.6552	62.8569 (39)
												62.5291
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	0.8246	0.8232	0.8219	0.8154	0.8140	0.8075	0.8075	0.8062	0.8101	0.8140	0.8167	0.8193 (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												2.3977 (42)
Hot water usage for mixer showers	64.4209	63.4528	62.0420	59.3428	57.3509	55.1295	53.8669	55.2669	56.8017	59.1868	61.9439	64.1741 (42a)
Hot water usage for baths	27.8263	27.4131	26.8311	25.7581	24.9546	24.0637	23.5825	24.1604	24.7896	25.7429	26.8380	27.7323 (42b)
Hot water usage for other uses	39.1846	37.7597	36.3349	34.9100	33.4851	32.0602	32.0602	33.4851	34.9100	36.3349	37.7597	39.1846 (42c)
Average daily hot water use (litres/day)												120.8157 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	131.4319	128.6256	125.2080	120.0109	115.7906	111.2534	109.5095	112.9123	116.5012	121.2645	126.5417	131.0910 (44)
Energy content (annual)	208.1560	183.1611	192.4400	164.2889	155.8764	136.7990	132.4422	139.8091	143.6576	164.5548	180.2818	205.2568 (45)
Distribution loss (46)m = 0.15 x (45)m	31.2234	27.4742	28.8660	24.6433	23.3815	20.5198	19.8663	20.9714	21.5486	24.6832	27.0423	30.7885 (46)
Water storage loss:												180.0000 (47)
Store volume												1.3200 (48)
a) If manufacturer declared loss factor is known (kWh/day):												0.5400 (49)
Temperature factor from Table 2b												0.7128 (55)
Enter (49) or (54) in (55)												
Total storage loss	22.0968	19.9584	22.0968	21.3840	22.0968	21.3840	22.0968	22.0968	21.3840	22.0968	21.3840	22.0968 (56)
If cylinder contains dedicated solar storage	22.0968	19.9584	22.0968	21.3840	22.0968	21.3840	22.0968	22.0968	21.3840	22.0968	21.3840	22.0968 (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	253.5152	224.1307	237.7992	208.1849	201.2356	180.6950	177.8014	185.1683	187.5536	209.9140	224.1778	250.6160 (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	253.5152	224.1307	237.7992	208.1849	201.2356	180.6950	177.8014	185.1683	187.5536	209.9140	224.1778	250.6160 (64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (64a)
Total Energy used by instantaneous electric shower (s) (kWh/year) = Sum(64a)m =												0.0000 (64a)
Heat gains from water heating, kWh/month	105.4992	93.6768	100.2737	89.7429	88.1163	80.6025	80.3244	82.7739	82.8830	91.0018	95.0605	104.5352 (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	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.2358	23.3024	18.9508	14.3470	10.7245	9.0541	9.7833	12.7167	17.0683	21.6721	25.2946	26.9650 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	317.0883	320.3787	312.0870	294.4350	272.1526	251.2103	237.2195	233.9291	242.2208	259.8727	282.1552	303.0975 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838 (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)	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072 (71)
Water heating gains (Table 5)	141.8000	139.3999	134.7764	124.6429	118.4358	111.9479	107.9629	111.2552	115.1152	122.3143	132.0285	140.5044 (72)
Total internal gains	584.8615	582.8184	565.5516	533.1623	501.0503	471.9496	454.7030	457.6384	474.1417	503.5965	539.2156	570.3043 (73)

#### 6. Solar gains

[Jan]	Area	Solar flux	g	FF	Access	Gains
	m2	Table 6a	Specific data	Specific data	factor	W
		W/m2	or Table 6b	or Table 6c	Table 6d	
Northeast	3.1500	11.2829	0.6300	0.7000	0.7700	10.8619 (75)
Southeast	2.9600	36.7938	0.6300	0.7000	0.7700	33.2842 (77)
Southwest	3.1500	36.7938	0.6300	0.7000	0.7700	35.4207 (79)
Northeast	3.7800	11.2829	0.6300	0.7000	0.7700	13.0342 (75)



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Solar gains	92.6011	165.6712	247.7615	342.3268	415.6897	426.8716	405.6454	348.7443	280.1679	188.7865	112.3602	78.3119 (83)
Total gains	677.4626	748.4896	813.3132	875.4891	916.7400	898.8212	860.3484	806.3827	754.3096	692.3830	651.5758	648.6162 (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	99.9079	100.0675	100.2276	101.0357	101.1989	102.0228	102.0228	102.1892	101.6917	101.1989	100.8730	100.5493	
alpha	7.6605	7.6712	7.6818	7.7357	7.7466	7.8015	7.8015	7.8126	7.7794	7.7466	7.7249	7.7033	
util living area	0.9878	0.9729	0.9296	0.8118	0.6267	0.4407	0.3168	0.3527	0.5655	0.8554	0.9709	0.9908 (86)	
Living	20.5864	20.6814	20.8069	20.9152	20.9537	20.9597	20.9601	20.9601	20.9578	20.9046	20.7299	20.5611	
Non living	19.7581	19.8767	20.0273	20.1495	20.1854	20.1955	20.1957	20.1969	20.1921	20.1429	19.9430	19.7304	
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	20.7884	20.6814	20.8069	20.9152	20.9537	20.9597	20.9601	20.9601	20.9578	20.9046	20.7299	20.6225 (87)	
Th 2	20.2321	20.2332	20.2344	20.2400	20.2412	20.2469	20.2469	20.2480	20.2446	20.2412	20.2389	20.2366 (88)	
util rest of house	0.9838	0.9648	0.9106	0.7743	0.5782	0.3890	0.2626	0.2951	0.5050	0.8152	0.9606	0.9878 (89)	
MIT 2	20.0431	19.8767	20.0273	20.1495	20.1854	20.1955	20.1957	20.1969	20.1921	20.1429	19.9430	19.8216 (90)	
Living area fraction									FLA = Living area / (4) =				
MIT	20.2513	20.1014	20.2450	20.3634	20.4000	20.4090	20.4092	20.4101	20.4060	20.3557	20.1628	20.0453 (92)	
Temperature adjustment												0.0000	
adjusted MIT	20.2513	20.1014	20.2450	20.3634	20.4000	20.4090	20.4092	20.4101	20.4060	20.3557	20.1628	20.0453 (93)	

## 8. Space heating requirement

Utilisation	0.9840	0.9631	0.9109	0.7807	0.5885	0.4002	0.2743	0.3075	0.5180	0.8217	0.9594	0.9869 (94)
Useful gains	666.5983	720.8739	740.8571	683.5067	539.4591	359.6898	235.9686	247.9979	390.7612	568.9322	625.1363	640.1013 (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	1009.0859	960.1154	866.7441	717.0837	543.3469	359.8607	235.9757	248.0151	391.9203	609.2757	818.4538	995.9896 (97)
Space heating kWh	254.8108	160.7703	93.6600	24.1754	2.8926	0.0000	0.0000	0.0000	0.0000	30.0155	139.1887	264.7809 (98a)
Space heating requirement - total per year (kWh/year)												970.2942
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	254.8108	160.7703	93.6600	24.1754	2.8926	0.0000	0.0000	0.0000	0.0000	30.0155	139.1887	264.7809 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												970.2942
Space heating per m2										(98c) / (4) =		12.6472 (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 %)												264.8630 (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	254.8108	160.7703	93.6600	24.1754	2.8926	0.0000	0.0000	0.0000	0.0000	30.0155	139.1887	264.7809 (98)
Space heating efficiency (main heating system 1)	264.8630	264.8630	264.8630	264.8630	264.8630	0.0000	0.0000	0.0000	0.0000	264.8630	264.8630	264.8630 (210)
Space heating fuel (main heating system)	96.2048	60.6994	35.3617	9.1275	1.0921	0.0000	0.0000	0.0000	0.0000	11.3325	52.5512	99.9690 (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	253.5152	224.1307	237.7992	208.1849	201.2356	180.6950	177.8014	185.1683	187.5536	209.9140	224.1778	250.6160 (64)
Efficiency of water heater (217)m	167.5316	167.5316	167.5316	167.5316	167.5316	167.5316	167.5316	167.5316	167.5316	167.5316	167.5316	167.5316 (216)
Fuel for water heating, kWh/month	151.3238	133.7842	141.9429	124.2661	120.1180	107.8573	106.1301	110.5274	111.9512	125.2982	133.8123	149.5933 (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	14.1600	12.7896	14.1600	13.7032	14.1600	13.7032	14.1600	14.1600	13.7032	14.1600	13.7032	14.1600 (231)
Lighting	22.9641	18.4226	16.5875	12.1527	9.3871	7.6694	8.5633	11.1308	14.4579	18.9695	21.4260	23.6023 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-58.6483	-84.3055	-122.2215	-135.2631	-144.7180	-134.8134	-132.9626	-126.4143	-112.3368	-94.2233	-64.3145	-50.3842 (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	-29.5147	-66.8324	-144.1203	-231.8220	-315.4895	-319.8702	-314.8099	-260.7407	-184.1055	-101.5855	-41.0936	-22.8074 (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												366.3382 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												167.5316

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Water heating fuel used		1516.6047	(219)
Space cooling fuel		0.0000	(221)
Electricity for pumps and fans:			
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7125)			
mechanical ventilation fans (SFP = 0.7125)		166.7221	(230a)
Total electricity for the above, kWh/year		166.7221	(231)
Electricity for lighting (calculated in Appendix L)		185.3332	(232)
Energy saving/generation technologies (Appendices M ,N and Q)			
PV generation		-3293.3975	(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		-1058.3992	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	366.3382	16.4900	60.4092 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1516.6047	16.4900	250.0881 (247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000 (247a)
Pumps, fans and electric keep-hot	166.7221	16.4900	27.4925 (249)
Energy for lighting	185.3332	16.4900	30.5615 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1260.6056	16.4900	-207.8739
PV Unit electricity exported	-2032.7919	5.5900	-113.6331
Total			-321.5069 (252)
Total energy cost			47.0443 (255)

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

Energy cost deflator (Table 12):		0.3600 (256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	0.1391 (257)
SAP value		97.7446
SAP rating (Section 12)		98 (258)
SAP band		A

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	366.3382	0.1584	58.0244 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1516.6047	0.1410	213.8045 (264)
Space and water heating			271.8289 (265)
Pumps, fans and electric keep-hot	166.7221	0.1387	23.1264 (267)
Energy for lighting	185.3332	0.1443	26.7493 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1260.6056	0.1346	-169.7323
PV Unit electricity exported	-2032.7919	0.1243	-252.6969
Total			-422.4292 (269)
Total CO2, kg/year			-100.7246 (272)
CO2 emissions per m2			-1.3100 (273)
EI value			101.1089
EI rating			101 (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**  
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	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	76.7200 (1b)	x 2.5000 (2b)	= 191.8000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	76.7200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	191.8000 (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)

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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 AF50 1.5000 (17)  
 Infiltration rate 0.0750 (18)  
 Number of sides sheltered 2 (19)  
 Shelter factor (20) = 1 - [0.075 x (19)] = 0.8500 (20)  
 Infiltration rate adjusted to include shelter factor (21) = (18) x (20) = 0.0638 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	8.0000	7.4000	7.1000	6.3000	6.3000	5.6000	5.4000	5.4000	6.2000	7.0000	7.4000	8.0000
Wind factor	2.0000	1.8500	1.7750	1.5750	1.5750	1.4000	1.3500	1.3500	1.5500	1.7500	1.8500	2.0000
Adj infilt rate	0.1275	0.1179	0.1132	0.1004	0.1004	0.0892	0.0861	0.0861	0.0988	0.1116	0.1179	0.1275
Balanced mechanical ventilation with heat recovery												
If mechanical ventilation												0.5000
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												84.6000
Effective ac	0.2045	0.1949	0.1902	0.1774	0.1774	0.1662	0.1631	0.1631	0.1758	0.1886	0.1949	0.2045

### 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
NEW OPENINGS (Uw = 1.20)			9.2600	1.1450	10.6031		(27)
DOOR			2.2100	1.2000	2.6520		(26)
PAT DOORS (Uw = 1.20)			3.7800	1.1450	4.3282		(27)
Heat Loss Floor 1			76.7200	0.1200	9.2064	75.0000	5754.0000 (28a)
External Wall 1	90.4250	15.2500	75.1750	0.1800	13.5315	60.0000	4510.5000 (29a)
PLANE	76.7200		76.7200	0.1000	7.6720	9.0000	690.4800 (30)
Total net area of external elements Aum(A, m2)			243.8650				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...	(30) + (32) =	47.9932	(33)
Party Wall 1			8.7300	0.0000	0.0000	110.0000	960.3000 (32)
Internal Wall 2			144.5000			75.0000	10837.5000 (32c)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 22752.7800 (34)  
 Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 296.5691 (35)

#### List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	20.5800	0.0650	1.3377
E3 Sill	19.5300	0.0250	0.4883
E4 Jamb	35.4000	0.0200	0.7080
E5 Ground floor (normal)	36.1700	0.0230	0.8319
E10 Eaves (insulation at ceiling level)	16.3200	0.0370	0.6038
E12 Gable (insulation at ceiling level)	19.8500	0.0390	0.7742
E16 Corner (normal)	15.0000	0.0350	0.5250
E17 Corner (inverted - internal area greater than external area)	10.0000	-0.0780	-0.7800
E18 Party wall between dwellings	5.0000	0.0550	0.2750
P1 Party wall - Ground floor	3.4900	0.0580	0.2024
P4 Party wall - Roof (insulation at ceiling level)	3.4900	0.0810	0.2827

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 5.2490 (36)  
 Point Thermal bridges 0.0000  
 Total fabric heat loss (33) + (36) + (36a) = 53.2422 (37)

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

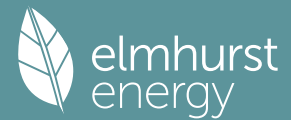
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	12.9436	12.3384	12.0357	11.2288	11.2288	10.5226	10.3209	10.3209	11.1279	11.9349	12.3384	12.9436
Heat transfer coeff	66.1858	65.5805	65.2779	64.4709	64.4709	63.7648	63.5630	63.5630	64.3700	65.1770	65.5805	66.1858
Average = Sum(39)m / 12 =												64.8492

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	0.8627	0.8548	0.8509	0.8403	0.8403	0.8311	0.8285	0.8285	0.8390	0.8495	0.8548	0.8627
HLP (average)												0.8453
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												2.3977
Hot water usage for mixer showers	64.4209	63.4528	62.0420	59.3428	57.3509	55.1295	53.8669	55.2669	56.8017	59.1868	61.9439	64.1741
Hot water usage for baths	27.8263	27.4131	26.8311	25.7581	24.9546	24.0637	23.5825	24.1604	24.7896	25.7429	26.8380	27.7323
Hot water usage for other uses	39.1846	37.7597	36.3349	34.9100	33.4851	32.0602	32.0602	33.4851	34.9100	36.3349	37.7597	39.1846
Average daily hot water use (litres/day)												120.8157
Daily hot water use	131.4319	128.6256	125.2080	120.0109	115.7906	111.2534	109.5095	112.9123	116.5012	121.2645	126.5417	131.0910
Energy conte	208.1560	183.1611	192.4400	164.2889	155.8764	136.7990	132.4422	139.8091	143.6576	164.5548	180.2818	205.2568
Energy content (annual)										Total = Sum(45)m =		2006.7237
Distribution loss (46)m = 0.15 x (45)m	31.2234	27.4742	28.8660	24.6433	23.3815	20.5198	19.8663	20.9714	21.5486	24.6832	27.0423	30.7885
Water storage loss:												180.0000
Store volume												1.3200
a) If manufacturer declared loss factor is known (kWh/day):												0.5400
Temperature factor from Table 2b												0.7128
Enter (49) or (54) in (55)												
Total storage loss	22.0968	19.9584	22.0968	21.3840	22.0968	21.3840	22.0968	22.0968	21.3840	22.0968	21.3840	22.0968
If cylinder contains dedicated solar storage	22.0968	19.9584	22.0968	21.3840	22.0968	21.3840	22.0968	22.0968	21.3840	22.0968	21.3840	22.0968
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
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

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Total heat required for water heating calculated for each month												
	253.5152	224.1307	237.7992	208.1849	201.2356	180.6950	177.8014	185.1683	187.5536	209.9140	224.1778	250.6160 (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	253.5152	224.1307	237.7992	208.1849	201.2356	180.6950	177.8014	185.1683	187.5536	209.9140	224.1778	250.6160 (64)
	Total per year (kWh/year) = Sum(64)m =											2540.7917 (64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (64a)
	Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =											0.0000 (64a)
Heat gains from water heating, kWh/month	105.4992	93.6768	100.2737	89.7429	88.1163	80.6025	80.3244	82.7739	82.8830	91.0018	95.0605	104.5352 (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	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.2358	23.3024	18.9508	14.3470	10.7245	9.0541	9.7833	12.7167	17.0683	21.6721	25.2946	26.9650 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	317.0883	320.3787	312.0870	294.4350	272.1526	251.2103	237.2195	233.9291	242.2208	259.8727	282.1552	303.0975 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838 (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)	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072 (71)
Water heating gains (Table 5)	141.8000	139.3999	134.7764	124.6429	118.4358	111.9479	107.9629	111.2552	115.1152	122.3143	132.0285	140.5044 (72)
Total internal gains	584.8615	582.8184	565.5516	533.1623	501.0503	471.9496	454.7030	457.6384	474.1417	503.5965	539.2156	570.3043 (73)

## 6. Solar gains

[Jan]	Area		Solar flux		Specific data		Specific data		Access factor		Gains	
	m2		Table 6a		or Table 6b		or Table 6c		Table 6d		W	
			W/m2									
Northeast	3.1500		15.8605		0.6300		0.7000		0.7700		15.2686 (75)	
Southeast	2.9600		15.8605		0.6300		0.7000		0.7700		43.3689 (77)	
Southwest	3.1500		15.8605		0.6300		0.7000		0.7700		46.1527 (79)	
Northeast	3.7800		15.8605		0.6300		0.7000		0.7700		18.3223 (75)	
Solar gains	123.1124	190.6595	284.0370	403.0467	466.3189	525.3243	452.8643	418.5879	340.7623	227.4782	143.4134	100.8754 (83)
Total gains	707.9740	773.4779	849.5887	936.2090	967.3692	997.2739	907.5674	876.2263	814.9039	731.0747	682.6290	671.1797 (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	95.4921	96.3734	96.8201	98.0321	98.0321	99.1177	99.4323	99.4323	98.1857	96.9700	96.3734	95.4921
alpha	7.3661	7.4249	7.4547	7.5355	7.5355	7.6078	7.6288	7.6288	7.5457	7.4647	7.4249	7.3661
util living area	0.9637	0.9403	0.8879	0.7692	0.6133	0.4407	0.3641	0.3554	0.5041	0.7461	0.9110	0.9667 (86)
Living	20.7239	20.7815	20.8553	20.9259	20.9527	20.9586	20.9591	20.9591	20.9576	20.9376	20.8501	20.7236
Non living	19.8994	19.9726	20.0579	20.1380	20.1614	20.1737	20.1763	20.1763	20.1662	20.1426	20.0528	19.8998
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	20.8588	20.7815	20.8553	20.9259	20.9527	20.9586	20.9591	20.9591	20.9576	20.9376	20.8501	20.7236 (87)
Th 2	20.1993	20.2061	20.2095	20.2185	20.2185	20.2264	20.2287	20.2287	20.2196	20.2106	20.2061	20.1993 (88)
util rest of house	0.9513	0.9223	0.8597	0.7280	0.5642	0.3915	0.3101	0.2995	0.4434	0.6891	0.8812	0.9547 (89)
MIT 2	20.0798	19.9726	20.0579	20.1380	20.1614	20.1737	20.1763	20.1763	20.1662	20.1426	20.0528	19.9538 (90)
Living area fraction	fLA = Living area / (4) =											
MIT	20.2974	20.1986	20.2806	20.3581	20.3824	20.3930	20.3950	20.3950	20.3873	20.3646	20.2755	20.1796 (92)
Temperature adjustment	0.0000											
adjusted MIT	20.2974	20.1986	20.2806	20.3581	20.3824	20.3930	20.3950	20.3950	20.3873	20.3646	20.2755	20.1796 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9530	0.9221	0.8624	0.7357	0.5747	0.4021	0.3218	0.3115	0.4565	0.7006	0.8841	0.9543 (94)
Useful gains	674.7200	713.2305	732.7100	688.7407	555.9043	401.0338	292.0362	272.9770	371.9748	512.2227	603.5066	640.5346 (95)
Ext temp.	7.0000	7.1000	7.8000	9.3000	11.7000	14.1000	15.8000	16.1000	14.6000	12.3000	9.8000	7.5000 (96)
Heat loss rate W	880.0956	859.0113	814.7079	712.9244	559.7627	401.2693	292.0709	273.0027	372.5259	525.6291	686.9909	839.2108 (97)
Space heating kWh	152.7995	97.9647	61.0065	17.4123	2.8706	0.0000	0.0000	0.0000	0.0000	9.9744	60.1087	147.8151 (98a)
Space heating requirement - total per year (kWh/year)												549.9517
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	152.7995	97.9647	61.0065	17.4123	2.8706	0.0000	0.0000	0.0000	0.0000	9.9744	60.1087	147.8151 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												549.9517
Space heating per m2												(98c) / (4) = 7.1683 (99)

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

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													264.6897 (206)
Efficiency of main space heating system 2 (in %)													0.0000 (207)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement	152.7995	97.9647	61.0065	17.4123	2.8706	0.0000	0.0000	0.0000	0.0000	9.9744	60.1087	147.8151	(98)
Space heating efficiency (main heating system 1)	264.6897	264.6897	264.6897	264.6897	264.6897	0.0000	0.0000	0.0000	0.0000	264.6897	264.6897	264.6897	(210)
Space heating fuel (main heating system)	57.7278	37.0112	23.0483	6.5784	1.0845	0.0000	0.0000	0.0000	0.0000	3.7683	22.7091	55.8447	(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	253.5152	224.1307	237.7992	208.1849	201.2356	180.6950	177.8014	185.1683	187.5536	209.9140	224.1778	250.6160	(64)
Efficiency of water heater	167.5462	167.5462	167.5462	167.5462	167.5462	167.5462	167.5462	167.5462	167.5462	167.5462	167.5462	167.5462	(216)
Fuel for water heating, kWh/month	151.3106	133.7725	141.9306	124.2552	120.1075	107.8479	106.1209	110.5177	111.9414	125.2872	133.8006	149.5802	(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	14.1600	12.7896	14.1600	13.7032	14.1600	13.7032	14.1600	14.1600	13.7032	14.1600	13.7032	14.1600	(231)
Lighting	22.9641	18.4226	16.5875	12.1527	9.3871	7.6694	8.5633	11.1308	14.4579	18.9695	21.4260	23.6023	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-73.3045	-92.7101	-131.8792	-145.5870	-151.1096	-144.5218	-138.0938	-135.9338	-123.8399	-105.8631	-76.7230	-61.7796	(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	-47.1403	-85.2508	-177.5218	-287.4091	-362.8030	-411.4979	-358.9817	-328.1404	-239.7816	-134.7668	-61.3906	-35.1755	(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													207.7722 (211)
Space heating fuel - main system 2													0.0000 (213)
Space heating fuel - secondary													0.0000 (215)
Efficiency of water heater													167.5462
Water heating fuel used													1516.4724 (219)
Space cooling fuel													0.0000 (221)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7125)													
mechanical ventilation fans (SFP = 0.7125)													166.7221 (230a)
Total electricity for the above, kWh/year													166.7221 (231)
Electricity for lighting (calculated in Appendix L)													185.3332 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation													-3911.2049 (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													-1834.9049 (238)

## 10a. Fuel costs - using BEDF prices (533)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	207.7722	21.5100	44.6918	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1516.4724	21.5100	326.1932	(247)
Energy for instantaneous electric shower(s)	0.0000	21.5100	0.0000	(247a)
Pumps, fans and electric keep-hot	166.7221	21.5100	35.8619	(249)
Energy for lighting	185.3332	21.5100	39.8652	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1381.3454	21.5100	-297.1274	
PV Unit electricity exported	-2529.8596	5.5900	-141.4191	
Total			-438.5465	(252)
Total energy cost			8.0656	(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	207.7722	0.1588	32.9859	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1516.4724	0.1410	213.7858	(264)
Space and water heating			246.7717	(265)
Pumps, fans and electric keep-hot	166.7221	0.1387	23.1264	(267)
Energy for lighting	185.3332	0.1443	26.7493	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1381.3454	0.1352	-186.7819	
PV Unit electricity exported	-2529.8596	0.1252	-316.7192	
Total			-503.5011	(269)
Total CO2, kg/year			-206.8536	(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	207.7722	1.5877	329.8792 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1516.4724	1.5213	2306.9807 (278)
Space and water heating			2636.8598 (279)
Pumps, fans and electric keep-hot	166.7221	1.5128	252.2173 (281)
Energy for lighting	185.3332	1.5338	284.2703 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1381.3454	1.4998	-2071.6893
PV Unit electricity exported	-2529.8596	0.4595	-1162.5486
Total			-3234.2378 (283)
Total Primary energy kWh/year			-60.8904 (286)

## SAP 10 EPC IMPROVEMENTS

### AS DESIGNED

Current energy efficiency rating: A 98  
 Current environmental impact rating: A 101

	SAP change	Cost change	CO2 change	Recommended
N Solar water heating	+ 2.2	-£ 73	-52 kg (25.3%)	Recommended
U Solar photovoltaic panels				Already installed
V2 Wind turbine				Not applicable

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£73	0.68 kg/m <sup>2</sup>	A 100 A 102
<b>Total Savings</b>	<b>£73</b>	<b>0.68 kg/m<sup>2</sup></b>	

Potential energy efficiency rating: A 100  
 Potential environmental impact rating: A 102

Fuel prices for cost data on this page from database revision number 533 TEST (30 Nov 2023)  
 Recommendation texts revision number 6.1 (11 Jun 2019)

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

	Current	Potential	Saving
Electricity	£447	£356	£91
Space heating	£81	£98	-£17
Water heating	£326	£218	£108
Lighting	£40	£40	£0
Generated (PV)	-£439	-£421	-£17
Total cost of fuels	£8	-£65	£74
Total cost of uses	£8	-£65	£74
Delivered energy	-24 kWh/m <sup>2</sup>	-29 kWh/m <sup>2</sup>	5 kWh/m <sup>2</sup>
Carbon dioxide emissions	-0.2 tonnes	-0.3 tonnes	0.1 tonnes
CO2 emissions per m <sup>2</sup>	-3 kg/m <sup>2</sup>	-3 kg/m <sup>2</sup>	1 kg/m <sup>2</sup>
Primary energy	-1 kWh/m <sup>2</sup>	-7 kWh/m <sup>2</sup>	7 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	76.7200 (1b)	x 2.5000 (2b)	= 191.8000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	76.7200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 191.8000 (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)

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Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =											Air changes per hour	0.0000 / (5) =	0.0000 (8)
Pressure test												Yes		
Pressure Test Method												Blower Door		
Measured/design AP50												1.5000	(17)	
Infiltration rate												0.0750	(18)	
Number of sides sheltered												2	(19)	
Shelter factor												(20) = 1 - [0.075 x (19)] =	0.8500 (20)	
Infiltration rate adjusted to include shelter factor												(21) = (18) x (20) =	0.0638 (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	0.0813	0.0797	0.0781	0.0701	0.0685	0.0606	0.0606	0.0590	0.0638	0.0685	0.0717	0.0749	(22b)
Balanced mechanical ventilation with heat recovery													
If mechanical ventilation													0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)													0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =													84.6000 (23c)
Effective ac	0.1583	0.1567	0.1551	0.1471	0.1455	0.1376	0.1376	0.1360	0.1407	0.1455	0.1487	0.1519	(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	
NEW OPENINGS (Uw = 1.20)			9.2600	1.1450	10.6031			(27)
DOOR			2.2100	1.2000	2.6520			(26)
PAT DOORS (Uw = 1.20)			3.7800	1.1450	4.3282			(27)
Heat Loss Floor 1			76.7200	0.1200	9.2064	75.0000	5754.0000	(28a)
External Wall 1	90.4250	15.2500	75.1750	0.1800	13.5315	60.0000	4510.5000	(29a)
PLANE	76.7200		76.7200	0.1000	7.6720	9.0000	690.4800	(30)
Total net area of external elements Aum(A, m2)			243.8650					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	47.9932			(33)
Party Wall 1			8.7300	0.0000	0.0000	110.0000	960.3000	(32)
Internal Wall 2			144.5000			75.0000	10837.5000	(32c)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 22752.7800 (34)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 296.5691 (35)

#### List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	20.5800	0.0650	1.3377
E3 Sill	19.5300	0.0250	0.4883
E4 Jamb	35.4000	0.0200	0.7080
E5 Ground floor (normal)	36.1700	0.0230	0.8319
E10 Eaves (insulation at ceiling level)	16.3200	0.0370	0.6038
E12 Gable (insulation at ceiling level)	19.8500	0.0390	0.7742
E16 Corner (normal)	15.0000	0.0350	0.5250
E17 Corner (inverted - internal area greater than external area)	10.0000	-0.0780	-0.7800
E18 Party wall between dwellings	5.0000	0.0550	0.2750
P1 Party wall - Ground floor	3.4900	0.0580	0.2024
P4 Party wall - Roof (insulation at ceiling level)	3.4900	0.0810	0.2827

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 5.2490 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 53.2422 (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	10.0183	9.9174	9.8165	9.3121	9.2113	8.7069	8.7069	8.6060	8.9086	9.2113	9.4130	9.6148	(38)
Heat transfer coeff	63.2604	63.1595	63.0587	62.5543	62.4534	61.9490	61.9490	61.8482	62.1508	62.4534	62.6552	62.8569	(39)
Average = Sum(39)m / 12 =													62.5291

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8246	0.8232	0.8219	0.8154	0.8140	0.8075	0.8075	0.8062	0.8101	0.8140	0.8167	0.8193	(40)
HLP (average)													0.8150
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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

Assumed occupancy													2.3977 (42)
Hot water usage for mixer showers													64.4209
Hot water usage for baths													27.8263
Hot water usage for other uses													39.1846
Average daily hot water use (litres/day)													120.8157 (43)

Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	131.4319	128.6256	125.2080	120.0109	115.7906	111.2534	109.5095	112.9123	116.5012	121.2645	126.5417	131.0910	(44)
Energy conte	208.1560	183.1611	192.4400	164.2889	155.8764	136.7990	132.4422	139.8091	143.6576	164.5548	180.2818	205.2568	(45)
Energy content (annual)													2006.7237
Distribution loss (46)m = 0.15 x (45)m													31.2234
Water storage loss:													180.0000 (47)

Store volume a) If manufacturer declared loss factor is known (kWh/day): 1.3200 (48)

Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 0.7128 (55)

Total storage loss 22.0968 19.9584 22.0968 21.3840 22.0968 21.3840 22.0968 22.0968 21.3840 22.0968 21.3840 22.0968 22.0968 (56)

If cylinder contains dedicated solar storage 22.0968 19.9584 22.0968 21.3840 22.0968 21.3840 22.0968 22.0968 21.3840 22.0968 21.3840 22.0968 22.0968 (57)

Primary loss 23.2624 21.0112 21.8667 15.7584 10.4681 9.9053 10.2355 11.1660 17.1091 21.8667 22.5120 23.2624 (59)

Combi loss 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (61)

Total heat required for water heating calculated for each month 253.5152 224.1307 236.4035 201.4313 188.4413 168.0883 164.7745 173.0718 182.1507 208.5182 224.1778 250.6160 (62)

WWHRS 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (63a)

PV diverter -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 -0.0000 (63b)



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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													610.6804 (H24)
Heat delivered to space heating													0.0000 (H29)
Solar input													610.6804
Solar input	-0.0000	-16.2246	-57.8453	-79.0099	-102.3998	-94.1569	-93.3236	-82.0488	-57.0720	-28.5996	-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													
	253.5152	207.9061	178.5582	122.4214	86.0415	73.9313	71.4509	91.0231	125.0788	179.9187	224.1778		250.6160 (64)
													1864.6390 (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)
													0.0000 (64a)
Heat gains from water heating, kWh/month													
	105.4992	93.6768	99.1571	84.3400	77.8808	70.5171	69.9029	73.0967	78.5607	89.8852	95.0605		104.5352 (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	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.2358	23.3024	18.9508	14.3470	10.7245	9.0541	9.7833	12.7167	17.0683	21.6721	25.2946	26.9650	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	317.0883	320.3787	312.0870	294.4350	272.1526	251.2103	237.2195	233.9291	242.2208	259.8727	282.1552	303.0975	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838	(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)	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	(71)
Water heating gains (Table 5)	141.8000	139.3999	133.2756	117.1389	104.6785	97.9404	93.9554	98.2483	109.1120	120.8135	132.0285	140.5044	(72)
Total internal gains	584.8615	582.8184	564.0508	525.6583	487.2930	457.9421	440.6956	444.6314	468.1385	502.0957	539.2156	570.3043	(73)

## 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	FF	Access factor Table 6d	Gains W						
Northeast	3.1500	11.2829	0.6300	0.7000	0.7700	10.8619	(75)						
Southeast	2.9600	36.7938	0.6300	0.7000	0.7700	33.2842	(77)						
Southwest	3.1500	36.7938	0.6300	0.7000	0.7700	35.4207	(79)						
Northeast	3.7800	11.2829	0.6300	0.7000	0.7700	13.0342	(75)						
Solar gains	92.6011	165.6712	247.7615	342.3268	415.6897	426.8716	405.6454	348.7443	280.1679	188.7865	112.3602	78.3119	(83)
Total gains	677.4626	748.4896	811.8124	867.9851	902.9827	884.8137	846.3410	793.3757	748.3064	690.8822	651.5758	648.6162	(84)

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area, nil,m (see Table 9a)													21.0000 (85)
tau	99.9079	100.0675	100.2276	101.0357	101.1989	102.0228	102.0228	102.1892	101.6917	101.1989	100.8730	100.5493	
alpha	7.6605	7.6712	7.6818	7.7357	7.7466	7.8015	7.8015	7.8126	7.7794	7.7466	7.7249	7.7033	
util living area	0.9878	0.9729	0.9302	0.8166	0.6355	0.4476	0.3220	0.3585	0.5698	0.8565	0.9709	0.9908	(86)
Living	20.5864	20.6814	20.8060	20.9133	20.9531	20.9597	20.9601	20.9601	20.9577	20.9041	20.7299	20.5611	
Non living	19.7581	19.8767	20.0263	20.1478	20.1850	20.1955	20.1957	20.1969	20.1920	20.1424	19.9430	19.7304	
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	20.7884	20.6814	20.8060	20.9133	20.9531	20.9597	20.9601	20.9601	20.9577	20.9041	20.7299	20.6225	(87)
Th 2	20.2321	20.2332	20.2344	20.2400	20.2412	20.2469	20.2469	20.2480	20.2446	20.2412	20.2389	20.2366	(88)
util rest of house	0.9838	0.9648	0.9113	0.7794	0.5866	0.3952	0.2669	0.3000	0.5090	0.8164	0.9606	0.9878	(89)
MIT 2	20.0431	19.8767	20.0263	20.1478	20.1850	20.1955	20.1957	20.1969	20.1920	20.1424	19.9430	19.8216	(90)
Living area fraction													FLA = Living area / (4) =
MIT	20.2513	20.1014	20.2441	20.3616	20.3996	20.4090	20.4092	20.4101	20.4059	20.3552	20.1628	20.0453	(91)
Temperature adjustment													0.0000
adjusted MIT	20.2513	20.1014	20.2441	20.3616	20.3996	20.4090	20.4092	20.4101	20.4059	20.3552	20.1628	20.0453	(93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9840	0.9631	0.9116	0.7857	0.5970	0.4065	0.2788	0.3126	0.5221	0.8229	0.9594	0.9869	(94)
Useful gains	666.5983	720.8739	740.0327	681.9403	539.0386	359.6679	235.9676	247.9955	390.6924	568.5036	625.1363	640.1013	(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	1009.0859	960.1154	866.6836	716.9726	543.3173	359.8590	235.9756	248.0149	391.9153	609.2450	818.4538	995.9896	(97)
Space heating kWh	254.8108	160.7703	94.2282	25.2233	3.1833	0.0000	0.0000	0.0000	0.0000	30.3116	139.1887	264.7809	(98a)
Space heating requirement - total per year (kWh/year)													972.4972
Solar heating kWh													

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Solar heating contribution - total per year (kWh/year)	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(98b)
Space heating kWh	254.8108	160.7703	94.2282	25.2233	3.1833	0.0000	0.0000	0.0000	0.0000	30.3116	139.1887	264.7809	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												972.4972	
Space heating per m2												12.6759	(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 %)													264.8630	(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	254.8108	160.7703	94.2282	25.2233	3.1833	0.0000	0.0000	0.0000	0.0000	30.3116	139.1887	264.7809	(98)	
Space heating efficiency (main heating system 1)	264.8630	264.8630	264.8630	264.8630	264.8630	0.0000	0.0000	0.0000	0.0000	264.8630	264.8630	264.8630	(210)	
Space heating fuel (main heating system)	96.2048	60.6994	35.5762	9.5231	1.2019	0.0000	0.0000	0.0000	0.0000	11.4443	52.5512	99.9690	(211)	
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)	
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)	
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)	
Water heating requirement	253.5152	207.9061	178.5582	122.4214	86.0415	73.9313	71.4509	91.0231	125.0788	179.9187	224.1778	250.6160	(64)	
Efficiency of water heater (217)m	167.5316	167.5316	167.5316	167.5316	167.5316	167.5316	167.5316	167.5316	167.5316	167.5316	167.5316	167.5316	(217)	
Fuel for water heating, kWh/month	151.3238	124.0996	106.5818	73.0736	51.3584	44.1298	42.6492	54.3319	74.6598	107.3939	133.8123	149.5933	(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	20.9545	18.9266	20.9545	20.2785	20.9545	20.2785	20.9545	20.9545	20.2785	20.9545	20.2785	20.9545	(231)	
Lighting	22.9641	18.4226	16.5875	12.1527	9.3871	7.6694	8.5633	11.1308	14.4579	18.9695	21.4260	23.6023	(232)	
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-58.8013	-84.1092	-119.0995	-126.9201	-128.9615	-118.9237	-117.2284	-114.6581	-106.9166	-93.1883	-64.5540	-50.5064	(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	-29.3616	-67.0287	-147.2423	-240.1651	-331.2460	-335.7600	-330.5441	-272.4969	-189.5257	-102.6204	-40.8540	-22.6853	(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													367.1699	(211)
Space heating fuel - main system 2													0.0000	(213)
Space heating fuel - secondary													0.0000	(215)
Efficiency of water heater													167.5316	
Water heating fuel used													1113.0075	(219)
Space cooling fuel													0.0000	(221)
Electricity for pumps and fans: (BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7125) mechanical ventilation fans (SFP = 0.7125) pump for solar water heating													166.7221	(230a)
Total electricity for the above, kWh/year													80.0000	(230g)
Electricity for lighting (calculated in Appendix L)													246.7221	(231)
													185.3332	(232)
Energy saving/generation technologies (Appendices M ,N and Q)														
PV generation													-3293.3975	(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													-1381.1647	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	367.1699	16.4900	60.5463
Total CO2 associated with community systems			0.0000
Water heating (other fuel)	1113.0075	16.4900	183.5349
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000
Pumps, fans and electric keep-hot	166.7221	16.4900	27.4925
Pump for solar water heating	80.0000	16.4900	13.1920
Energy for lighting	185.3332	16.4900	30.5615
Additional standing charges			0.0000
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1183.8673	16.4900	-195.2197
PV Unit electricity exported	-2109.5302	5.5900	-117.9227
Total			-313.1425
Total energy cost			2.1847

## 11a. SAP rating - Individual heating systems

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Energy cost deflator (Table 12):		0.3600 (256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	0.0065 (257)
SAP value		99.8953
SAP rating (Section 12)		100 (258)
SAP band		A

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	367.1699	0.1584	58.1435 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1113.0075	0.1460	162.4758 (264)
Space and water heating			220.6193 (265)
Pumps, fans and electric keep-hot	246.7221	0.1387	34.2234 (267)
Energy for lighting	185.3332	0.1443	26.7493 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1183.8673	0.1354	-160.2594
PV Unit electricity exported	-2109.5302	0.1239	-261.4593
Total			-421.7187 (269)
Total CO2, kg/year			-140.1267 (272)
CO2 emissions per m2			-1.8300 (273)
EI value			101.5426
EI rating			102 (274)
EI band			A

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

### 1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	76.7200 (1b)	x 2.5000 (2b)	= 191.8000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	76.7200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 191.8000 (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		1.5000	(17)
Infiltration rate		0.0750	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.0638 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	8.0000	7.4000	7.1000	6.3000	6.3000	5.6000	5.4000	5.4000	6.2000	7.0000	7.4000	8.0000 (22)
Wind factor	2.0000	1.8500	1.7750	1.5750	1.5750	1.4000	1.3500	1.3500	1.5500	1.7500	1.8500	2.0000 (22a)
Adj infilt rate	0.1275	0.1179	0.1132	0.1004	0.1004	0.0892	0.0861	0.0861	0.0988	0.1116	0.1179	0.1275 (22b)
Balanced mechanical ventilation with heat recovery												
If mechanical ventilation												0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												84.6000 (23c)
Effective ac	0.2045	0.1949	0.1902	0.1774	0.1774	0.1662	0.1631	0.1631	0.1758	0.1886	0.1949	0.2045 (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
NEW OPENINGS (Uw = 1.20)			9.2600	1.1450	10.6031		(27)
DOOR			2.2100	1.2000	2.6520		(26)
PAT DOORS (Uw = 1.20)			3.7800	1.1450	4.3282		(27)
Heat Loss Floor 1			76.7200	0.1200	9.2064	75.0000	5754.0000 (28a)
External Wall 1	90.4250	15.2500	75.1750	0.1800	13.5315	60.0000	4510.5000 (29a)
PLANE	76.7200		76.7200	0.1000	7.6720	9.0000	690.4800 (30)
Total net area of external elements Aum(A, m2)			243.8650				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	47.9932		(33)
Party Wall 1			8.7300	0.0000	0.0000	110.0000	960.3000 (32)

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Internal Wall 2 144.5000 75.0000 10837.5000 (32c)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 22752.7800 (34)  
 Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 296.5691 (35)

List of Thermal Bridges	Length	Psi-value	Total
K1 Element			
E1 Steel lintel with perforated steel base plate	20.5800	0.0650	1.3377
E3 Sill	19.5300	0.0250	0.4883
E4 Jamb	35.4000	0.0200	0.7080
E5 Ground floor (normal)	36.1700	0.0230	0.8319
E10 Eaves (insulation at ceiling level)	16.3200	0.0370	0.6038
E12 Gable (insulation at ceiling level)	19.8500	0.0390	0.7742
E16 Corner (normal)	15.0000	0.0350	0.5250
E17 Corner (inverted - internal area greater than external area)	10.0000	-0.0780	-0.7800
E18 Party wall between dwellings	5.0000	0.0550	0.2750
P1 Party wall - Ground floor	3.4900	0.0580	0.2024
P4 Party wall - Roof (insulation at ceiling level)	3.4900	0.0810	0.2827
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			5.2490 (36)
Point Thermal bridges			0.0000
Total fabric heat loss			(33) + (36) + (36a) = 53.2422 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	12.9436	12.3384	12.0357	11.2288	11.2288	10.5226	10.3209	10.3209	11.1279	11.9349	12.3384	12.9436 (38)
Heat transfer coeff	66.1858	65.5805	65.2779	64.4709	64.4709	63.7648	63.5630	63.5630	64.3700	65.1770	65.5805	66.1858 (39)
Average = Sum(39)m / 12 =												64.8492
HLP	0.8627	0.8548	0.8509	0.8403	0.8403	0.8311	0.8285	0.8285	0.8390	0.8495	0.8548	0.8627 (40)
HLP (average)												0.8453
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

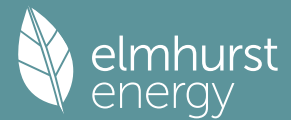
#### 4. Water heating energy requirements (kWh/year)

Assumed occupancy	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hot water usage for mixer showers	64.4209	63.4528	62.0420	59.3428	57.3509	55.1295	53.8669	55.2669	56.8017	59.1868	61.9439	64.1741 (42a)
Hot water usage for baths	27.8263	27.4131	26.8311	25.7581	24.9546	24.0637	23.5825	24.1604	24.7896	25.7429	26.8380	27.7323 (42b)
Hot water usage for other uses	39.1846	37.7597	36.3349	34.9100	33.4851	32.0602	32.0602	33.4851	34.9100	36.3349	37.7597	39.1846 (42c)
Average daily hot water use (litres/day)												120.8157 (43)
Daily hot water use	131.4319	128.6256	125.2080	120.0109	115.7906	111.2534	109.5095	112.9123	116.5012	121.2645	126.5417	131.0910 (44)
Energy conte	208.1560	183.1611	192.4400	164.2889	155.8764	136.7990	132.4422	139.8091	143.6576	164.5548	180.2818	205.2568 (45)
Energy content (annual)										Total = Sum(45)m =		2006.7237
Distribution loss (46)m = 0.15 x (45)m	31.2234	27.4742	28.8660	24.6433	23.3815	20.5198	19.8663	20.9714	21.5486	24.6832	27.0423	30.7885 (46)
Water storage loss:												
Store volume												180.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3200 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.7128 (55)
Total storage loss	22.0968	19.9584	22.0968	21.3840	22.0968	21.3840	22.0968	22.0968	21.3840	22.0968	21.3840	22.0968 (56)
If cylinder contains dedicated solar storage	22.0968	19.9584	22.0968	21.3840	22.0968	21.3840	22.0968	22.0968	21.3840	22.0968	21.3840	22.0968 (57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624 (59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
Total heat required for water heating calculated for each month	253.5152	224.1307	236.4035	201.4313	188.4413	168.0883	164.7745	173.0718	182.1507	208.5182	224.1778	250.6160 (62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63a)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000 (63b)
Aperture area of solar collector												3.0000 (H1)
Zero-loss collector efficiency												0.8000 (H2)
Collector linear heat loss coefficient												1.8000 (H3)
Collector 2nd order heat loss coefficient												0.0000 (H4)
Collector loop efficiency												0.9000 (H5)
Incidence angle modifier												1.0000 (H6)
Overshading factor												0.8000 (H8)
Overall heat loss coefficient of system												6.5000 (H10)
Heat loss coefficient of collector loop												3.9667 (H11)
Dedicated solar storage volume												75.0000 (H12)
Effective solar volume												75.0000 (H14)
Reference volume												225.0000 (H15)
Storage tank correction coefficient												1.3161 (H16)
Heat delivered to hot water												774.6492 (H24)
Heat delivered to space heating												0.0000 (H29)
Solar input												774.6492
Solar input	-9.4168	-27.7002	-73.1721	-96.7884	-114.7526	-114.8389	-103.0405	-100.1530	-76.1166	-45.8236	-12.8465	-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	244.0984	196.4305	163.2314	104.6429	73.6887	53.2494	61.7340	72.9188	106.0341	162.6947	211.3314	250.6160 (64)
												Total per year (kWh/year) = Sum(64)m = 1700.6702 (64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (64a)
												Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)
Heat gains from water heating, kWh/month	105.4992	93.6768	99.1571	84.3400	77.8808	70.5171	69.9029	73.0967	78.5607	89.8852	95.0605	104.5352 (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	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608	143.8608 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.2358	23.3024	18.9508	14.3470	10.7245	9.0541	9.7833	12.7167	17.0683	21.6721	25.2946	26.9650 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	317.0883	320.3787	312.0870	294.4350	272.1526	251.2103	237.2195	233.9291	242.2208	259.8727	282.1552	303.0975 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838	51.7838 (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)	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072	-95.9072 (71)
Water heating gains (Table 5)	141.8000	139.3999	133.2756	117.1389	104.6785	97.9404	93.9554	98.2483	109.1120	120.8135	132.0285	140.5044 (72)
Total internal gains	584.8615	582.8184	564.0508	525.6583	487.2930	457.9421	440.6956	444.6314	468.1385	502.0957	539.2156	570.3043 (73)

## 6. Solar gains

[Jan]	Area m <sup>2</sup>	Solar flux Table 6a W/m <sup>2</sup>	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
Northeast	3.1500	15.8605	0.6300	0.7000	0.7700	15.2686 (75)
Southeast	2.9600	47.9418	0.6300	0.7000	0.7700	43.3689 (77)
Southwest	3.1500	47.9418	0.6300	0.7000	0.7700	46.1527 (79)
Northeast	3.7800	15.8605	0.6300	0.7000	0.7700	18.3223 (75)

Solar gains	123.1124	190.6595	284.0370	403.0467	466.3189	525.3243	452.8643	418.5879	340.7623	227.4782	143.4134	100.8754 (83)
Total gains	707.9740	773.4779	848.0879	928.7050	953.6119	983.2665	893.5599	863.2194	808.9007	729.5739	682.6290	671.1797 (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	95.4921	96.3734	96.8201	98.0321	98.0321	99.1177	99.4323	99.4323	98.1857	96.9700	96.3734	95.4921	
alpha	7.3661	7.4249	7.4547	7.5355	7.5355	7.6078	7.6288	7.6288	7.5457	7.4647	7.4249	7.3661	
util living area	0.9637	0.9403	0.8886	0.7739	0.6215	0.4469	0.3698	0.3607	0.5078	0.7473	0.9110	0.9667 (86)	
Living	20.7239	20.7815	20.8546	20.9245	20.9521	20.9586	20.9591	20.9591	20.9576	20.9374	20.8501	20.7236	
Non living	19.8994	19.9726	20.0572	20.1368	20.1610	20.1737	20.1763	20.1763	20.1662	20.1424	20.0528	19.8998	
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	20.8588	20.7815	20.8546	20.9245	20.9521	20.9586	20.9591	20.9591	20.9576	20.9374	20.8501	20.7623 (87)	
Th 2	20.1993	20.2061	20.2095	20.2185	20.2185	20.2264	20.2287	20.2287	20.2196	20.2106	20.2061	20.1993 (88)	
util rest of house	0.9513	0.9223	0.8605	0.7329	0.5721	0.3971	0.3150	0.3040	0.4466	0.6903	0.8812	0.9547 (89)	
MIT 2	20.0798	19.9726	20.0572	20.1368	20.1610	20.1737	20.1763	20.1763	20.1662	20.1424	20.0528	19.9538 (90)	
Living area fraction									fLA = Living area / (4) =				0.2793 (91)
MIT	20.2974	20.1986	20.2799	20.3568	20.3820	20.3929	20.3950	20.3950	20.3872	20.3645	20.2755	20.1796 (92)	
Temperature adjustment												0.0000	
adjusted MIT	20.2974	20.1986	20.2799	20.3568	20.3820	20.3929	20.3950	20.3950	20.3872	20.3645	20.2755	20.1796 (93)	

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9530	0.9221	0.8632	0.7404	0.5825	0.4078	0.3268	0.3162	0.4598	0.7019	0.8841	0.9543 (94)
Useful gains	674.7200	713.2305	732.1104	687.6350	555.5181	401.0076	292.0318	272.9738	371.9445	512.0617	603.5066	640.5346 (95)
Ext temp.	7.0000	7.1000	7.8000	9.3000	11.7000	14.1000	15.8000	16.1000	14.6000	12.3000	9.8000	7.5000 (96)
Heat loss rate W	880.0956	859.0113	814.6630	712.8444	559.7347	401.2674	292.0705	273.0025	372.5236	525.6173	686.9909	839.2108 (97)
Space heating kWh	152.7995	97.9647	61.4192	18.1508	3.1372	0.0000	0.0000	0.0000	0.0000	10.0854	60.1087	147.8151 (98a)
Space heating requirement - total per year (kWh/year)												551.4805
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	152.7995	97.9647	61.4192	18.1508	3.1372	0.0000	0.0000	0.0000	0.0000	10.0854	60.1087	147.8151 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												551.4805
Space heating per m <sup>2</sup>										(98c) / (4) =		7.1882 (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 %)												264.6897 (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	152.7995	97.9647	61.4192	18.1508	3.1372	0.0000	0.0000	0.0000	0.0000	10.0854	60.1087	147.8151 (98)
Space heating efficiency (main heating system 1)	264.6897	264.6897	264.6897	264.6897	264.6897	0.0000	0.0000	0.0000	0.0000	264.6897	264.6897	264.6897 (210)
Space heating fuel (main heating system 1)	57.7278	37.0112	23.2042	6.8574	1.1852	0.0000	0.0000	0.0000	0.0000	3.8103	22.7091	55.8447 (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	244.0984	196.4305	163.2314	104.6429	73.6887	53.2494	61.7340	72.9188	106.0341	162.6947	211.3314	250.6160 (64)
Efficiency of water heater (217)m	167.5462	167.5462	167.5462	167.5462	167.5462	167.5462	167.5462	167.5462	167.5462	167.5462	167.5462	167.5462 (216)
Fuel for water heating, kWh/month	145.6902	117.2396	97.4247	62.4561	43.9811	31.7819	36.8459	43.5216	63.2865	97.1044	126.1332	149.5802 (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	20.9545	18.9266	20.9545	20.2785	20.9545	20.2785	20.9545	20.9545	20.2785	20.9545	20.2785	20.9545 (231)

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Lighting	22.9641	18.4226	16.5875	12.1527	9.3871	7.6694	8.5633	11.1308	14.4579	18.9695	21.4260	23.6023	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-73.3481	-91.9577	-126.8010	-133.1781	-131.4944	-121.3223	-118.9953	-118.8381	-114.6156	-103.2383	-76.6618	-61.9767	(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	-47.0966	-86.0031	-182.6000	-299.8181	-382.4182	-434.6974	-378.0803	-345.2361	-249.0059	-137.3915	-61.4518	-34.9784	(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												208.3498	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												167.5462	
Water heating fuel used												1015.0456	(219)
Space cooling fuel												0.0000	(221)

Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.7125)													
mechanical ventilation fans (SFP = 0.7125)												166.7221	(230a)
pump for solar water heating												80.0000	(230g)
Total electricity for the above, kWh/year												246.7221	(231)
Electricity for lighting (calculated in Appendix L)												185.3332	(232)

Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-3911.2049	(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												-2255.7542	(238)

## 10a. Fuel costs - using BEDF prices (533)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	208.3498	21.5100	44.8160	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1015.0456	21.5100	218.3363	(247)
Energy for instantaneous electric shower(s)	0.0000	21.5100	0.0000	(247a)
Pumps, fans and electric keep-hot	166.7221	21.5100	35.8619	(249)
Pump for solar water heating	80.0000	21.5100	17.2080	(249)
Energy for lighting	185.3332	21.5100	39.8652	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1272.4276	21.5100	-273.6992	
PV Unit electricity exported	-2638.7773	5.5900	-147.5077	
Total			-421.2068	(252)
Total energy cost			-65.1194	(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	208.3498	0.1587	33.0687	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1015.0456	0.1471	149.2815	(264)
Space and water heating			182.3502	(265)
Pumps, fans and electric keep-hot	246.7221	0.1387	34.2234	(267)
Energy for lighting	185.3332	0.1443	26.7493	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1272.4276	0.1362	-173.2500	
PV Unit electricity exported	-2638.7773	0.1248	-329.3257	
Total			-502.5756	(269)
Total CO2, kg/year			-259.2527	(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	208.3498	1.5875	330.7633	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1015.0456	1.5441	1567.3141	(278)
Space and water heating			1898.0774	(279)
Pumps, fans and electric keep-hot	246.7221	1.5128	373.2413	(281)
Energy for lighting	185.3332	1.5338	284.2703	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1272.4276	1.5033	-1912.8364	
PV Unit electricity exported	-2638.7773	0.4581	-1208.7793	
Total			-3121.6157	(283)
Total Primary energy kWh/year			-566.0267	(286)

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Property Reference	_23.SAP.144 ABDS Mullion p5			Issued on Date	09/09/2023
Assessment Reference	AS DESIGNED	Prop Type Ref			
Property	Development at, Meaver Road, HELSTON, TR12 7DP				
SAP Rating	96 A	DER	-0.32	TER	7.24
Environmental	100 A	% DER < TER			104.42
CO <sub>2</sub> Emissions (t/year)	-0.22	DFEE	37.98	TFEE	44.77
Compliance Check	See BREL	% DFEE < TFEE			15.16
% DPER < TPER	75.18	DPER	10.01	TPER	40.34
Assessor Details	Mrs. Sophie Oakland			Assessor ID	F859-0001
Client	ABDS, ABDS				

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	149.9000 (1b)	2.5000 (2b)	374.7500 (1b) - (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	149.9000		374.7500 (5)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 374.7500 (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		1.5000 (17)
Infiltration rate		0.0750 (18)
Number of sides sheltered		2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.0638 (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	0.0813	0.0797	0.0781	0.0701	0.0685	0.0606	0.0606	0.0590	0.0638	0.0685	0.0717	0.0749 (22b)
Balanced mechanical ventilation with heat recovery												
If mechanical ventilation												0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												83.7000 (23c)
Effective ac	0.1628	0.1612	0.1596	0.1516	0.1500	0.1421	0.1421	0.1405	0.1452	0.1500	0.1532	0.1564 (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
NEW OPENINGS (Uw = 1.20)			21.0300	1.1450	24.0802		(27)
DOOR			2.2100	1.2000	2.6520		(26)
PAT DOORS (Uw = 1.20)			12.0300	1.1450	13.7748		(27)



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Heat Loss Floor 1				149.9000	0.1200	17.9880	75.0000	11242.5000	(28a)
External Wall 1	134.4000	35.2700		99.1300	0.1800	17.8434	60.0000	5947.8000	(29a)
PLANE	149.9000			149.9000	0.1000	14.9900	9.0000	1349.1000	(30)
Total net area of external elements Aum(A, m2)				434.2000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =		91.3284			(33)
Internal Wall 2				289.2000			75.0000	21690.0000	(32c)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 40229.4000 (34)  
 Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 268.3749 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	20.5800	0.0640	1.3171
E3 Sill	19.5300	0.0250	0.4883
E4 Jamb	35.4000	0.0200	0.7080
E5 Ground floor (normal)	53.7600	0.0230	1.2365
E10 Eaves (insulation at ceiling level)	36.4800	0.0370	1.3498
E12 Gable (insulation at ceiling level)	17.2800	0.0390	0.6739
E16 Corner (normal)	15.0000	0.0350	0.5250
E17 Corner (inverted - internal area greater than external area)	5.0000	-0.0780	-0.3900

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 5.9085 (36)

Point Thermal bridges 0.0000 (36a) =  
 Total fabric heat loss (33) + (36) + (36a) = 97.2369 (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	20.1308	19.9337	19.7366	18.7511	18.5540	17.5685	17.5685	17.3714	17.9627	18.5540	18.9482	19.3424
Average = Sum(39)m / 12 =	117.3676	117.1705	116.9735	115.9880	115.7909	114.8054	114.8054	114.6083	115.1996	115.7909	116.1851	116.5793

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	0.7830	0.7817	0.7803	0.7738	0.7725	0.7659	0.7659	0.7646	0.7685	0.7725	0.7751	0.7777
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Hot water usage for mixer showers	73.4139	72.3107	70.7030	67.6270	65.3570	62.8255	61.3866	62.9821	64.7310	67.4491	70.5912	73.1326
Hot water usage for baths	31.6936	31.2229	30.5601	29.3379	28.4228	27.4081	26.8599	27.5181	28.2348	29.3206	30.5679	31.5865
Hot water usage for other uses	44.6774	43.0528	41.4282	39.8035	38.1789	36.5543	36.5543	38.1789	39.8035	41.4282	43.0528	44.6774
Average daily hot water use (litres/day)												137.6860

Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy content (annual)	149.7850	146.5864	142.6912	136.7684	131.9586	126.7878	124.8008	128.6791	132.7694	138.1979	144.2119	149.3965
Distribution loss (46)m = 0.15 x (45)m	237.2228	208.7370	219.3111	187.2291	177.6417	155.9004	150.9357	159.3316	163.7179	187.5332	205.4563	233.9189
Total = Sum(45)m =	35.5834	31.3106	32.8967	28.0844	26.6463	23.3851	22.6404	23.8997	24.5577	28.1300	30.8184	35.0878

Water storage loss: 300.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day):  
 Temperature factor from Table 2b 2.0600 (48)  
 Enter (49) or (54) in (55) 0.5400 (49)  
 Total storage loss 1.1124 (55)

Primary loss	34.4844	31.1472	34.4844	33.3720	34.4844	33.3720	34.4844	34.4844	33.3720	34.4844	33.3720	34.4844
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total heat required for water heating calculated for each month	294.9696	260.8954	277.0579	243.1131	235.3885	211.7844	208.6825	217.0784	219.6019	245.2800	261.3403	291.6657
WVHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Output from w/h	294.9696	260.8954	277.0579	243.1131	235.3885	211.7844	208.6825	217.0784	219.6019	245.2800	261.3403	291.6657

Total per year (kWh/year) = Sum(64)m = 2966.8577 (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 125.0740 111.1318 119.1184 106.9609 105.2633 96.5441 96.3836 99.1752 99.1434 108.5522 113.0214 123.9755 (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	176.0419	176.0419	176.0419	176.0419	176.0419	176.0419	176.0419	176.0419	176.0419	176.0419	176.0419	176.0419
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	38.8694	34.5234	28.0763	21.2556	15.8888	13.4140	14.4943	18.8402	25.2873	32.1081	37.4748	39.9497
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	478.2297	483.1922	470.6868	444.0643	410.4581	378.8730	357.7723	352.8097	365.3151	391.9377	425.5438	457.1289

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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.5382	55.5382	55.5382	55.5382	55.5382	55.5382	55.5382	55.5382	55.5382	55.5382	55.5382	55.5382	55.5382 (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	0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613 (71)
Water heating gains (Table 5)	168.1102	165.3747	160.1053	148.5568	141.4829	134.0890	129.5478	133.3000	137.6992	145.9035	156.9742	166.6337	166.6337 (72)
Total internal gains	799.4281	797.3092	773.0873	728.0955	682.0487	640.5949	616.0332	619.1688	642.5205	684.1682	734.2118	777.9311	777.9311 (73)

## 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	FF	Access factor Table 6d	Gains W
Northeast	6.4800	11.2829	0.6300	0.7000	0.7700	0.7700	22.3444 (75)
Southwest	13.2900	36.7938	0.6300	0.7000	0.7700	0.7700	149.4417 (79)
Northwest	1.2600	11.2829	0.6300	0.7000	0.7700	0.7700	4.3447 (81)
Northeast	10.0800	11.2829	0.6300	0.7000	0.7700	0.7700	34.7580 (75)
Southeast	1.9500	36.7938	0.6300	0.7000	0.7700	0.7700	21.9271 (77)

Solar gains	232.8160	416.9820	624.7463	864.9608	1051.7699	1080.6474	1026.6767	881.7310	707.0542	475.4713	282.5768	196.8369	196.8369 (83)
Total gains	1032.2441	1214.2912	1397.8337	1593.0563	1733.8186	1721.2422	1642.7099	1500.8999	1349.5747	1159.6394	1016.7886	974.7680	974.7680 (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, n <sub>l,m</sub> (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	95.2122	95.3724	95.5331	96.3448	96.5088	97.3372	97.3372	97.5046	97.0041	96.5088	96.1813	95.8561
alpha	7.3475	7.3582	7.3689	7.4230	7.4339	7.4891	7.4891	7.5003	7.4669	7.4339	7.4121	7.3904
util living area	0.9957	0.9857	0.9473	0.8186	0.6141	0.4265	0.3075	0.3512	0.5843	0.8974	0.9877	0.9971 (86)
Living	20.4533	20.5846	20.7564	20.9042	20.9516	20.9581	20.9584	20.9584	20.9549	20.8695	20.6271	20.4236
Non living	19.6252	19.7920	20.0033	20.1734	20.2188	20.2295	20.2297	20.2309	20.2253	20.1425	19.8520	19.5913
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	20.7203	20.5846	20.7564	20.9042	20.9516	20.9581	20.9584	20.9584	20.9549	20.8695	20.6271	20.5042 (87)
Th 2	20.2681	20.2693	20.2704	20.2761	20.2773	20.2830	20.2830	20.2841	20.2807	20.2773	20.2750	20.2727 (88)
util rest of house	0.9943	0.9814	0.9331	0.7841	0.5689	0.3789	0.2574	0.2966	0.5255	0.8658	0.9833	0.9962 (89)
MIT 2	20.0118	19.7920	20.0033	20.1734	20.2188	20.2295	20.2297	20.2309	20.2253	20.1425	19.8520	19.7141 (90)
Living area fraction	f <sub>LA</sub> = Living area / (4) =											0.1446 (91)
MIT	20.1143	19.9066	20.1122	20.2791	20.3248	20.3349	20.3351	20.3361	20.3308	20.2476	19.9641	19.8284 (92)
Temperature adjustment	0.0000											
adjusted MIT	20.1143	19.9066	20.1122	20.2791	20.3248	20.3349	20.3351	20.3361	20.3308	20.2476	19.9641	19.8284 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9940	0.9787	0.9295	0.7843	0.5719	0.3823	0.2610	0.3005	0.5296	0.8643	0.9809	0.9954 (94)
Useful gains	1026.0493	1188.4710	1299.3397	1249.3874	991.5969	658.0895	428.7942	451.0739	714.7571	1002.2984	997.3222	970.2893 (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	1856.0848	1758.3330	1592.2715	1319.8408	998.6754	658.3940	428.8078	451.1122	717.7839	1117.1076	1494.6125	1821.9434 (97)
Space heating kWh	617.5465	382.9473	217.9412	50.7264	5.2664	0.0000	0.0000	0.0000	0.0000	85.4180	358.0490	633.6306 (98a)
Space heating requirement - total per year (kWh/year)												2351.5254
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	617.5465	382.9473	217.9412	50.7264	5.2664	0.0000	0.0000	0.0000	0.0000	85.4180	358.0490	633.6306 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2351.5254
Space heating per m2												(98c) / (4) = 15.6873 (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 %)													272.1742 (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	617.5465	382.9473	217.9412	50.7264	5.2664	0.0000	0.0000	0.0000	0.0000	85.4180	358.0490	633.6306 (98)	



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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	863.9781	0.1583	136.7469 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1680.6286	0.1409	236.8365 (264)
Space and water heating			373.5834 (265)
Pumps, fans and electric keep-hot	460.8526	0.1387	63.9259 (267)
Energy for lighting	274.5780	0.1443	39.6301 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1692.6320	0.1346	-227.7748
PV Unit electricity exported	-2506.4498	0.1240	-310.7512
Total			-538.5260 (269)
Total CO2, kg/year			-61.3866 (272)
CO2 emissions per m2			-0.4100 (273)
EI value			100.4221
EI rating			100 (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**  
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	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	149.9000 (1b)	x 2.5000 (2b)	= 374.7500 (1b) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	149.9000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 374.7500 (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		1.5000 (17)
Infiltration rate		0.0750 (18)
Number of sides sheltered		2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.0638 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	8.0000	7.4000	7.1000	6.3000	6.3000	5.6000	5.4000	5.4000	6.2000	7.0000	7.4000	8.0000 (22)
Wind factor	2.0000	1.8500	1.7750	1.5750	1.5750	1.4000	1.3500	1.3500	1.5500	1.7500	1.8500	2.0000 (22a)
Adj infilt rate	0.1275	0.1179	0.1132	0.1004	0.1004	0.0892	0.0861	0.0861	0.0988	0.1116	0.1179	0.1275 (22b)
Balanced mechanical ventilation with heat recovery												
If mechanical ventilation												0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												83.7000 (23c)
Effective ac	0.2090	0.1994	0.1947	0.1819	0.1819	0.1707	0.1676	0.1676	0.1803	0.1931	0.1994	0.2090 (25)

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**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
NEW OPENINGS (Uw = 1.20)			21.0300	1.1450	24.0802		(27)
DOOR			2.2100	1.2000	2.6520		(26)
PAT DOORS (Uw = 1.20)			12.0300	1.1450	13.7748		(27)
Heat Loss Floor 1			149.9000	0.1200	17.9880	75.0000	11242.5000 (28a)
External Wall 1	134.4000	35.2700	99.1300	0.1800	17.8434	60.0000	5947.8000 (29a)
PLANE	149.9000		149.9000	0.1000	14.9900	9.0000	1349.1000 (30)
Total net area of external elements Aum(A, m2)			434.2000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	91.3284	(33)
Internal Wall 2			289.2000			75.0000	21690.0000 (32c)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 40229.4000 (34)  
 Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 268.3749 (35)

### List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	20.5800	0.0640	1.3171
E3 Sill	19.5300	0.0250	0.4883
E4 Jamb	35.4000	0.0200	0.7080
E5 Ground floor (normal)	53.7600	0.0230	1.2365
E10 Eaves (insulation at ceiling level)	36.4800	0.0370	1.3498
E12 Gable (insulation at ceiling level)	17.2800	0.0390	0.6739
E16 Corner (normal)	15.0000	0.0350	0.5250
E17 Corner (inverted - internal area greater than external area)	5.0000	-0.0780	-0.3900

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 5.9085 (36)

Point Thermal bridges (36a) = 0.0000  
 Total fabric heat loss (33) + (36) + (36a) = 97.2369 (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	25.8465	24.6639	24.0727	22.4959	22.4959	21.1162	20.7220	20.7220	22.2988	23.8756	24.6639	25.8465 (38)
Average = Sum(39)m / 12 =	123.0834	121.9008	121.3095	119.7328	119.7328	118.3531	117.9589	117.9589	119.5357	121.1124	121.9008	123.0834 (39)

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	0.8211	0.8132	0.8093	0.7988	0.7988	0.7895	0.7869	0.7869	0.7974	0.8080	0.8132	0.8211 (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													2.9340 (42)
Hot water usage for mixer showers	73.4139	72.3107	70.7030	67.6270	65.3570	62.8255	61.3866	62.9821	64.7310	67.4491	70.5912	73.1326	73.1326 (42a)
Hot water usage for baths	31.6936	31.2229	30.5601	29.3379	28.4228	27.4081	26.8599	27.5181	28.2348	29.3206	30.5679	31.5865	31.5865 (42b)
Hot water usage for other uses	44.6774	43.0528	41.4282	39.8035	38.1789	36.5543	36.5543	38.1789	39.8035	41.4282	43.0528	44.6774	44.6774 (42c)
Average daily hot water use (litres/day)	35.5834	34.3106	32.8967	28.0844	26.6463	23.3851	22.6404	23.8997	24.5577	28.1300	30.8184	35.0878	35.0878 (43)

Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	149.7850	146.5864	142.6912	136.7684	131.9586	126.7878	124.8008	128.6791	132.7694	138.1979	144.2119	149.3965 (44)
Energy content (annual)	237.2228	208.7370	219.3111	187.2291	177.6417	155.9004	150.9357	159.3316	163.7179	187.5332	205.4563	233.9189 (45)
Distribution loss (46)m = 0.15 x (45)m	35.5834	31.3106	32.8967	28.0844	26.6463	23.3851	22.6404	23.8997	24.5577	28.1300	30.8184	35.0878 (46)

Water storage loss:  
 Store volume 300.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 2.0600 (48)

Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 1.1124 (55)

Total storage loss

34.4844 31.1472 34.4844 33.3720 34.4844 33.3720 34.4844 34.4844 33.3720 34.4844 33.3720 34.4844 (56)

If cylinder contains dedicated solar storage

34.4844 31.1472 34.4844 33.3720 34.4844 33.3720 34.4844 34.4844 33.3720 34.4844 33.3720 34.4844 (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

294.9696 260.8954 277.0579 243.1131 235.3885 211.7844 208.6825 217.0784 219.6019 245.2800 261.3403 291.6657 (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 294.9696 260.8954 277.0579 243.1131 235.3885 211.7844 208.6825 217.0784 219.6019 245.2800 261.3403 291.6657 (64)

Total per year (kWh/year) = Sum(64)m = 2966.8577 (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 125.0740 111.1318 119.1184 106.9609 105.2633 96.5441 96.3836 99.1752 99.1434 108.5522 113.0214 123.9755 (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
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(66)m	176.0419	176.0419	176.0419	176.0419	176.0419	176.0419	176.0419	176.0419	176.0419	176.0419	176.0419	176.0419	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	38.8694	34.5234	28.0763	21.2556	15.8888	13.4140	14.4943	18.8402	25.2873	32.1081	37.4748	39.9497	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	478.2297	483.1922	470.6868	444.0643	410.4581	378.8730	357.7723	352.8097	365.3151	391.9377	425.5438	457.1289	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.5382	55.5382	55.5382	55.5382	55.5382	55.5382	55.5382	55.5382	55.5382	55.5382	55.5382	55.5382	(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)	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	(71)
Water heating gains (Table 5)	168.1102	165.3747	160.1053	148.5568	141.4829	134.0890	129.5478	133.3000	137.6992	145.9035	156.9742	166.6337	(72)
Total internal gains	799.4281	797.3092	773.0873	728.0955	682.0487	640.5949	616.0332	619.1688	642.5205	684.1682	734.2118	777.9311	(73)

## 6. Solar gains

[Jan]	Area m <sup>2</sup>	Solar flux Table 6a W/m <sup>2</sup>	Specific data g or Table 6b	Specific data FF or Table 6c	Access factor Table 6d	Gains W
Northeast	6.4800	15.8605	0.6300	0.7000	0.7700	31.4097 (75)
Southwest	13.2900	47.9418	0.6300	0.7000	0.7700	194.7203 (79)
Northwest	1.2600	15.8605	0.6300	0.7000	0.7700	6.1074 (81)
Northeast	10.0800	15.8605	0.6300	0.7000	0.7700	48.8595 (75)
Southeast	1.9500	47.9418	0.6300	0.7000	0.7700	28.5707 (77)

Solar gains	309.6676	480.1412	716.6649	1018.9604	1180.3986	1330.3908	1146.6563	1058.8680	860.5069	573.2583	360.8479	253.6572	(83)
Total gains	1109.0958	1277.4503	1489.7523	1747.0559	1862.4473	1970.9856	1762.6895	1678.0369	1503.0275	1257.4264	1095.0597	1031.5884	(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	90.7907	91.6715	92.1183	93.3314	93.3314	94.4194	94.7350	94.7350	93.4853	92.2682	91.6715	90.7907	
alpha	7.0527	7.1114	7.1412	7.2221	7.2221	7.2946	7.3157	7.3157	7.2324	7.1512	7.1114	7.0527	
util living area	0.9836	0.9633	0.9064	0.7633	0.5919	0.4139	0.3479	0.3444	0.5071	0.7877	0.9505	0.9866	(86)
Living	20.6162	20.7067	20.8213	20.9206	20.9510	20.9569	20.9574	20.9574	20.9555	20.9225	20.7817	20.6099	
Non living	19.8030	19.9192	20.0551	20.1676	20.1949	20.2075	20.2101	20.2101	20.1996	20.1646	20.0116	19.7959	
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	20.8037	20.7067	20.8213	20.9206	20.9510	20.9569	20.9574	20.9574	20.9555	20.9225	20.7817	20.6645	(87)
Th 2	20.2351	20.2419	20.2453	20.2544	20.2544	20.2624	20.2647	20.2647	20.2556	20.2464	20.2419	20.2351	(88)
util rest of house	0.9778	0.9518	0.8829	0.7247	0.5466	0.3699	0.2987	0.2927	0.4490	0.7355	0.9320	0.9815	(89)
MIT 2	20.0628	19.9192	20.0551	20.1676	20.1949	20.2075	20.2101	20.2101	20.1996	20.1646	20.0116	19.8750	(90)
Living area fraction									fLA = Living area / (4) =			0.1446	(91)
MIT	20.1700	20.0331	20.1659	20.2765	20.3042	20.3159	20.3182	20.3182	20.3089	20.2742	20.1230	19.9892	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.1700	20.0331	20.1659	20.2765	20.3042	20.3159	20.3182	20.3182	20.3089	20.2742	20.1230	19.9892	(93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9772	0.9481	0.8802	0.7259	0.5497	0.3731	0.3023	0.2965	0.4532	0.7375	0.9286	0.9794	(94)
Useful gains	1083.8074	1211.1205	1311.2563	1268.1434	1023.7631	735.3179	532.8996	497.5237	681.1818	927.3725	1016.8528	1010.3691	(95)
Ext temp.	7.0000	7.1000	7.8000	9.3000	11.7000	14.1000	15.8000	16.1000	14.6000	12.3000	9.8000	7.5000	(96)
Heat loss rate W	1621.0069	1576.5539	1500.1053	1314.2508	1030.2080	735.6661	532.9585	497.5717	682.4171	965.7805	1258.3811	1537.2117	(97)
Space heating kWh	399.6764	245.5712	140.5037	33.1973	4.7950	0.0000	0.0000	0.0000	0.0000	28.5756	173.9004	391.9709	(98a)
Space heating requirement - total per year (kWh/year)												1418.1905	
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	399.6764	245.5712	140.5037	33.1973	4.7950	0.0000	0.0000	0.0000	0.0000	28.5756	173.9004	391.9709	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1418.1905	
Space heating per m <sup>2</sup>										(98c) / (4) =		9.4609	(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 %)	270.7316	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)

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Efficiency of secondary/supplementary heating system, %												0.0000 (208)	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	399.6764	245.5712	140.5037	33.1973	4.7950	0.0000	0.0000	0.0000	0.0000	28.5756	173.9004	391.9709	(98)
Space heating efficiency (main heating system 1)	270.7316	270.7316	270.7316	270.7316	270.7316	0.0000	0.0000	0.0000	0.0000	270.7316	270.7316	270.7316	(210)
Space heating fuel (main heating system)	147.6283	90.7065	51.8978	12.2621	1.7711	0.0000	0.0000	0.0000	0.0000	10.5549	64.2335	144.7821	(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	294.9696	260.8954	277.0579	243.1131	235.3885	211.7844	208.6825	217.0784	219.6019	245.2800	261.3403	291.6657	(64)
Efficiency of water heater (217)m	176.0899	176.0899	176.0899	176.0899	176.0899	176.0899	176.0899	176.0899	176.0899	176.0899	176.0899	176.0899	(216)
Fuel for water heating, kWh/month	167.5108	148.1603	157.3389	138.0619	133.6752	120.2706	118.5091	123.2770	124.7101	139.2925	148.4130	165.6345	(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	39.1409	35.3531	39.1409	37.8783	39.1409	37.8783	39.1409	39.1409	37.8783	39.1409	37.8783	39.1409	(231)
Lighting	34.0221	27.2938	24.5750	18.0047	13.9074	11.3624	12.6868	16.4907	21.4198	28.1040	31.7434	34.9677	(232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-97.6421	-124.1300	-177.0793	-196.1264	-204.4839	-196.9707	-187.7780	-183.9945	-166.2651	-140.8098	-102.0163	-81.9812	(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	-55.9250	-102.7700	-217.4069	-355.9437	-450.7547	-511.9544	-445.9933	-407.7001	-297.3523	-165.9932	-74.0786	-41.6365	(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													523.8364 (211)
Space heating fuel - main system 2													0.0000 (213)
Space heating fuel - secondary													0.0000 (215)
Efficiency of water heater													176.0899
Water heating fuel used													1684.8537 (219)
Space cooling fuel													0.0000 (221)
Electricity for pumps and fans: (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 1.0080) mechanical ventilation fans (SFP = 1.0080)													460.8526 (230a)
Total electricity for the above, kWh/year													460.8526 (231)
Electricity for lighting (calculated in Appendix L)													274.5780 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation													-4986.7863 (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													-2042.6657 (238)

## 10a. Fuel costs - using BEDF prices (524)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	523.8364	21.5100	112.6772	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1684.8537	21.5100	362.4120	(247)
Energy for instantaneous electric shower(s)	0.0000	21.5100	0.0000	(247a)
Pumps, fans and electric keep-hot	460.8526	21.5100	99.1294	(249)
Energy for lighting	274.5780	21.5100	59.0617	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1859.2775	21.5100	-399.9306	
PV Unit electricity exported	-3127.5088	5.5900	-174.8277	
Total			-574.7583	(252)
Total energy cost			58.5220	(255)

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

	Energy	Emission factor	Emissions
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	kWh/year	kg CO2/kWh	kg CO2/year
Space heating - main system 1	523.8364	0.1589	83.2383 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1684.8537	0.1409	237.4319 (264)
Space and water heating			320.6702 (265)
Pumps, fans and electric keep-hot	460.8526	0.1387	63.9259 (267)
Energy for lighting	274.5780	0.1443	39.6301 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1859.2775	0.1351	-251.1967
PV Unit electricity exported	-3127.5088	0.1249	-390.6927
Total			-641.8894 (269)
Total CO2, kg/year			-217.6632 (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	523.8364	1.5882	831.9473 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1684.8537	1.5211	2562.7927 (278)
Space and water heating			3394.7400 (279)
Pumps, fans and electric keep-hot	460.8526	1.5128	697.1778 (281)
Energy for lighting	274.5780	1.5338	421.1568 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1859.2775	1.4993	-2787.6846
PV Unit electricity exported	-3127.5088	0.4585	-1434.0689
Total			-4221.7534 (283)
Total Primary energy kWh/year			291.3212 (286)

## SAP 10 EPC IMPROVEMENTS

### AS DESIGNED

Current energy efficiency rating:	A 96
Current environmental impact rating:	A 100

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	+ 1.3	-£ 74	-52 kg (23.8%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£74	0.35 kg/m <sup>2</sup>	A 98
Total Savings	£74	0.35 kg/m <sup>2</sup>	A 101

Potential energy efficiency rating:	A 98
Potential environmental impact rating:	A 101

Fuel prices for cost data on this page from database revision number 524 TEST (01 Aug 2023)  
Recommendation texts revision number 6.1 (11 Jun 2019)

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

	Current	Potential	Saving
Electricity	£633	£544	£89
Space heating	£212	£229	-£17
Water heating	£362	£256	£107
Lighting	£59	£59	£0
Generated (PV)	-£575	-£559	-£15
Total cost of fuels	£58	-£15	£74
Total cost of uses	£58	-£15	£75
Delivered energy	-14 kWh/m <sup>2</sup>	-16 kWh/m <sup>2</sup>	3 kWh/m <sup>2</sup>
Carbon dioxide emissions	-0.2 tonnes	-0.3 tonnes	0.1 tonnes
CO2 emissions per m <sup>2</sup>	-1 kg/m <sup>2</sup>	-2 kg/m <sup>2</sup>	0 kg/m <sup>2</sup>
Primary energy	2 kWh/m <sup>2</sup>	-1 kWh/m <sup>2</sup>	3 kWh/m <sup>2</sup>

## 1. Overall dwelling characteristics

		Area (m <sup>2</sup> )		Storey height (m)		Volume (m <sup>3</sup> )
Ground floor		149.9000 (1b)	x	2.5000 (2b)	=	374.7500 (1b) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	149.9000					(4)
Dwelling volume						(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 374.7500 (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)
						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						1.5000 (17)
Infiltration rate						0.0750 (18)
Number of sides sheltered						2 (19)
Shelter factor						(20) = 1 - [0.075 x (19)] = 0.8500 (20)
Infiltration rate adjusted to include shelter factor						(21) = (18) x (20) = 0.0638 (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	0.0813	0.0797	0.0781	0.0701	0.0685	0.0606	0.0606	0.0590	0.0638	0.0685	0.0717	0.0749 (22b)
Balanced mechanical ventilation with heat recovery												
If mechanical ventilation												0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												83.7000 (23c)
Effective ac	0.1628	0.1612	0.1596	0.1516	0.1500	0.1421	0.1421	0.1405	0.1452	0.1500	0.1532	0.1564 (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
NEW OPENINGS (Uw = 1.20)			21.0300	1.1450	24.0802		(27)
DOOR			2.2100	1.2000	2.6520		(26)
PAT DOORS (Uw = 1.20)			12.0300	1.1450	13.7748		(27)
Heat Loss Floor 1			149.9000	0.1200	17.9880	75.0000	11242.5000 (28a)
External Wall 1	134.4000	35.2700	99.1300	0.1800	17.8434	60.0000	5947.8000 (29a)
PLANE	149.9000		149.9000	0.1000	14.9900	9.0000	1349.1000 (30)
Total net area of external elements Aum(A, m <sup>2</sup> )			434.2000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 91.3284		(33)
Internal Wall 2			289.2000			75.0000	21690.0000 (32c)

Heat capacity Cm = Sum(A x k)												
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K												(28)...(30) + (32) + (32a)...(32e) = 40229.4000 (34)
												268.3749 (35)

### List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	20.5800	0.0640	1.3171
E3 Sill	19.5300	0.0250	0.4883
E4 Jamb	35.4000	0.0200	0.7080
E5 Ground floor (normal)	53.7600	0.0230	1.2365
E10 Eaves (insulation at ceiling level)	36.4800	0.0370	1.3498
E12 Gable (insulation at ceiling level)	17.2800	0.0390	0.6739
E16 Corner (normal)	15.0000	0.0350	0.5250
E17 Corner (inverted - internal area greater than external area)	5.0000	-0.0780	-0.3900
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			5.9085 (36)
Point Thermal bridges			(36a) = 0.0000
Total fabric heat loss			(33) + (36) + (36a) = 97.2369 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	20.1308	19.9337	19.7366	18.7511	18.5540	17.5685	17.5685	17.3714	17.9627	18.5540	18.9482	19.3424 (38)
Heat transfer coeff	117.3676	117.1705	116.9735	115.9880	115.7909	114.8054	114.8054	114.6083	115.1996	115.7909	116.1851	116.5793 (39)
Average = Sum(39)m / 12 =												115.9387

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	0.7830	0.7817	0.7803	0.7738	0.7725	0.7659	0.7659	0.7646	0.7685	0.7725	0.7751	0.7777 (40)
HLP (average)												0.7734
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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

Assumed occupancy												2.9340 (42)
Hot water usage for mixer showers												73.1326 (42a)
Hot water usage for baths												31.5865 (42b)
Hot water usage for other uses												44.6774 (42c)
Average daily hot water use (litres/day)												137.6860 (43)
Daily hot water use												149.3965 (44)
Energy content (annual)												233.9189 (45)
Distribution loss (46)m = 0.15 x (45)m												2286.9357
Water storage loss:												35.0878 (46)
Store volume												300.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												2.0600 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												1.1124 (55)
Total storage loss												34.4844 (56)
If cylinder contains dedicated solar storage												34.4844 (57)
Primary loss												23.2624 (59)
Combi loss												0.0000 (61)
Total heat required for water heating calculated for each month												291.6657 (62)
WWHRS												0.0000 (63a)
PV diverter												-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												634.2336 (H24)
Heat delivered to space heating												0.0000 (H29)
Solar input												634.2336
Solar input												-0.0000 (63c)
FGHRS												0.0000 (63d)
Output from w/h												291.6657 (64)
Total per year (kWh/year) = Sum(64)m =												2267.1517 (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												123.9755 (65)

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

Metabolic gains (Table 5), Watts												
(66)m												176.0419 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												39.9497 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												457.1289 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												55.5382 (69)
Pumps, fans												0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)												-117.3613 (71)
Water heating gains (Table 5)												166.6337 (72)
Total internal gains												777.9311 (73)

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## 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			
Northeast		6.4800	11.2829	0.6300		0.7000	0.7700	22.3444 (75)				
Southwest		13.2900	36.7938	0.6300		0.7000	0.7700	149.4417 (79)				
Northwest		1.2600	11.2829	0.6300		0.7000	0.7700	4.3447 (81)				
Northeast		10.0800	11.2829	0.6300		0.7000	0.7700	34.7580 (75)				
Southeast		1.9500	36.7938	0.6300		0.7000	0.7700	21.9271 (77)				
Solar gains	232.8160	416.9820	624.7463	864.9608	1051.7699	1080.6474	1026.6767	881.7310	707.0542	475.4713	282.5768	196.8369 (83)
Total gains	1032.2441	1214.2912	1396.3329	1585.5523	1720.0613	1707.2348	1628.7024	1487.8930	1343.5715	1158.1386	1016.7886	974.7680 (84)

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	95.2122	95.3724	95.5331	96.3448	96.5088	97.3372	97.3372	97.5046	97.0041	96.5088	96.1813	95.8561
alpha	7.3475	7.3582	7.3689	7.4230	7.4339	7.4891	7.4891	7.5003	7.4669	7.4339	7.4121	7.3904
util living area	0.9957	0.9857	0.9475	0.8211	0.6187	0.4299	0.3101	0.3542	0.5868	0.8979	0.9877	0.9971 (86)
Living	20.4533	20.5846	20.7558	20.9031	20.9513	20.9580	20.9584	20.9584	20.9548	20.8691	20.6271	20.4236
Non living	19.6252	19.7920	20.0027	20.1723	20.2186	20.2295	20.2297	20.2309	20.2252	20.1421	19.8520	19.5913
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	20.7203	20.5846	20.7558	20.9031	20.9513	20.9580	20.9584	20.9584	20.9548	20.8691	20.6271	20.5042 (87)
Th 2	20.2681	20.2693	20.2704	20.2761	20.2773	20.2830	20.2830	20.2841	20.2807	20.2773	20.2750	20.2727 (88)
util rest of house	0.9943	0.9814	0.9334	0.7868	0.5732	0.3820	0.2596	0.2992	0.5278	0.8664	0.9833	0.9962 (89)
MIT 2	20.0118	19.7920	20.0027	20.1723	20.2186	20.2295	20.2297	20.2309	20.2252	20.1421	19.8520	19.7141 (90)
Living area fraction									fLA = Living area / (4) =			0.1446 (91)
MIT	20.1143	19.9066	20.1116	20.2780	20.3246	20.3349	20.3351	20.3361	20.3307	20.2472	19.9641	19.8284 (92)
Temperature adjustment												0.0000
adjusted MIT	20.1143	19.9066	20.1116	20.2780	20.3246	20.3349	20.3351	20.3361	20.3307	20.2472	19.9641	19.8284 (93)

## 8. Space heating requirement

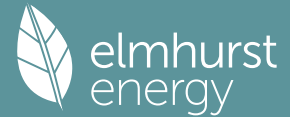
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9940	0.9787	0.9299	0.7869	0.5763	0.3855	0.2633	0.3032	0.5319	0.8649	0.9809	0.9954 (94)
Useful gains	1026.0493	1188.4710	1298.3903	1247.7000	991.2144	658.0705	428.7933	451.0712	714.6629	1001.6891	997.3222	970.2893 (95)
Ext temp.	4.3000	4.9000	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	1856.0848	1758.3330	1592.1958	1319.7115	998.6466	658.3926	428.8077	451.1120	717.7767	1117.0600	1494.6125	1821.9434 (97)
Space heating kWh	617.5465	382.9473	218.5913	51.8483	5.5296	0.0000	0.0000	0.0000	0.0000	85.8360	358.0490	633.6306 (98a)
Space heating requirement - total per year (kWh/year)												2353.9785
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	617.5465	382.9473	218.5913	51.8483	5.5296	0.0000	0.0000	0.0000	0.0000	85.8360	358.0490	633.6306 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2353.9785
Space heating per m2										(98c) / (4) =		15.7037 (99)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												272.1742 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement	617.5465	382.9473	218.5913	51.8483	5.5296	0.0000	0.0000	0.0000	0.0000	85.8360	358.0490	633.6306 (98)
Space heating efficiency (main heating system 1)	272.1742	272.1742	272.1742	272.1742	272.1742	0.0000	0.0000	0.0000	0.0000	272.1742	272.1742	272.1742 (210)
Space heating fuel (main heating system)	226.8938	140.6993	80.3130	19.0497	2.0316	0.0000	0.0000	0.0000	0.0000	31.5372	131.5514	232.8033 (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

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Efficiency of water heater (217)m	294.9696	244.7045	216.7238	154.8132	115.3484	100.1769	97.2903	119.3903	155.6070	215.1219	261.3403	291.6657 (64)
Fuel for water heating, kWh/month	176.5326	176.5326	176.5326	176.5326	176.5326	176.5326	176.5326	176.5326	176.5326	176.5326	176.5326	176.5326 (216)
Space cooling fuel requirement (221)m	167.0907	138.6171	122.7670	87.6966	65.3411	56.7469	55.1118	67.6307	88.1463	121.8596	148.0408	165.2191 (219)
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 (221)
Lighting	45.9354	41.4901	45.9354	44.4536	45.9354	44.4536	45.9354	45.9354	44.4536	45.9354	44.4536	45.9354 (231)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	34.0221	27.2938	24.5750	18.0047	13.9074	11.3624	12.6868	16.4907	21.4198	28.1040	31.7434	34.9677 (232)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	-77.9815	-112.8149	-161.7682	-174.6023	-181.2694	-168.3970	-166.1798	-159.8344	-145.3229	-124.7196	-85.8239	-66.7779 (233a)
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	-34.4263	-79.8859	-177.8177	-293.4313	-405.4952	-411.3246	-404.7302	-333.7882	-232.6410	-124.9365	-48.5714	-26.5415 (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												864.8794 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												176.5326
Water heating fuel used												1284.2679 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 1.0080)												
mechanical ventilation fans (SFP = 1.0080)												460.8526 (230a)
pump for solar water heating												80.0000 (230g)
Total electricity for the above, kWh/year												540.8526 (231)
Electricity for lighting (calculated in Appendix L)												274.5780 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-4199.0818 (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												-1234.5040 (238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	864.8794	16.4900	142.6186 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1284.2679	16.4900	211.7758 (247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000 (247a)
Pumps, fans and electric keep-hot	460.8526	16.4900	75.9946 (249)
Pump for solar water heating	80.0000	16.4900	13.1920 (249)
Energy for lighting	274.5780	16.4900	45.2779 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1625.4919	16.4900	-268.0436
PV Unit electricity exported	-2573.5899	5.5900	-143.8637
Total			-411.9073 (252)
Total energy cost			76.9516 (255)

## 11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600 (256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	0.1421 (257)
SAP value		97.6960
SAP rating (Section 12)		98 (258)
SAP band		A

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	864.8794	0.1583	136.8760 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1284.2679	0.1452	186.4768 (264)
Space and water heating			323.3529 (265)

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Pumps, fans and electric keep-hot	540.8526	0.1387	75.0229 (267)
Energy for lighting	274.5780	0.1443	39.6301 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1625.4919	0.1350	-219.4981
PV Unit electricity exported	-2573.5899	0.1237	-318.3947
Total			-537.8929 (269)
Total CO2, kg/year			-99.8870 (272)
CO2 emissions per m2			-0.6700 (273)
EI value			100.6868
EI rating			101 (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 (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	149.9000 (1b)	x 2.5000 (2b)	= 374.7500 (1b) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	149.9000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 374.7500 (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) =	Air changes per hour
Pressure test	0.0000 / (5) = 0.0000 (8)
Pressure Test Method	Yes
Measured/design AP50	Blower Door
Infiltration rate	1.5000 (17)
Number of sides sheltered	0.0750 (18)
	2 (19)

Shelter factor	(20) = 1 - [0.075 x (19)] = 0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.0638 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	8.0000	7.4000	7.1000	6.3000	6.3000	5.6000	5.4000	5.4000	6.2000	7.0000	7.4000	8.0000 (22)
Wind factor	2.0000	1.8500	1.7750	1.5750	1.5750	1.4000	1.3500	1.3500	1.5500	1.7500	1.8500	2.0000 (22a)
Adj infilt rate	0.1275	0.1179	0.1132	0.1004	0.1004	0.0892	0.0861	0.0861	0.0988	0.1116	0.1179	0.1275 (22b)
Balanced mechanical ventilation with heat recovery												
If mechanical ventilation												0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												83.7000 (23c)
Effective ac	0.2090	0.1994	0.1947	0.1819	0.1819	0.1707	0.1676	0.1676	0.1803	0.1931	0.1994	0.2090 (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
NEW OPENINGS (Uw = 1.20)			21.0300	1.1450	24.0802		(27)
DOOR			2.2100	1.2000	2.6520		(26)
PAT DOORS (Uw = 1.20)			12.0300	1.1450	13.7748		(27)
Heat loss Floor 1			149.9000	0.1200	17.9880	75.0000	11242.5000 (28a)
External Wall 1	134.4000	35.2700	99.1300	0.1800	17.8434	60.0000	5947.8000 (29a)
PLANE	149.9000		149.9000	0.1000	14.9900	9.0000	1349.1000 (30)
Total net area of external elements Aum(A, m <sup>2</sup> )			434.2000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	91.3284		(33)
Internal Wall 2			289.2000			75.0000	21690.0000 (32c)

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Heat capacity Cm = Sum(A x k)													(28)...(30) + (32) + (32a)...(32e) =	40229.4000 (34)		
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K														268.3749 (35)		
List of Thermal Bridges																
K1 Element														Length	Psi-value	Total
E2 Other lintels (including other steel lintels)													20.5800	0.0640	1.3171	
E3 Sill													19.5300	0.0250	0.4883	
E4 Jamb													35.4000	0.0200	0.7080	
E5 Ground floor (normal)													53.7600	0.0230	1.2365	
E10 Eaves (insulation at ceiling level)													36.4800	0.0370	1.3498	
E12 Gable (insulation at ceiling level)													17.2800	0.0390	0.6739	
E16 Corner (normal)													15.0000	0.0350	0.5250	
E17 Corner (inverted - internal area greater than external area)													5.0000	-0.0780	-0.3900	
Thermal bridges (Sum(L x Psi) calculated using Appendix K)															5.9085 (36)	
Point Thermal bridges															0.0000 (36a) =	
Total fabric heat loss															97.2369 (37) (33) + (36) + (36a) =	
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	25.8465	24.6639	24.0727	22.4959	22.4959	21.1162	20.7220	20.7220	22.2988	23.8756	24.6639	25.8465	(38)			
Average = Sum(39)m / 12 =	123.0834	121.9008	121.3095	119.7328	119.7328	118.3531	117.9589	117.9589	119.5357	121.1124	121.9008	123.0834	(39)			
HLP	0.8211	0.8132	0.8093	0.7988	0.7988	0.7895	0.7869	0.7869	0.7974	0.8080	0.8132	0.8211	(40)			
HLP (average)													0.8037			
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31				
-----																
4. Water heating energy requirements (kWh/year)																
-----																
Assumed occupancy														2.9340 (42)		
Hot water usage for mixer showers																
Hot water usage for baths																
Hot water usage for other uses																
Average daily hot water use (litres/day)														137.6860 (43)		
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec				
Energy conte	149.7850	146.5864	142.6912	136.7684	131.9586	126.7878	124.8008	128.6791	132.7694	138.1979	144.2119	149.3965	(44)			
Energy content (annual)	237.2228	208.7370	219.3111	187.2291	177.6417	155.9004	150.9357	159.3316	163.7179	187.5332	205.4563	233.9189	(45)			
Distribution loss (46)m = 0.15 x (45)m														Total = Sum(45)m = 2286.9357		
Water storage loss:	35.5834	31.3106	32.8967	28.0844	26.6463	23.3851	22.6404	23.8997	24.5577	28.1300	30.8184	35.0878	(46)			
Store volume														300.0000 (47)		
a) If manufacturer declared loss factor is known (kWh/day):														2.0600 (48)		
Temperature factor from Table 2b														0.5400 (49)		
Enter (49) or (54) in (55)														1.1124 (55)		
Total storage loss	34.4844	31.1472	34.4844	33.3720	34.4844	33.3720	34.4844	34.4844	33.3720	34.4844	33.3720	34.4844	(56)			
If cylinder contains dedicated solar storage																
Primary loss	34.4844	31.1472	34.4844	33.3720	34.4844	33.3720	34.4844	34.4844	33.3720	34.4844	33.3720	34.4844	(57)			
Combi loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624	(59)			
Total heat required for water heating calculated for each month	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)			
WWHRS	294.9696	260.8954	275.6621	236.3595	222.5942	199.1776	195.6556	204.9820	214.1990	243.8843	261.3403	291.6657	(62)			
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)			
Aperture area of solar collector	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)			
Zero-loss collector efficiency														3.0000 (H1)		
Collector linear heat loss coefficient														0.8000 (H2)		
Collector 2nd order heat loss coefficient														1.8000 (H3)		
Collector loop efficiency														0.9000 (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														808.5794 (H24)		
Heat delivered to space heating														0.0000 (H29)		
Solar input														808.5794		
FGHRS	-9.2714	-27.9287	-74.8648	-100.5345	-120.8556	-122.1991	-109.2869	-105.4757	-78.8377	-46.6102	-12.7148	-0.0000	(63c)			
Output from w/h	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)			
Total per year (kWh/year) = Sum(64)m =	285.6982	232.9667	200.7973	135.8250	101.7386	76.9785	86.3687	99.5063	135.3613	197.2741	248.6254	291.6657	(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	125.0740	111.1318	118.0018	101.5580	95.0278	86.4587	85.9620	89.4980	94.8211	107.4356	113.0214	123.9755	(65)			



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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	176.0419	176.0419	176.0419	176.0419	176.0419	176.0419	176.0419	176.0419	176.0419	176.0419	176.0419	176.0419	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	38.8694	34.5234	28.0763	21.2556	15.8888	13.4140	14.4943	18.8402	25.2873	32.1081	37.4748	39.9497	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	478.2297	483.1922	470.6868	444.0643	410.4581	378.8730	357.7723	352.8097	365.3151	391.9377	425.5438	457.1289	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.5382	55.5382	55.5382	55.5382	55.5382	55.5382	55.5382	55.5382	55.5382	55.5382	55.5382	55.5382	(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)	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	(71)
Water heating gains (Table 5)	168.1102	165.3747	158.6045	141.0528	127.7256	120.0815	115.5403	120.2931	131.6960	144.4027	156.9742	166.6337	(72)
Total internal gains	799.4281	797.3092	771.5865	720.5915	668.2914	626.5874	602.0258	606.1619	636.5173	682.6674	734.2118	777.9311	(73)

## 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	Access factor Table 6d	Gains W							
Northeast	6.4800	15.8605	0.6300	0.7000	0.7700	31.4097 (75)							
Southwest	13.2900	47.9418	0.6300	0.7000	0.7700	194.7203 (79)							
Northwest	1.2600	15.8605	0.6300	0.7000	0.7700	6.1074 (81)							
Northeast	10.0800	15.8605	0.6300	0.7000	0.7700	48.8595 (75)							
Southeast	1.9500	47.9418	0.6300	0.7000	0.7700	28.5707 (77)							
Solar gains	309.6676	480.1412	716.6649	1018.9604	1180.3986	1330.3908	1146.6563	1058.8680	860.5069	573.2583	360.8479	253.6572	(83)
Total gains	1109.0958	1277.4503	1488.2515	1739.5519	1848.6899	1956.9782	1748.6820	1665.0299	1497.0243	1255.9256	1095.0597	1031.5884	(84)

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area, nil,m (see Table 9a)	90.7907	91.6715	92.1183	93.3314	93.3314	94.4194	94.7350	94.7350	93.4853	92.2682	91.6715	90.7907	21.0000 (85)
tau	7.0527	7.1114	7.1412	7.2221	7.2221	7.2946	7.3157	7.3157	7.2324	7.1512	7.1114	7.0527	
util living area	0.9836	0.9633	0.9068	0.7658	0.5961	0.4169	0.3507	0.3470	0.5091	0.7884	0.9505	0.9866	(86)
Living	20.6162	20.7067	20.8209	20.9199	20.9507	20.9569	20.9574	20.9574	20.9554	20.9223	20.7817	20.6099	
Non living	19.8030	19.9192	20.0546	20.1669	20.1947	20.2074	20.2101	20.2101	20.1996	20.1645	20.0116	19.7959	
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	20.8037	20.7067	20.8209	20.9199	20.9507	20.9569	20.9574	20.9574	20.9554	20.9223	20.7817	20.6645	(87)
Th 2	20.2351	20.2419	20.2453	20.2544	20.2544	20.2624	20.2647	20.2647	20.2556	20.2464	20.2419	20.2351	(88)
util rest of house	0.9778	0.9518	0.8834	0.7272	0.5505	0.3725	0.3011	0.2950	0.4508	0.7362	0.9320	0.9815	(89)
MIT 2	20.0628	19.9192	20.0546	20.1669	20.1947	20.2074	20.2101	20.2101	20.1996	20.1645	20.0116	19.8750	(90)
Living area fraction										flA = Living area / (4) =		0.1446	(91)
MIT	20.1700	20.0331	20.1655	20.2758	20.3040	20.3158	20.3182	20.3182	20.3089	20.2741	20.1230	19.9892	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.1700	20.0331	20.1655	20.2758	20.3040	20.3158	20.3182	20.3182	20.3089	20.2741	20.1230	19.9892	(93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9772	0.9481	0.8806	0.7284	0.5536	0.3757	0.3047	0.2988	0.4550	0.7382	0.9286	0.9794	(94)
Useful gains	1083.8074	1211.1205	1310.5588	1267.0638	1023.4444	735.2994	532.8960	497.5208	681.1469	927.1320	1016.8528	1010.3691	(95)
Ext temp.	7.0000	7.1000	7.8000	9.3000	11.7000	14.1000	15.8000	16.1000	14.6000	12.3000	9.8000	7.5000	(96)
Heat loss rate W	1621.0069	1576.5539	1500.0486	1314.1666	1030.1832	735.6646	532.9582	497.5715	682.4143	965.7614	1258.3811	1537.2117	(97)
Space heating kWh	399.6764	245.5712	140.9804	33.9140	5.0137	0.0000	0.0000	0.0000	0.0000	28.7403	173.9004	391.9709	(98a)
Space heating requirement - total per year (kWh/year)												1419.7674	
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	399.6764	245.5712	140.9804	33.9140	5.0137	0.0000	0.0000	0.0000	0.0000	28.7403	173.9004	391.9709	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1419.7674	
Space heating per m2										(98c) / (4) =		9.4714	(99)

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

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													270.7316 (206)
Efficiency of main space heating system 2 (in %)													0.0000 (207)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement	399.6764	245.5712	140.9804	33.9140	5.0137	0.0000	0.0000	0.0000	0.0000	28.7403	173.9004	391.9709	(98)
Space heating efficiency (main heating system 1)	270.7316	270.7316	270.7316	270.7316	270.7316	0.0000	0.0000	0.0000	0.0000	270.7316	270.7316	270.7316	(210)
Space heating fuel (main heating system)	147.6283	90.7065	52.0738	12.5268	1.8519	0.0000	0.0000	0.0000	0.0000	10.6158	64.2335	144.7821	(211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating requirement	285.6982	232.9667	200.7973	135.8250	101.7386	76.9785	86.3687	99.5063	135.3613	197.2741	248.6254	291.6657	(64)
Efficiency of water heater (217)m	176.0899	176.0899	176.0899	176.0899	176.0899	176.0899	176.0899	176.0899	176.0899	176.0899	176.0899	176.0899	(216)
Fuel for water heating, kWh/month	162.2456	132.2999	114.0311	77.1339	57.7765	43.7155	49.0480	56.5088	76.8706	112.0303	141.1923	165.6345	(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	45.9354	41.4901	45.9354	44.4536	45.9354	44.4536	45.9354	45.9354	44.4536	45.9354	44.4536	45.9354	(231)
Lighting	34.0221	27.2938	24.5750	18.0047	13.9074	11.3624	12.6868	16.4907	21.4198	28.1040	31.7434	34.9677	(232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-97.6873	-123.5462	-172.8432	-185.2806	-187.0101	-175.9993	-170.6515	-168.7629	-158.1791	-138.5937	-101.9860	-82.1376	(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	-55.8798	-103.3538	-221.6430	-366.7895	-468.2284	-532.9258	-463.1198	-422.9318	-305.4383	-168.2094	-74.1089	-41.4802	(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													524.4188 (211)
Space heating fuel - main system 2													0.0000 (213)
Space heating fuel - secondary													0.0000 (215)
Efficiency of water heater													176.0899
Water heating fuel used													1188.4870 (219)
Space cooling fuel													0.0000 (221)
Electricity for pumps and fans: (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 1.0000) mechanical ventilation fans (SFP = 1.0000) pump for solar water heating													460.8526 (230a) 80.0000 (230g)
Total electricity for the above, kWh/year													540.8526 (231)
Electricity for lighting (calculated in Appendix L)													274.5780 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation													-4986.7863 (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													-2458.4500 (238)

## 10a. Fuel costs - using BEDF prices (524)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	524.4188	21.5100	112.8025	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1188.4870	21.5100	255.6436	(247)
Energy for instantaneous electric shower(s)	0.0000	21.5100	0.0000	(247a)
Pumps, fans and electric keep-hot	460.8526	21.5100	99.1294	(249)
Pump for solar water heating	80.0000	21.5100	17.2080	(249)
Energy for lighting	274.5780	21.5100	59.0617	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1762.6776	21.5100	-379.1520	
PV Unit electricity exported	-3224.1087	5.5900	-180.2277	
Total			-559.3796	(252)
Total energy cost			-15.5345	(255)

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 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP  
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	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	524.4188	0.1589	83.3220 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1188.4870	0.1461	173.6694 (264)
Space and water heating			256.9914 (265)
Pumps, fans and electric keep-hot	540.8526	0.1387	75.0229 (267)
Energy for lighting	274.5780	0.1443	39.6301 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1762.6776	0.1357	-239.2145
PV Unit electricity exported	-3224.1087	0.1246	-401.8344
Total			-641.0489 (269)
Total CO2, kg/year			-269.4044 (272)

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 13a. Primary energy - Individual heating systems including micro-CHP  
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	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	524.4188	1.5881	832.8401 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1188.4870	1.5406	1830.9335 (278)
Space and water heating			2663.7736 (279)
Pumps, fans and electric keep-hot	540.8526	1.5128	818.2018 (281)
Energy for lighting	274.5780	1.5338	421.1568 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1762.6776	1.5016	-2646.8707
PV Unit electricity exported	-3224.1087	0.4575	-1474.9235
Total			-4121.7942 (283)
Total Primary energy kWh/year			-218.6621 (286)

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Property Reference	_23.SAP.144 ABDS Mullion p6			Issued on Date	09/09/2023
Assessment Reference	AS DESIGNED	Prop Type Ref			
Property	Development at, Meaver Road, HELSTON, TR12 7DP				
SAP Rating	96 A	DER	-0.31	TER	7.28
Environmental	100 A	% DER < TER			104.26
CO <sub>2</sub> Emissions (t/year)	-0.22	DFEE	38.16	TFEE	44.95
Compliance Check	See BREL	% DFEE < TFEE			15.11
% DPER < TPER	75.09	DPER	10.10	TPER	40.56
Assessor Details	Mrs. Sophie Oakland			Assessor ID	F859-0001
Client	ABDS, ABDS				

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	149.9000 (1b)	2.5000 (2b)	374.7500 (1b) - (4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	149.9000		374.7500 (5)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 374.7500 (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		1.5000 (17)										
Infiltration rate		0.0750 (18)										
Number of sides sheltered		2 (19)										
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)										
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.0638 (21)										
Wind speed	Jan 5.1000	Feb 5.0000	Mar 4.9000	Apr 4.4000	May 4.3000	Jun 3.8000	Jul 3.8000	Aug 3.7000	Sep 4.0000	Oct 4.3000	Nov 4.5000	Dec 4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.0813	0.0797	0.0781	0.0701	0.0685	0.0606	0.0606	0.0590	0.0638	0.0685	0.0717	0.0749 (22b)
Balanced mechanical ventilation with heat recovery												
If mechanical ventilation												0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												83.7000 (23c)
Effective ac	0.1628	0.1612	0.1596	0.1516	0.1500	0.1421	0.1421	0.1405	0.1452	0.1500	0.1532	0.1564 (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
NEW OPENINGS (Uw = 1.20)			21.0300	1.1450	24.0802		(27)
DOOR			2.2100	1.2000	2.6520		(26)
PAT DOORS (Uw = 1.20)			12.0300	1.1450	13.7748		(27)

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Heat Loss Floor 1				149.9000	0.1200	17.9880	75.0000	11242.5000	(28a)
External Wall 1	134.4000	35.2700		99.1300	0.1800	17.8434	60.0000	5947.8000	(29a)
PLANE	149.9000			149.9000	0.1000	14.9900	9.0000	1349.1000	(30)
Total net area of external elements Aum(A, m2)				434.2000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =		91.3284			(33)
Internal Wall 2				289.2000			75.0000	21690.0000	(32c)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 40229.4000 (34)  
 Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 268.3749 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	20.5800	0.0640	1.3171
E3 Sill	19.5300	0.0250	0.4883
E4 Jamb	35.4000	0.0200	0.7080
E5 Ground floor (normal)	53.7600	0.0230	1.2365
E10 Eaves (insulation at ceiling level)	36.4800	0.0370	1.3498
E12 Gable (insulation at ceiling level)	17.2800	0.0390	0.6739
E16 Corner (normal)	15.0000	0.0350	0.5250
E17 Corner (inverted - internal area greater than external area)	5.0000	-0.0780	-0.3900

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 5.9085 (36)

Point Thermal bridges 0.0000 (36a) =  
 Total fabric heat loss (33) + (36) + (36a) = 97.2369 (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	20.1308	19.9337	19.7366	18.7511	18.5540	17.5685	17.5685	17.3714	17.9627	18.5540	18.9482	19.3424
Average = Sum(39)m / 12 =	117.3676	117.1705	116.9735	115.9880	115.7909	114.8054	114.8054	114.6083	115.1996	115.7909	116.1851	116.5793

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	0.7830	0.7817	0.7803	0.7738	0.7725	0.7659	0.7659	0.7646	0.7685	0.7725	0.7751	0.7777
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.9340 (42)											
Hot water usage for mixer showers	73.4139	72.3107	70.7030	67.6270	65.3570	62.8255	61.3866	62.9821	64.7310	67.4491	70.5912	73.1326
Hot water usage for baths	31.6936	31.2229	30.5601	29.3379	28.4228	27.4081	26.8599	27.5181	28.2348	29.3206	30.5679	31.5865
Hot water usage for other uses	44.6774	43.0528	41.4282	39.8035	38.1789	36.5543	36.5543	38.1789	39.8035	41.4282	43.0528	44.6774
Average daily hot water use (litres/day)	137.6860 (43)											

Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy content	149.7850	146.5864	142.6912	136.7684	131.9586	126.7878	124.8008	128.6791	132.7694	138.1979	144.2119	149.3965
Energy content (annual)	237.2228	208.7370	219.3111	187.2291	177.6417	155.9004	150.9357	159.3316	163.7179	187.5332	205.4563	233.9189
Distribution loss (46)m = 0.15 x (45)m	Total = Sum(45)m = 2286.9357											
Distribution loss	35.5834	31.3106	32.8967	28.0844	26.6463	23.3851	22.6404	23.8997	24.5577	28.1300	30.8184	35.0878

Water storage loss:  
 Store volume 300.0000 (47)  
 a) If manufacturer declared loss factor is known (kWh/day):  
 Temperature factor from Table 2b 2.0600 (48)  
 Enter (49) or (54) in (55) 0.5400 (49)  
 Total storage loss 1.1124 (55)

Primary loss	34.4844	31.1472	34.4844	33.3720	34.4844	33.3720	34.4844	34.4844	33.3720	34.4844	33.3720	34.4844
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total heat required for water heating calculated for each month	294.9696	260.8954	277.0579	243.1131	235.3885	211.7844	208.6825	217.0784	219.6019	245.2800	261.3403	291.6657

WVHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Output from w/h	294.9696	260.8954	277.0579	243.1131	235.3885	211.7844	208.6825	217.0784	219.6019	245.2800	261.3403	291.6657
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =	2966.8577 (64)											

Heat gains from water heating, kWh/month	125.0740	111.1318	119.1184	106.9609	105.2633	96.5441	96.3836	99.1752	99.1434	108.5522	113.0214	123.9755
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5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	176.0419	176.0419	176.0419	176.0419	176.0419	176.0419	176.0419	176.0419	176.0419	176.0419	176.0419	176.0419
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	38.8694	34.5234	28.0763	21.2556	15.8888	13.4140	14.4943	18.8402	25.2873	32.1081	37.4748	39.9497
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	478.2297	483.1922	470.6868	444.0643	410.4581	378.8730	357.7723	352.8097	365.3151	391.9377	425.5438	457.1289

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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.5382	55.5382	55.5382	55.5382	55.5382	55.5382	55.5382	55.5382	55.5382	55.5382	55.5382	55.5382	55.5382 (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	0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613 (71)
Water heating gains (Table 5)	168.1102	165.3747	160.1053	148.5568	141.4829	134.0890	129.5478	133.3000	137.6992	145.9035	156.9742	166.6337	166.6337 (72)
Total internal gains	799.4281	797.3092	773.0873	728.0955	682.0487	640.5949	616.0332	619.1688	642.5205	684.1682	734.2118	777.9311	777.9311 (73)

## 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	FF	Access factor Table 6d	Gains W
Northeast	6.4800	11.2829	0.6300	0.7000	0.7700	0.7700	22.3444 (75)
Southeast	1.2600	36.7938	0.6300	0.7000	0.7700	0.7700	14.1683 (77)
Southwest	13.2900	36.7938	0.6300	0.7000	0.7700	0.7700	149.4417 (79)
Northeast	10.0800	11.2829	0.6300	0.7000	0.7700	0.7700	34.7580 (75)
Northwest	1.9500	11.2829	0.6300	0.7000	0.7700	0.7700	6.7240 (81)

Solar gains	227.4364	408.6089	615.3891	856.8852	1045.9362	1076.2685	1021.8671	875.0330	698.1066	466.7832	276.2772	192.1399	192.1399 (83)
Total gains	1026.8646	1205.9181	1388.4764	1584.9807	1727.9849	1716.8633	1637.9003	1494.2018	1340.6271	1150.9514	1010.4890	970.0711	970.0711 (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, n <sub>l,m</sub> (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	95.2122	95.3724	95.5331	96.3448	96.5088	97.3372	97.3372	97.5046	97.0041	96.5088	96.1813	95.8561	95.8561
alpha	7.3475	7.3582	7.3689	7.4230	7.4339	7.4891	7.4891	7.5003	7.4669	7.4339	7.4121	7.3904	7.3904
util living area	0.9959	0.9863	0.9489	0.8213	0.6161	0.4275	0.3084	0.3527	0.5880	0.9004	0.9882	0.9972	0.9972 (86)
Living	20.4504	20.5805	20.7529	20.9030	20.9515	20.9581	20.9584	20.9584	20.9547	20.8671	20.6240	20.4211	20.4211
Non living	19.6216	19.7869	19.9992	20.1722	20.2187	20.2295	20.2297	20.2309	20.2252	20.1401	19.8481	19.5881	19.5881
24 / 16	0	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	0
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	10
MIT	20.7189	20.5805	20.7529	20.9030	20.9515	20.9581	20.9584	20.9584	20.9547	20.8671	20.6240	20.5021	20.5021 (87)
Th 2	20.2681	20.2693	20.2704	20.2761	20.2773	20.2830	20.2830	20.2841	20.2807	20.2773	20.2750	20.2727	20.2727 (88)
util rest of house	0.9945	0.9821	0.9351	0.7870	0.5707	0.3799	0.2581	0.2979	0.5289	0.8693	0.9839	0.9963	0.9963 (89)
MIT 2	20.0104	19.7869	19.9992	20.1722	20.2187	20.2295	20.2297	20.2309	20.2252	20.1401	19.8481	19.7115	19.7115 (90)
Living area fraction									fLA = Living area / (4) =			0.1446	0.1446 (91)
MIT	20.1128	19.9016	20.1082	20.2779	20.3247	20.3349	20.3351	20.3361	20.3307	20.2452	19.9603	19.8258	19.8258 (92)
Temperature adjustment												0.0000	0.0000
adjusted MIT	20.1128	19.9016	20.1082	20.2779	20.3247	20.3349	20.3351	20.3361	20.3307	20.2452	19.9603	19.8258	19.8258 (93)

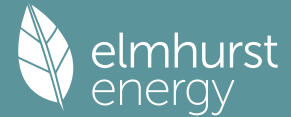
## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9942	0.9795	0.9315	0.7871	0.5738	0.3833	0.2618	0.3019	0.5330	0.8677	0.9815	0.9955	0.9955 (94)
Useful gains	1020.8940	1181.1942	1293.3884	1247.5700	991.4372	658.0837	428.7939	451.0725	714.6157	998.7355	991.7783	965.7429	965.7429 (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	4.2000 (96)
Heat loss rate W	1855.9168	1757.7512	1591.7969	1319.7016	998.6634	658.3936	428.8078	451.1121	717.7730	1116.8295	1494.1726	1821.6478	1821.6478 (97)
Space heating kWh	621.2570	387.4463	222.0159	51.9347	5.3763	0.0000	0.0000	0.0000	0.0000	87.8619	361.7239	636.7932	636.7932 (98a)
Space heating requirement - total per year (kWh/year)												2374.4093	2374.4093
Solar heating kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (98b)
Solar heating contribution - total per year (kWh/year)												0.0000	0.0000
Space heating kWh	621.2570	387.4463	222.0159	51.9347	5.3763	0.0000	0.0000	0.0000	0.0000	87.8619	361.7239	636.7932	636.7932 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2374.4093	2374.4093
Space heating per m2												15.8400	15.8400 (99)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													272.1742 (206)
Efficiency of main space heating system 2 (in %)													0.0000 (207)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement	621.2570	387.4463	222.0159	51.9347	5.3763	0.0000	0.0000	0.0000	0.0000	87.8619	361.7239	636.7932	636.7932 (98)

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Space heating efficiency (main heating system 1)	272.1742	272.1742	272.1742	272.1742	272.1742	0.0000	0.0000	0.0000	0.0000	0.0000	272.1742	272.1742	272.1742	(210)
Space heating fuel (main heating system)	228.2571	142.3523	81.5713	19.0814	1.9753	0.0000	0.0000	0.0000	0.0000	0.0000	32.2815	132.9016	233.9653	(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	0.0000	(212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating														
Water heating requirement	294.9696	260.8954	277.0579	243.1131	235.3885	211.7844	208.6825	217.0784	219.6019	245.2800	261.3403	291.6657		(64)
Efficiency of water heater	176.5326	176.5326	176.5326	176.5326	176.5326	176.5326	176.5326	176.5326	176.5326	176.5326	176.5326	176.5326		(216)
Fuel for water heating, kWh/month	167.0907	147.7888	156.9443	137.7157	133.3399	119.9690	118.2119	122.9679	124.3974	138.9432	148.0408	165.2191		(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	39.1409	35.3531	39.1409	37.8783	39.1409	37.8783	39.1409	39.1409	37.8783	39.1409	37.8783	39.1409		(231)
Lighting	34.0221	27.2938	24.5750	18.0047	13.9074	11.3624	12.6868	16.4907	21.4198	28.1040	31.7434	34.9677		(232)
Electricity generated by PVs (Appendix M) (negative quantity)														
(233a)m	-77.8878	-113.0238	-164.4339	-181.8356	-195.1625	-182.4720	-180.1241	-170.1418	-150.0014	-125.6166	-85.6721	-66.7008		(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	-34.5199	-79.6770	-175.1520	-286.1980	-391.6021	-397.2496	-390.7859	-323.4809	-227.9626	-124.0396	-48.7232	-26.6186		(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													872.3859	(211)
Space heating fuel - main system 2													0.0000	(213)
Space heating fuel - secondary													0.0000	(215)
Efficiency of water heater													176.5326	
Water heating fuel used													1680.6286	(219)
Space cooling fuel													0.0000	(221)
Electricity for pumps and fans:														
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 1.0080)														
mechanical ventilation fans (SFP = 1.0080)													460.8526	(230a)
Total electricity for the above, kWh/year													460.8526	(231)
Electricity for lighting (calculated in Appendix L)													274.5780	(232)
Energy saving/generation technologies (Appendices M ,N and Q)														
PV generation													-4199.0818	(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													-910.6367	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	872.3859	16.4900	143.8564	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1680.6286	16.4900	277.1357	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	460.8526	16.4900	75.9946	(249)
Energy for lighting	274.5780	16.4900	45.2779	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-1693.0724	16.4900	-279.1876	
PV Unit electricity exported	-2506.0094	5.5900	-140.0859	
Total			-419.2736	(252)
Total energy cost			122.9910	(255)

## 11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600	(256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	0.2272	(257)
SAP value		96.3175	
SAP rating (Section 12)		96	(258)
SAP band		A	



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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	872.3859	0.1582	138.0469 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1680.6286	0.1409	236.8365 (264)
Space and water heating			374.8834 (265)
Pumps, fans and electric keep-hot	460.8526	0.1387	63.9259 (267)
Energy for lighting	274.5780	0.1443	39.6301 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1693.0724	0.1346	-227.8409
PV Unit electricity exported	-2506.0094	0.1240	-310.6770
Total			-538.5179 (269)
Total CO2, kg/year			-60.0785 (272)
CO2 emissions per m2			-0.4000 (273)
EI value			100.4131
EI rating			100 (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**  
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	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	149.9000 (1b)	x 2.5000 (2b)	= 374.7500 (1b) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	149.9000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	374.7500 (5)

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**2. Ventilation rate**  
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		m3 per hour
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	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		1.5000 (17)
Infiltration rate		0.0750 (18)
Number of sides sheltered		2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.0638 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	8.0000	7.4000	7.1000	6.3000	6.3000	5.6000	5.4000	5.4000	6.2000	7.0000	7.4000	8.0000 (22)
Wind factor	2.0000	1.8500	1.7750	1.5750	1.5750	1.4000	1.3500	1.3500	1.5500	1.7500	1.8500	2.0000 (22a)
Adj infilt rate	0.1275	0.1179	0.1132	0.1004	0.1004	0.0892	0.0861	0.0861	0.0988	0.1116	0.1179	0.1275 (22b)
Balanced mechanical ventilation with heat recovery												
If mechanical ventilation												0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												83.7000 (23c)
Effective ac	0.2090	0.1994	0.1947	0.1819	0.1819	0.1707	0.1676	0.1676	0.1803	0.1931	0.1994	0.2090 (25)

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**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
NEW OPENINGS (Uw = 1.20)			21.0300	1.1450	24.0802		(27)
DOOR			2.2100	1.2000	2.6520		(26)
PAT DOORS (Uw = 1.20)			12.0300	1.1450	13.7748		(27)
Heat Loss Floor 1			149.9000	0.1200	17.9880	75.0000	11242.5000 (28a)
External Wall 1	134.4000	35.2700	99.1300	0.1800	17.8434	60.0000	5947.8000 (29a)
PLANE	149.9000		149.9000	0.1000	14.9900	9.0000	1349.1000 (30)
Total net area of external elements Aum(A, m2)			434.2000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 91.3284		(33)
Internal Wall 2			289.2000			75.0000	21690.0000 (32c)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 40229.4000 (34)  
 Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 268.3749 (35)

### List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	20.5800	0.0640	1.3171
E3 Sill	19.5300	0.0250	0.4883
E4 Jamb	35.4000	0.0200	0.7080
E5 Ground floor (normal)	53.7600	0.0230	1.2365
E10 Eaves (insulation at ceiling level)	36.4800	0.0370	1.3498
E12 Gable (insulation at ceiling level)	17.2800	0.0390	0.6739
E16 Corner (normal)	15.0000	0.0350	0.5250
E17 Corner (inverted - internal area greater than external area)	5.0000	-0.0780	-0.3900

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 5.9085 (36)

Point Thermal bridges (36a) = 0.0000  
 Total fabric heat loss (33) + (36) + (36a) = 97.2369 (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	25.8465	24.6639	24.0727	22.4959	22.4959	21.1162	20.7220	20.7220	22.2988	23.8756	24.6639	25.8465 (38)
Average = Sum(39)m / 12 =	123.0834	121.9008	121.3095	119.7328	119.7328	118.3531	117.9589	117.9589	119.5357	121.1124	121.9008	123.0834 (39)

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	0.8211	0.8132	0.8093	0.7988	0.7988	0.7895	0.7869	0.7869	0.7974	0.8080	0.8132	0.8211 (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													2.9340 (42)
Hot water usage for mixer showers	73.4139	72.3107	70.7030	67.6270	65.3570	62.8255	61.3866	62.9821	64.7310	67.4491	70.5912	73.1326	73.1326 (42a)
Hot water usage for baths	31.6936	31.2229	30.5601	29.3379	28.4228	27.4081	26.8599	27.5181	28.2348	29.3206	30.5679	31.5865	31.5865 (42b)
Hot water usage for other uses	44.6774	43.0528	41.4282	39.8035	38.1789	36.5543	36.5543	38.1789	39.8035	41.4282	43.0528	44.6774	44.6774 (42c)
Average daily hot water use (litres/day)	35.5834	34.3106	32.8967	28.0844	26.6463	23.3851	22.6404	23.8997	24.5577	28.1300	30.8184	35.0878	35.0878 (43)

Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	149.7850	146.5864	142.6912	136.7684	131.9586	126.7878	124.8008	128.6791	132.7694	138.1979	144.2119	149.3965 (44)
Energy content (annual)	237.2228	208.7370	219.3111	187.2291	177.6417	155.9004	150.9357	159.3316	163.7179	187.5332	205.4563	233.9189 (45)
Distribution loss (46)m = 0.15 x (45)m	35.5834	31.3106	32.8967	28.0844	26.6463	23.3851	22.6404	23.8997	24.5577	28.1300	30.8184	35.0878 (46)

Water storage loss:  
 Store volume 300.0000 (47)

a) If manufacturer declared loss factor is known (kWh/day): 2.0600 (48)

Temperature factor from Table 2b 0.5400 (49)

Enter (49) or (54) in (55) 1.1124 (55)

Total storage loss 34.4844 (56)

If cylinder contains dedicated solar storage 34.4844 (57)

Primary loss 23.2624 (59)

Combi loss 0.0000 (61)

Total heat required for water heating calculated for each month 294.9696 (62)

WWHRS 0.0000 (63a)

PV diverter -0.0000 (63b)

Solar input 0.0000 (63c)

FGHRS 0.0000 (63d)

Output from w/h 294.9696 (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 125.0740 (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
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(66)m	176.0419	176.0419	176.0419	176.0419	176.0419	176.0419	176.0419	176.0419	176.0419	176.0419	176.0419	176.0419	176.0419	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	38.8694	34.5234	28.0763	21.2556	15.8888	13.4140	14.4943	18.8402	25.2873	32.1081	37.4748	39.9497	39.9497	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	478.2297	483.1922	470.6868	444.0643	410.4581	378.8730	357.7723	352.8097	365.3151	391.9377	425.5438	457.1289	457.1289	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.5382	55.5382	55.5382	55.5382	55.5382	55.5382	55.5382	55.5382	55.5382	55.5382	55.5382	55.5382	55.5382	(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	0.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	(71)
Water heating gains (Table 5)	168.1102	165.3747	160.1053	148.5568	141.4829	134.0890	129.5478	133.3000	137.6992	145.9035	156.9742	166.6337	166.6337	(72)
Total internal gains	799.4281	797.3092	773.0873	728.0955	682.0487	640.5949	616.0332	619.1688	642.5205	684.1682	734.2118	777.9311	777.9311	(73)

## 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data g or Table 6b	Specific data FF or Table 6c	Access factor Table 6d	Gains W
Northeast	6.4800	15.8605	0.6300	0.7000	0.7700	31.4097 (75)
Southeast	1.2600	47.9418	0.6300	0.7000	0.7700	18.4611 (77)
Southwest	13.2900	47.9418	0.6300	0.7000	0.7700	194.7203 (79)
Northeast	10.0800	15.8605	0.6300	0.7000	0.7700	48.8595 (75)
Northwest	1.9500	15.8605	0.6300	0.7000	0.7700	9.4520 (81)

Solar gains	302.9026	471.2366	707.1706	1011.0443	1175.3075	1326.3933	1142.5807	1052.3465	851.0895	563.7244	353.2891	247.9019	247.9019	(83)
Total gains	1102.3307	1268.5458	1480.2580	1739.1398	1857.3562	1966.9881	1758.6139	1671.5153	1493.6100	1247.8926	1087.5009	1025.8330	1025.8330	(84)

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area, nil,m (see Table 9a)	0.9841	0.9645	0.9088	0.7660	0.5935	0.4148	0.3487	0.3457	0.5102	0.7920	0.9521	0.9870	21.0000 (85)
tau	90.7907	91.6715	92.1183	93.3314	93.3314	94.4194	94.7350	94.7350	93.4853	92.2682	91.6715	90.7907	
alpha	7.0527	7.1114	7.1412	7.2221	7.2221	7.2946	7.3157	7.3157	7.2324	7.1512	7.1114	7.0527	
util living area	0.9841	0.9645	0.9088	0.7660	0.5935	0.4148	0.3487	0.3457	0.5102	0.7920	0.9521	0.9870	(86)
Living	20.6129	20.7029	20.8186	20.9198	20.9509	20.9569	20.9574	20.9574	20.9554	20.9213	20.7788	20.6071	
Non living	19.7990	19.9147	20.0521	20.1669	20.1948	20.2075	20.2101	20.2101	20.1995	20.1636	20.0083	19.7924	
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	20.8020	20.7029	20.8186	20.9198	20.9509	20.9569	20.9574	20.9574	20.9554	20.9213	20.7788	20.6621	(87)
Th 2	20.2351	20.2419	20.2453	20.2544	20.2544	20.2624	20.2647	20.2647	20.2556	20.2464	20.2419	20.2351	(88)
util rest of house	0.9785	0.9534	0.8856	0.7274	0.5481	0.3706	0.2994	0.2939	0.4518	0.7399	0.9341	0.9820	(89)
MIT 2	20.0612	19.9147	20.0521	20.1669	20.1948	20.2075	20.2101	20.2101	20.1995	20.1636	20.0083	19.8721	(90)
Living area fraction									fLA = Living area / (4) =			0.1446	(91)
MIT	20.1684	20.0287	20.1629	20.2758	20.3042	20.3159	20.3182	20.3182	20.3089	20.2732	20.1197	19.9864	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.1684	20.0287	20.1629	20.2758	20.3042	20.3159	20.3182	20.3182	20.3089	20.2732	20.1197	19.9864	(93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9779	0.9497	0.8828	0.7285	0.5511	0.3738	0.3030	0.2976	0.4560	0.7419	0.9306	0.9800	(94)
Useful gains	1077.9819	1204.6880	1306.8111	1267.0039	1023.6470	735.3128	532.8986	497.5222	681.1267	925.8208	1012.0134	1005.3308	(95)
Ext temp.	7.0000	7.1000	7.8000	9.3000	11.7000	14.1000	15.8000	16.1000	14.6000	12.3000	9.8000	7.5000	(96)
Heat loss rate W	1620.8085	1576.0206	1499.7433	1314.1620	1030.1990	735.6657	532.9584	497.5716	682.4127	965.6572	1257.9807	1536.8662	(97)
Space heating kWh	403.8630	249.5355	143.5415	33.9538	4.8747	0.0000	0.0000	0.0000	0.0000	29.6383	177.0964	395.4624	(98a)
Space heating requirement - total per year (kWh/year)												1437.9656	
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	403.8630	249.5355	143.5415	33.9538	4.8747	0.0000	0.0000	0.0000	0.0000	29.6383	177.0964	395.4624	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1437.9656	
Space heating per m2										(98c) / (4) =		9.5928	(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 %)	270.7316	(206)
Efficiency of main space heating system 2 (in %)	0.0000	(207)

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Efficiency of secondary/supplementary heating system, %												0.0000 (208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	403.8630	249.5355	143.5415	33.9538	4.8747	0.0000	0.0000	0.0000	0.0000	29.6383	177.0964	395.4624 (98)
Space heating efficiency (main heating system 1)	270.7316	270.7316	270.7316	270.7316	270.7316	0.0000	0.0000	0.0000	0.0000	270.7316	270.7316	270.7316 (210)
Space heating fuel (main heating system)	149.1747	92.1708	53.0199	12.5415	1.8005	0.0000	0.0000	0.0000	0.0000	10.9475	65.4140	146.0717 (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	294.9696	260.8954	277.0579	243.1131	235.3885	211.7844	208.6825	217.0784	219.6019	245.2800	261.3403	291.6657 (64)
Efficiency of water heater (217)m	176.0899	176.0899	176.0899	176.0899	176.0899	176.0899	176.0899	176.0899	176.0899	176.0899	176.0899	176.0899 (216)
Fuel for water heating, kWh/month	167.5108	148.1603	157.3389	138.0619	133.6752	120.2706	118.5091	123.2770	124.7101	139.2925	148.4130	165.6345 (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	39.1409	35.3531	39.1409	37.8783	39.1409	37.8783	39.1409	39.1409	37.8783	39.1409	37.8783	39.1409 (231)
Lighting	34.0221	27.2938	24.5750	18.0047	13.9074	11.3624	12.6868	16.4907	21.4198	28.1040	31.7434	34.9677 (232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-97.6878	-124.2170	-177.2059	-196.1796	-204.4909	-196.9707	-187.7780	-183.9945	-166.2651	-140.8515	-102.0716	-82.0111 (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	-55.8793	-102.6830	-217.2803	-355.8905	-450.7477	-511.9544	-445.9933	-407.7001	-297.3523	-165.9516	-74.0233	-41.6067 (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												531.1407 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												176.0899
Water heating fuel used												1684.8537 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans: (BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 1.0080) mechanical ventilation fans (SFP = 1.0080)												460.8526 (230a)
Total electricity for the above, kWh/year												460.8526 (231)
Electricity for lighting (calculated in Appendix L)												274.5780 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-4986.7863 (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												-2035.3614 (238)

## 10a. Fuel costs - using BEDF prices (524)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	531.1407	21.5100	114.2484 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1684.8537	21.5100	362.4120 (247)
Energy for instantaneous electric shower(s)	0.0000	21.5100	0.0000 (247a)
Pumps, fans and electric keep-hot	460.8526	21.5100	99.1294 (249)
Energy for lighting	274.5780	21.5100	59.0617 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1859.7239	21.5100	-400.0266
PV Unit electricity exported	-3127.0624	5.5900	-174.8028
Total			-574.8294 (252)
Total energy cost			60.0221 (255)

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

	Energy	Emission factor	Emissions
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	kWh/year	kg CO2/kWh	kg CO2/year
Space heating - main system 1	531.1407	0.1589	84.3820 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1684.8537	0.1409	237.4319 (264)
Space and water heating			321.8139 (265)
Pumps, fans and electric keep-hot	460.8526	0.1387	63.9259 (267)
Energy for lighting	274.5780	0.1443	39.6301 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1859.7239	0.1351	-251.2648
PV Unit electricity exported	-3127.0624	0.1249	-390.6150
Total			-641.8799 (269)
Total CO2, kg/year			-216.5099 (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	531.1407	1.5881	843.4861 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1684.8537	1.5211	2562.7927 (278)
Space and water heating			3406.2788 (279)
Pumps, fans and electric keep-hot	460.8526	1.5128	697.1778 (281)
Energy for lighting	274.5780	1.5338	421.1568 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1859.7239	1.4994	-2788.3835
PV Unit electricity exported	-3127.0624	0.4585	-1433.7831
Total			-4222.1666 (283)
Total Primary energy kWh/year			302.4468 (286)

## SAP 10 EPC IMPROVEMENTS

### AS DESIGNED

Current energy efficiency rating:	A 96
Current environmental impact rating:	A 100

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	+ 1.3	-£ 74	-52 kg (23.9%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£74	0.35 kg/m <sup>2</sup>	A 98
Total Savings	£74	0.35 kg/m <sup>2</sup>	A 101

Potential energy efficiency rating:	A 98
Potential environmental impact rating:	A 101

Fuel prices for cost data on this page from database revision number 524 TEST (01 Aug 2023)  
 Recommendation texts revision number 6.1 (11 Jun 2019)

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

	Current	Potential	Saving
Electricity	£635	£545	£89
Space heating	£213	£231	-£17
Water heating	£362	£256	£107
Lighting	£59	£59	£0
Generated (PV)	-£575	-£559	-£15
Total cost of fuels	£60	-£14	£74
Total cost of uses	£59	-£13	£75
Delivered energy	-14 kWh/m <sup>2</sup>	-16 kWh/m <sup>2</sup>	3 kWh/m <sup>2</sup>
Carbon dioxide emissions	-0.2 tonnes	-0.3 tonnes	0.1 tonnes
CO2 emissions per m <sup>2</sup>	-1 kg/m <sup>2</sup>	-2 kg/m <sup>2</sup>	0 kg/m <sup>2</sup>
Primary energy	2 kWh/m <sup>2</sup>	-1 kWh/m <sup>2</sup>	3 kWh/m <sup>2</sup>

## 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )		Storey height (m)		Volume (m <sup>3</sup> )
Ground floor	149.9000 (1b)	x	2.5000 (2b)	=	374.7500 (1b) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	149.9000				(4)
Dwelling volume				=	374.7500 (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					1.5000 (17)
Infiltration rate					0.0750 (18)
Number of sides sheltered					2 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.0638 (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	0.0813	0.0797	0.0781	0.0701	0.0685	0.0606	0.0606	0.0590	0.0638	0.0685	0.0717	0.0749 (22b)
Balanced mechanical ventilation with heat recovery												
If mechanical ventilation												0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												83.7000 (23c)
Effective ac	0.1628	0.1612	0.1596	0.1516	0.1500	0.1421	0.1421	0.1405	0.1452	0.1500	0.1532	0.1564 (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
NEW OPENINGS (Uw = 1.20)			21.0300	1.1450	24.0802		(27)
DOOR			2.2100	1.2000	2.6520		(26)
PAT DOORS (Uw = 1.20)			12.0300	1.1450	13.7748		(27)
Heat Loss Floor 1			149.9000	0.1200	17.9880	75.0000	11242.5000 (28a)
External Wall 1	134.4000	35.2700	99.1300	0.1800	17.8434	60.0000	5947.8000 (29a)
PLANE	149.9000		149.9000	0.1000	14.9900	9.0000	1349.1000 (30)
Total net area of external elements Aum(A, m <sup>2</sup> )			434.2000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	91.3284	(33)
Internal Wall 2			289.2000			75.0000	21690.0000 (32c)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 40229.4000 (34)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m<sup>2</sup>K 268.3749 (35)

### List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	20.5800	0.0640	1.3171
E3 Sill	19.5300	0.0250	0.4883
E4 Jamb	35.4000	0.0200	0.7080
E5 Ground floor (normal)	53.7600	0.0230	1.2365
E10 Eaves (insulation at ceiling level)	36.4800	0.0370	1.3498
E12 Gable (insulation at ceiling level)	17.2800	0.0390	0.6739
E16 Corner (normal)	15.0000	0.0350	0.5250
E17 Corner (inverted - internal area greater than external area)	5.0000	-0.0780	-0.3900
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			5.9085 (36)
Point Thermal bridges			(36a) = 0.0000
Total fabric heat loss			(33) + (36) + (36a) = 97.2369 (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	20.1308	19.9337	19.7366	18.7511	18.5540	17.5685	17.5685	17.3714	17.9627	18.5540	18.9482	19.3424 (38)
Average = Sum(39)m / 12 =	117.3676	117.1705	116.9735	115.9880	115.7909	114.8054	114.8054	114.6083	115.1996	115.7909	116.1851	116.5793 (39)
												115.9387

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	0.7830	0.7817	0.7803	0.7738	0.7725	0.7659	0.7659	0.7646	0.7685	0.7725	0.7751	0.7777 (40)
HLP (average)												0.7734
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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

Assumed occupancy												2.9340 (42)
Hot water usage for mixer showers												
73.4139	72.3107	70.7030	67.6270	65.3570	62.8255	61.3866	62.9821	64.7310	67.4491	70.5912	73.1326	(42a)
Hot water usage for baths												
31.6936	31.2229	30.5601	29.3379	28.4228	27.4081	26.8599	27.5181	28.2348	29.3206	30.5679	31.5865	(42b)
Hot water usage for other uses												
44.6774	43.0528	41.4282	39.8035	38.1789	36.5543	36.5543	38.1789	39.8035	41.4282	43.0528	44.6774	(42c)
Average daily hot water use (litres/day)												137.6860 (43)
Daily hot water use												
149.7850	146.5864	142.6912	136.7684	131.9586	126.7878	124.8008	128.6791	132.7694	138.1979	144.2119	149.3965	(44)
Energy content (annual)												
237.2228	208.7370	219.3111	187.2291	177.6417	155.9004	150.9357	159.3316	163.7179	187.5332	205.4563	233.9189	(45)
Distribution loss (46)m = 0.15 x (45)m												2286.9357
35.5834	31.3106	32.8967	28.0844	26.6463	23.3851	22.6404	23.8997	24.5577	28.1300	30.8184	35.0878	(46)
Water storage loss:												300.0000 (47)
Store volume												2.0600 (48)
a) If manufacturer declared loss factor is known (kWh/day):												0.5400 (49)
Temperature factor from Table 2b												1.1124 (55)
Enter (49) or (54) in (55)												
Total storage loss												
34.4844	31.1472	34.4844	33.3720	34.4844	33.3720	34.4844	34.4844	33.3720	34.4844	33.3720	34.4844	(56)
If cylinder contains dedicated solar storage												
34.4844	31.1472	34.4844	33.3720	34.4844	33.3720	34.4844	34.4844	33.3720	34.4844	33.3720	34.4844	(57)
Primary loss												
23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624	(59)
Combi loss												
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month												
294.9696	260.8954	275.6621	236.3595	222.5942	199.1776	195.6556	204.9820	214.1990	243.8843	261.3403	291.6657	(62)
WWHRS												
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter												
-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)
Aperture area of solar collector												3.0000 (H1)
Zero-loss collector efficiency												0.8000 (H2)
Collector linear heat loss coefficient												1.8000 (H3)
Collector 2nd order heat loss coefficient												0.0000 (H4)
Collector loop efficiency												0.9000 (H5)
Incidence angle modifier												1.0000 (H6)
Overshading factor												0.8000 (H8)
Overall heat loss coefficient of system												6.5000 (H10)
Heat loss coefficient of collector loop												3.9667 (H11)
Dedicated solar storage volume												75.0000 (H12)
Effective solar volume												75.0000 (H14)
Reference volume												225.0000 (H15)
Storage tank correction coefficient												1.3161 (H16)
Heat delivered to hot water												634.2336 (H24)
Heat delivered to space heating												0.0000 (H29)
Solar input												634.2336
Solar input												-0.0000 (63c)
FGHRS												0.0000 (63d)
Output from w/h												
294.9696	244.7045	216.7238	154.8132	115.3484	100.1769	97.2903	119.3903	155.6070	215.1219	261.3403	291.6657	(64)
Total per year (kWh/year) = Sum(64)m =												2267.1517 (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												
125.0740	111.1318	118.0018	101.5580	95.0278	86.4587	85.9620	89.4980	94.8211	107.4356	113.0214	123.9755	(65)

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

Metabolic gains (Table 5), Watts												
(66)m	176.0419	176.0419	176.0419	176.0419	176.0419	176.0419	176.0419	176.0419	176.0419	176.0419	176.0419	176.0419 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
38.8694	34.5234	28.0763	21.2556	15.8888	13.4140	14.4943	18.8402	25.2873	32.1081	37.4748	39.9497	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
478.2297	483.1922	470.6868	444.0643	410.4581	378.8730	357.7723	352.8097	365.3151	391.9377	425.5438	457.1289	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
55.5382	55.5382	55.5382	55.5382	55.5382	55.5382	55.5382	55.5382	55.5382	55.5382	55.5382	55.5382	(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)												
-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	(71)
Water heating gains (Table 5)												
168.1102	165.3747	158.6045	141.0528	127.7256	120.0815	115.5403	120.2931	131.6960	144.4027	156.9742	166.6337	(72)
Total internal gains												
799.4281	797.3092	771.5865	720.5915	668.2914	626.5874	602.0258	606.1619	636.5173	682.6674	734.2118	777.9311	(73)



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## 6. Solar gains

[Jan]		Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W					
Northeast		6.4800	11.2829	0.6300	0.7000	0.7700	22.3444 (75)					
Southeast		1.2600	36.7938	0.6300	0.7000	0.7700	14.1683 (77)					
Southwest		13.2900	36.7938	0.6300	0.7000	0.7700	149.4417 (79)					
Northeast		10.0800	11.2829	0.6300	0.7000	0.7700	34.7580 (75)					
Northwest		1.9500	11.2829	0.6300	0.7000	0.7700	6.7240 (81)					
Solar gains	227.4364	408.6089	615.3891	856.8852	1045.9362	1076.2685	1021.8671	875.0330	698.1066	466.7832	276.2772	192.1399 (83)
Total gains	1026.8646	1205.9181	1386.9756	1577.4767	1714.2275	1702.8559	1623.8928	1481.1949	1334.6239	1149.4506	1010.4890	970.0711 (84)

## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000 (85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	95.2122	95.3724	95.5331	96.3448	96.5088	97.3372	97.3372	97.5046	97.0041	96.5088	96.1813	95.8561
alpha	7.3475	7.3582	7.3689	7.4230	7.4339	7.4891	7.4891	7.5003	7.4669	7.4339	7.4121	7.3904
util living area	0.9959	0.9863	0.9492	0.8239	0.6207	0.4310	0.3110	0.3558	0.5905	0.9009	0.9882	0.9972 (86)
Living	20.4504	20.5805	20.7523	20.9018	20.9512	20.9580	20.9584	20.9584	20.9546	20.8667	20.6240	20.4211
Non living	19.6216	19.7869	19.9985	20.1711	20.2185	20.2295	20.2297	20.2309	20.2251	20.1397	19.8481	19.5881
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	20.7189	20.5805	20.7523	20.9018	20.9512	20.9580	20.9584	20.9584	20.9546	20.8667	20.6240	20.5021 (87)
Th 2	20.2681	20.2693	20.2704	20.2761	20.2773	20.2830	20.2830	20.2841	20.2807	20.2773	20.2750	20.2727 (88)
util rest of house	0.9945	0.9821	0.9354	0.7897	0.5751	0.3830	0.2604	0.3005	0.5312	0.8699	0.9839	0.9963 (89)
MIT 2	20.0104	19.7869	19.9985	20.1711	20.2185	20.2295	20.2297	20.2309	20.2251	20.1397	19.8481	19.7115 (90)
Living area fraction									fLA = Living area / (4) =			0.1446 (91)
MIT	20.1128	19.9016	20.1075	20.2768	20.3245	20.3349	20.3351	20.3361	20.3306	20.2448	19.9603	19.8258 (92)
Temperature adjustment												0.0000
adjusted MIT	20.1128	19.9016	20.1075	20.2768	20.3245	20.3349	20.3351	20.3361	20.3306	20.2448	19.9603	19.8258 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9942	0.9795	0.9318	0.7898	0.5781	0.3864	0.2641	0.3045	0.5354	0.8683	0.9815	0.9955 (94)
Useful gains	1020.8940	1181.1942	1292.4268	1245.8439	991.0459	658.0643	428.7930	451.0698	714.5170	998.1113	991.7783	965.7429 (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	1855.9168	1757.7512	1591.7202	1319.5693	998.6338	658.3921	428.8077	451.1119	717.7655	1116.7808	1494.1726	1821.6478 (97)
Space heating kWh	621.2570	387.4463	222.6743	53.0823	5.6455	0.0000	0.0000	0.0000	0.0000	88.2901	361.7239	636.7932 (98a)
Space heating requirement - total per year (kWh/year)												2376.9126
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	621.2570	387.4463	222.6743	53.0823	5.6455	0.0000	0.0000	0.0000	0.0000	88.2901	361.7239	636.7932 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2376.9126
Space heating per m2										(98c) / (4) =		15.8567 (99)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												272.1742 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement	621.2570	387.4463	222.6743	53.0823	5.6455	0.0000	0.0000	0.0000	0.0000	88.2901	361.7239	636.7932 (98)
Space heating efficiency (main heating system 1)	272.1742	272.1742	272.1742	272.1742	272.1742	0.0000	0.0000	0.0000	0.0000	272.1742	272.1742	272.1742 (210)
Space heating fuel (main heating system)	228.2571	142.3523	81.8132	19.5031	2.0742	0.0000	0.0000	0.0000	0.0000	32.4388	132.9016	233.9653 (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

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Efficiency of water heater (217)m	294.9696	244.7045	216.7238	154.8132	115.3484	100.1769	97.2903	119.3903	155.6070	215.1219	261.3403	291.6657 (64)
Fuel for water heating, kWh/month	176.5326	176.5326	176.5326	176.5326	176.5326	176.5326	176.5326	176.5326	176.5326	176.5326	176.5326	176.5326 (216)
Space cooling fuel requirement (221)m	167.0907	138.6171	122.7670	87.6966	65.3411	56.7469	55.1118	67.6307	88.1463	121.8596	148.0408	165.2191 (219)
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 (221)
Lighting	45.9354	41.4901	45.9354	44.4536	45.9354	44.4536	45.9354	45.9354	44.4536	45.9354	44.4536	45.9354 (231)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	34.0221	27.2938	24.5750	18.0047	13.9074	11.3624	12.6868	16.4907	21.4198	28.1040	31.7434	34.9677 (232)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	-78.0049	-112.8888	-161.9112	-174.6810	-181.2797	-168.3970	-166.1798	-159.8344	-145.3229	-124.7937	-85.8629	-66.7937 (233a)
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	-34.4029	-79.8121	-177.6747	-293.3526	-405.4849	-411.3246	-404.7302	-333.7882	-232.6410	-124.8624	-48.5324	-26.5257 (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												873.3057 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												176.5326
Water heating fuel used												1284.2679 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 1.0080)												
mechanical ventilation fans (SFP = 1.0080)												460.8526 (230a)
pump for solar water heating												80.0000 (230g)
Total electricity for the above, kWh/year												540.8526 (231)
Electricity for lighting (calculated in Appendix L)												274.5780 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-4199.0818 (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												-1226.0777 (238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	873.3057	16.4900	144.0081 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1284.2679	16.4900	211.7758 (247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000 (247a)
Pumps, fans and electric keep-hot	460.8526	16.4900	75.9946 (249)
Pump for solar water heating	80.0000	16.4900	13.1920 (249)
Energy for lighting	274.5780	16.4900	45.2779 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1625.9499	16.4900	-268.1191
PV Unit electricity exported	-2573.1319	5.5900	-143.8381
Total			-411.9572 (252)
Total energy cost			78.2912 (255)

## 11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600 (256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.1446 (257)
SAP value		97.6558
SAP rating (Section 12)		98 (258)
SAP band		A

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	873.3057	0.1582	138.1786 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1284.2679	0.1452	186.4768 (264)
Space and water heating			324.6554 (265)

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Pumps, fans and electric keep-hot	540.8526	0.1387	75.0229 (267)
Energy for lighting	274.5780	0.1443	39.6301 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1625.9499	0.1350	-219.5668
PV Unit electricity exported	-2573.1319	0.1237	-318.3178
Total			-537.8846 (269)
Total CO2, kg/year			-98.5761 (272)
CO2 emissions per m2			-0.6600 (273)
EI value			100.6777
EI rating			101 (274)
EI band			A

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 SAP 10 WORKSHEET FOR New Build (As Designed) (Version 10.2, February 2022)  
 CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING  
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 1. Overall dwelling characteristics  
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	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	149.9000 (1b)	x 2.5000 (2b)	= 374.7500 (1b) -
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	149.9000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	374.7500 (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) =	Air changes per hour	0.0000 / (5) = 0.0000 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50	1.5000 (17)	
Infiltration rate	0.0750 (18)	
Number of sides sheltered	2 (19)	
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.0638 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	8.0000	7.4000	7.1000	6.3000	6.3000	5.6000	5.4000	5.4000	6.2000	7.0000	7.4000	8.0000 (22)
Wind factor	2.0000	1.8500	1.7750	1.5750	1.5750	1.4000	1.3500	1.3500	1.5500	1.7500	1.8500	2.0000 (22a)
Adj infilt rate	0.1275	0.1179	0.1132	0.1004	0.1004	0.0892	0.0861	0.0861	0.0988	0.1116	0.1179	0.1275 (22b)
Balanced mechanical ventilation with heat recovery												
If mechanical ventilation												0.5000 (23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.5000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												83.7000 (23c)
Effective ac	0.2090	0.1994	0.1947	0.1819	0.1819	0.1707	0.1676	0.1676	0.1803	0.1931	0.1994	0.2090 (25)

-----  
 3. Heat losses and heat loss parameter  
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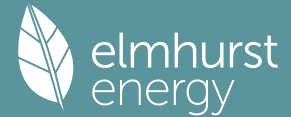
Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
NEW OPENINGS (Uw = 1.20)			21.0300	1.1450	24.0802		(27)
DOOR			2.2100	1.2000	2.6520		(26)
PAT DOORS (Uw = 1.20)			12.0300	1.1450	13.7748		(27)
Heat Loss Floor 1			149.9000	0.1200	17.9880	75.0000	11242.5000 (28a)
External Wall 1	134.4000	35.2700	99.1300	0.1800	17.8434	60.0000	5947.8000 (29a)
PLANE	149.9000		149.9000	0.1000	14.9900	9.0000	1349.1000 (30)
Total net area of external elements Aum(A, m2)			434.2000				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	91.3284		(33)
Internal Wall 2			289.2000			75.0000	21690.0000 (32c)

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Heat capacity Cm = Sum(A x k)													(28)...(30) + (32) + (32a)...(32e) =	40229.4000 (34)	
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K														268.3749 (35)	
List of Thermal Bridges															
K1 Element													Length	Psi-value	Total
E2 Other lintels (including other steel lintels)													20.5800	0.0640	1.3171
E3 Sill													19.5300	0.0250	0.4883
E4 Jamb													35.4000	0.0200	0.7080
E5 Ground floor (normal)													53.7600	0.0230	1.2365
E10 Eaves (insulation at ceiling level)													36.4800	0.0370	1.3498
E12 Gable (insulation at ceiling level)													17.2800	0.0390	0.6739
E16 Corner (normal)													15.0000	0.0350	0.5250
E17 Corner (inverted - internal area greater than external area)													5.0000	-0.0780	-0.3900
Thermal bridges (Sum(L x Psi) calculated using Appendix K)															5.9085 (36)
Point Thermal bridges															(36a) = 0.0000
Total fabric heat loss															(33) + (36) + (36a) = 97.2369 (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	25.8465	24.6639	24.0727	22.4959	22.4959	21.1162	20.7220	20.7220	22.2988	23.8756	24.6639	25.8465	(38)		
Average = Sum(39)m / 12 =	123.0834	121.9008	121.3095	119.7328	119.7328	118.3531	117.9589	117.9589	119.5357	121.1124	121.9008	123.0834	(39)		
	120.4719														
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
HLP (average)	0.8211	0.8132	0.8093	0.7988	0.7988	0.7895	0.7869	0.7869	0.7974	0.8080	0.8132	0.8211	(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														2.9340 (42)	
Hot water usage for mixer showers															
	73.4139	72.3107	70.7030	67.6270	65.3570	62.8255	61.3866	62.9821	64.7310	67.4491	70.5912	73.1326	(42a)		
Hot water usage for baths															
	31.6936	31.2229	30.5601	29.3379	28.4228	27.4081	26.8599	27.5181	28.2348	29.3206	30.5679	31.5865	(42b)		
Hot water usage for other uses															
	44.6774	43.0528	41.4282	39.8035	38.1789	36.5543	36.5543	38.1789	39.8035	41.4282	43.0528	44.6774	(42c)		
Average daily hot water use (litres/day)														137.6860 (43)	
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
Energy conte	149.7850	146.5864	142.6912	136.7684	131.9586	126.7878	124.8008	128.6791	132.7694	138.1979	144.2119	149.3965	(44)		
Energy content (annual)	237.2228	208.7370	219.3111	187.2291	177.6417	155.9004	150.9357	159.3316	163.7179	187.5332	205.4563	233.9189	(45)		
Distribution loss (46)m = 0.15 x (45)m													Total = Sum(45)m = 2286.9357		
	35.5834	31.3106	32.8967	28.0844	26.6463	23.3851	22.6404	23.8997	24.5577	28.1300	30.8184	35.0878	(46)		
Water storage loss:															
Store volume														300.0000 (47)	
a) If manufacturer declared loss factor is known (kWh/day):														2.0600 (48)	
Temperature factor from Table 2b														0.5400 (49)	
Enter (49) or (54) in (55)														1.1124 (55)	
Total storage loss	34.4844	31.1472	34.4844	33.3720	34.4844	33.3720	34.4844	34.4844	33.3720	34.4844	33.3720	34.4844	(56)		
If cylinder contains dedicated solar storage															
Primary loss	34.4844	31.1472	34.4844	33.3720	34.4844	33.3720	34.4844	34.4844	33.3720	34.4844	33.3720	34.4844	(57)		
Combi loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624	(59)		
Total heat required for water heating calculated for each month	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)		
WWHRS	294.9696	260.8954	275.6621	236.3595	222.5942	199.1776	195.6556	204.9820	214.1990	243.8843	261.3403	291.6657	(62)		
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)		
Aperture area of solar collector	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	(63b)		
Zero-loss collector efficiency													3.0000 (H1)		
Collector linear heat loss coefficient													0.8000 (H2)		
Collector 2nd order heat loss coefficient													1.8000 (H3)		
Collector loop efficiency													0.9000 (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													808.5794 (H24)		
Heat delivered to space heating													0.0000 (H29)		
Solar input													808.5794		
FGHRS	-9.2714	-27.9287	-74.8648	-100.5345	-120.8556	-122.1991	-109.2869	-105.4757	-78.8377	-46.6102	-12.7148	-0.0000	(63c)		
Output from w/h	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)		
Total per year (kWh/year) = Sum(64)m =	285.6982	232.9667	200.7973	135.8250	101.7386	76.9785	86.3687	99.5063	135.3613	197.2741	248.6254	291.6657	(64)		
Electric shower(s)													2092.8059 (64)		
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)		
Heat gains from water heating, kWh/month	125.0740	111.1318	118.0018	101.5580	95.0278	86.4587	85.9620	89.4980	94.8211	107.4356	113.0214	123.9755	(65)		

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

Metabolic gains (Table 5), Watts													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	176.0419	176.0419	176.0419	176.0419	176.0419	176.0419	176.0419	176.0419	176.0419	176.0419	176.0419	176.0419	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	38.8694	34.5234	28.0763	21.2556	15.8888	13.4140	14.4943	18.8402	25.2873	32.1081	37.4748	39.9497	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	478.2297	483.1922	470.6868	444.0643	410.4581	378.8730	357.7723	352.8097	365.3151	391.9377	425.5438	457.1289	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.5382	55.5382	55.5382	55.5382	55.5382	55.5382	55.5382	55.5382	55.5382	55.5382	55.5382	55.5382	(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)	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	-117.3613	(71)
Water heating gains (Table 5)	168.1102	165.3747	158.6045	141.0528	127.7256	120.0815	115.5403	120.2931	131.6960	144.4027	156.9742	166.6337	(72)
Total internal gains	799.4281	797.3092	771.5865	720.5915	668.2914	626.5874	602.0258	606.1619	636.5173	682.6674	734.2118	777.9311	(73)

## 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	Access factor Table 6d	Gains W							
Northeast	6.4800	15.8605	0.6300	0.7000	0.7700	31.4097 (75)							
Southeast	1.2600	47.9418	0.6300	0.7000	0.7700	18.4611 (77)							
Southwest	13.2900	47.9418	0.6300	0.7000	0.7700	194.7203 (79)							
Northeast	10.0800	15.8605	0.6300	0.7000	0.7700	48.8595 (75)							
Northwest	1.9500	15.8605	0.6300	0.7000	0.7700	9.4520 (81)							
Solar gains	302.9026	471.2366	707.1706	1011.0443	1175.3075	1326.3933	1142.5807	1052.3465	851.0895	563.7244	353.2891	247.9019	(83)
Total gains	1102.3307	1268.5458	1478.7572	1731.6358	1843.5989	1952.9807	1744.6065	1658.5084	1487.6068	1246.3918	1087.5009	1025.8330	(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	90.7907	91.6715	92.1183	93.3314	93.3314	94.4194	94.7350	94.7350	93.4853	92.2682	91.6715	90.7907	
alpha	7.0527	7.1114	7.1412	7.2221	7.2221	7.2946	7.3157	7.3157	7.2324	7.1512	7.1114	7.0527	
util living area	0.9841	0.9645	0.9091	0.7685	0.5976	0.4177	0.3515	0.3484	0.5122	0.7926	0.9521	0.9870	(86)
Living	20.6129	20.7029	20.8181	20.9191	20.9506	20.9569	20.9574	20.9574	20.9554	20.9211	20.7788	20.6071	
Non living	19.7990	19.9147	20.0516	20.1662	20.1946	20.2074	20.2101	20.2101	20.1995	20.1635	20.0083	19.7924	
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	20.8020	20.7029	20.8181	20.9191	20.9506	20.9569	20.9574	20.9574	20.9554	20.9211	20.7788	20.6621	(87)
Th 2	20.2351	20.2419	20.2453	20.2544	20.2544	20.2624	20.2647	20.2647	20.2556	20.2464	20.2419	20.2351	(88)
util rest of house	0.9785	0.9534	0.8861	0.7299	0.5520	0.3733	0.3018	0.2962	0.4536	0.7406	0.9341	0.9820	(89)
MIT 2	20.0612	19.9147	20.0516	20.1662	20.1946	20.2074	20.2101	20.2101	20.1995	20.1635	20.0083	19.8721	(90)
Living area fraction									fLA = Living area / (4) =				
MIT	20.1684	20.0287	20.1625	20.2751	20.3039	20.3158	20.3182	20.3182	20.3088	20.2731	20.1197	19.9864	(92)
Temperature adjustment												0.0000	
adjusted MIT	20.1684	20.0287	20.1625	20.2751	20.3039	20.3158	20.3182	20.3182	20.3088	20.2731	20.1197	19.9864	(93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9779	0.9497	0.8832	0.7310	0.5551	0.3765	0.3055	0.3000	0.4578	0.7426	0.9306	0.9800	(94)
Useful gains	1077.9819	1204.6880	1306.1013	1265.8992	1023.3224	735.2940	532.8949	497.5193	681.0902	925.5713	1012.0134	1005.3308	(95)
Ext temp.	7.0000	7.1000	7.8000	9.3000	11.7000	14.1000	15.8000	16.1000	14.6000	12.3000	9.8000	7.5000	(96)
Heat loss rate W	1620.8085	1576.0206	1499.6854	1314.0758	1030.1738	735.6642	532.9581	497.5714	682.4098	965.6374	1257.9807	1536.8662	(97)
Space heating kWh	403.8630	249.5355	144.0266	34.6872	5.0974	0.0000	0.0000	0.0000	0.0000	29.8092	177.0964	395.4624	(98a)
Space heating requirement - total per year (kWh/year)												1439.5777	
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	403.8630	249.5355	144.0266	34.6872	5.0974	0.0000	0.0000	0.0000	0.0000	29.8092	177.0964	395.4624	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1439.5777	
Space heating per m2										(98c) / (4) =		9.6036	(99)

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

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Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													270.7316 (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	403.8630	249.5355	144.0266	34.6872	5.0974	0.0000	0.0000	0.0000	0.0000	29.8092	177.0964	395.4624	(98)
Space heating efficiency (main heating system 1)	270.7316	270.7316	270.7316	270.7316	270.7316	0.0000	0.0000	0.0000	0.0000	270.7316	270.7316	270.7316	(210)
Space heating fuel (main heating system)	149.1747	92.1708	53.1990	12.8124	1.8828	0.0000	0.0000	0.0000	0.0000	11.0106	65.4140	146.0717	(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	285.6982	232.9667	200.7973	135.8250	101.7386	76.9785	86.3687	99.5063	135.3613	197.2741	248.6254	291.6657	(64)
Efficiency of water heater	176.0899	176.0899	176.0899	176.0899	176.0899	176.0899	176.0899	176.0899	176.0899	176.0899	176.0899	176.0899	(216)
Fuel for water heating, kWh/month	162.2456	132.2999	114.0311	77.1339	57.7765	43.7155	49.0480	56.5088	76.8706	112.0303	141.1923	165.6345	(219)
Space cooling fuel requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	45.9354	41.4901	45.9354	44.4536	45.9354	44.4536	45.9354	45.9354	44.4536	45.9354	44.4536	45.9354	(231)
Lighting	34.0221	27.2938	24.5750	18.0047	13.9074	11.3624	12.6868	16.4907	21.4198	28.1040	31.7434	34.9677	(232)
Electricity generated by PVs (Appendix M) (negative quantity)	-97.7330	-123.6348	-172.9785	-185.3409	-187.0185	-175.9993	-170.6515	-168.7629	-158.1791	-138.6375	-102.0414	-82.1671	(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)	-55.8341	-103.2652	-221.5077	-366.7292	-468.2201	-532.9258	-463.1198	-422.9318	-305.4383	-168.1656	-74.0535	-41.4507	(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													531.7361 (211)
Space heating fuel - main system 2													0.0000 (213)
Space heating fuel - secondary													0.0000 (215)
Efficiency of water heater													176.0899
Water heating fuel used													1188.4870 (219)
Space cooling fuel													0.0000 (221)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.4000, SFP = 1.0000)													
mechanical ventilation fans (SFP = 1.0000)													460.8526 (230a)
pump for solar water heating													80.0000 (230g)
Total electricity for the above, kWh/year													540.8526 (231)
Electricity for lighting (calculated in Appendix L)													274.5780 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation													-4986.7863 (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													-2451.1327 (238)

## 10a. Fuel costs - using BEDF prices (524)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	531.7361	21.5100	114.3764 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1188.4870	21.5100	255.6436 (247)
Energy for instantaneous electric shower(s)	0.0000	21.5100	0.0000 (247a)
Pumps, fans and electric keep-hot	460.8526	21.5100	99.1294 (249)
Pump for solar water heating	80.0000	21.5100	17.2080 (249)
Energy for lighting	274.5780	21.5100	59.0617 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1763.1444	21.5100	-379.2524
PV Unit electricity exported	-3223.6419	5.5900	-180.2016
Total			-559.4539 (252)
Total energy cost			-14.0348 (255)

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 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP  
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	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	531.7361	0.1589	84.4676 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1188.4870	0.1461	173.6694 (264)
Space and water heating			258.1370 (265)
Pumps, fans and electric keep-hot	540.8526	0.1387	75.0229 (267)
Energy for lighting	274.5780	0.1443	39.6301 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1763.1444	0.1357	-239.2856
PV Unit electricity exported	-3223.6419	0.1246	-401.7534
Total			-641.0391 (269)
Total CO2, kg/year			-268.2491 (272)

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 13a. Primary energy - Individual heating systems including micro-CHP  
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	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	531.7361	1.5880	844.3988 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1188.4870	1.5406	1830.9335 (278)
Space and water heating			2675.3323 (279)
Pumps, fans and electric keep-hot	540.8526	1.5128	818.2018 (281)
Energy for lighting	274.5780	1.5338	421.1568 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1763.1444	1.5016	-2647.6011
PV Unit electricity exported	-3223.6419	0.4574	-1474.6256
Total			-4122.2267 (283)
Total Primary energy kWh/year			-207.5358 (286)



