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Our Reference : CB-56

Sent By : E-Mail

19 March 2024

### ENERGY STATEMENT (PLANNING)

Statement By :	Joe Solti Accredited SAP Assessor (Elmhurst)
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Thank you for sending the drawings. We are pleased to present our report as follows.

### Development Details

Site Location :	The Hill, Ham Link, Burrington, North Somerset BS40 7AR
Development :	1 Bedroom Dwelling
Local Authority :	North Somerset Council
Policy (CS2) :	> 10% reduction in predicted energy (on site renewables or LZCs)

### Baseline Energy Demand

Base Energy (DPER) :	118.76 kWh/m <sup>2</sup> /year
Base Energy (Total) :	6413.04 kWh/year

Note 1 : See thermal (SAP) calculation CB5601

Note 2 : Calculation is based on SAP10 (Part L Building Regulations 2021)

Note 3 : DPER = Dwelling Primary Energy Rate

### Actual Energy Demand

Actual Energy (DPER) :	104.89 kWh/m <sup>2</sup> /year
Actual Energy (Total) :	5664.06 kWh/year
Renewable/LZC :	0.9kW (minimum) solar PV

Note 1 : See thermal (SAP) calculation CB5602

Note 2 : Calculation is based on SAP10 (Part L Building Regulations 2021)

Note 3 : DPER = Dwelling Primary Energy Rate

### Energy Demand (kWh) Saving

Energy Saving (kWh)	748.98 kWh/year = 11.68%
Renewable/LZC :	0.9kW (minimum) solar PV

The > 10% saving in on-site renewables is to be provided by minimum 0.9 kW/peak of solar pv panels, located on the east/south-east facing roof slope.

## Design

### **Energy & CO<sub>2</sub> Emissions**

- > Fabric insulation standards (including glazing) will meet or exceed current (2021) Building Regulations Part L standards (effective June 2022).
- > Attention to be paid to minimise thermal bridging and air leakage at junctions.
- > 100% of new internal fixed lighting and external lighting will be low-energy (LED/CFL).
- > Air source heat pump (PCDB listed) with advanced heating controls.
- > Where supplied, white goods will be energy efficient.

### **Materials**

- > Consideration will be given to using materials and construction that have a low environmental impact, such as those achieving an A+ or A rated under BRE's Green Guide.
- > Where possible, materials will be chosen that are responsibly sourced (such as FSC timber), recycled or reclaimed.
- > All insulation materials will have a GWP (Global Warming Potential) of 5 or less.

### **Water Use**

- > Indoor water use will be restricted by use of fittings with lower flow rates, bath with smaller capacity, dual-flush WC, and (where applicable) washing machine and dishwasher with low water usage. Consideration to be given to installation of a water butt.

### **Surface Water & Flood Risk**

- > Where possible, Sustainable Drainage Systems will be used to avoid, reduce, and delay the discharge of rain-fall run-off to public watercourses and sewers.
- > Measures are to be undertaken to reduce the risk of flooding where developments are in medium or high risk flood zones.

### **Waste**

- > Construction site waste is to be minimised (diverted from landfill) by re-using materials on site (or to/from other sites), returning to the supplier where possible/practical, recovery/recycling, and composting.
- > Hazardous waste will be avoided (or minimised where unavoidable).

> If available, the kitchen/utility design will incorporate fixed bin(s) in the cupboards to encourage recycling.

### **Health & Wellbeing**

> Key rooms have good levels of daylighting, and décor will enhance this. The need for artificial lighting will also be reduced.

> Sound insulation (between dwelling and adjoining buildings, where applicable), and within the dwelling, will meet or exceed current Building Regulation standards.

> To ensure the dwelling is usable/adaptable for all potential existing and future owner or occupier, as many as possible/practical of the 16 no Lifetime Homes criteria will be incorporated into the design and construction of the dwelling.

### **Management**

> Guidance will be provided to the end owner/occupier of the dwelling, providing information on the correct and efficient use of their home.

> Security measures will be incorporated into the design and construction of the dwelling.

## **Summary/Conclusion**

The dwelling is to be designed to high levels of fabric insulation and air tightness, in line with current thinking (better than Part L 2021) to reduce energy use and CO2 emissions, with solar pv panels added to reduce energy use (kWh) by a further 10% (or greater).

Therefore the proposal meet North Somerset Council's requirements (Core Strategy CS2).

I trust this is satisfactory. Should you have any queries, or would like to discuss anything, please do not hesitate to contact me.

Yours sincerely

Joe Solti (Project Director) [joe@thermenergy.co.uk](mailto:joe@thermenergy.co.uk)

# Full SAP Calculation Printout



Property Reference	CB5601	Issued on Date	19/03/2024
Assessment Reference	CB5601	Prop Type Ref	CB-56
Property	The Hill, Ham Link, Burrington, North Somerset, BS40 7AR		
SAP Rating	60 D	DER	11.43
Environmental	92 A	% DER < TER	15.40
CO <sub>2</sub> Emissions (t/year)	0.57	DFEE	103.92
Compliance Check	See BREL	% DFEE < TFEE	-99.08
% DPER < TPER	-64.51	DPER	118.76
Assessor Details	Mr. Joe Solti	Assessor ID	5122-0001
Client	WD Architects, .		

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

## 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	54.0000 (1b)	2.6000 (2b)	140.4000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	54.0000		140.4000 (4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 140.4000 (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	3 * 10 = 30.0000 (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) =	30.0000 / (5) = 0.2137 (8)
Pressure test	No
Pressure Test Method	Blower Door
Measured/design AP50	15.0000 (17)
Infiltration rate	0.9637 (18)
Number of sides sheltered	1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.8914 (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	1.1365	1.1142	1.0920	0.9805	0.9583	0.8468	0.8468	0.8245	0.8914	0.9583	1.0028	1.0474 (22b)
Effective ac	1.1365	1.1142	1.0920	0.9807	0.9591	0.8586	0.8586	0.8399	0.8973	0.9591	1.0028	1.0474 (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
Doors			2.0000	1.4000	2.8000		(26)
Windows (Uw = 1.40)			13.5000	1.3258	17.8977		(27)
Rooflights (N)			0.9000	1.3258	1.1932		(27a)
Rooflights (S)			0.9000	1.3258	1.1932		(27a)
Roof Glazing			3.5000	1.3258	4.6402		(27a)
Floor			54.0000	0.2500	13.5000		(28a)
Wall (uninsulated)	3.5000		3.5000	2.5000	8.7500		(29a)
Wall (upgrade)	48.0000	3.6500	44.3500	0.3000	13.3050		(29a)
Wall (new)	43.0000	11.8500	31.1500	0.1800	5.6070		(29a)
Roof	58.0000	1.8000	56.2000	0.1500	8.4300		(30)
Roof (flat)	6.0000	3.5000	2.5000	0.1500	0.3750		(30)
Total net area of external elements Aum (A, m <sup>2</sup> )			212.5000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 77.6912		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							100.0000 (35)
Thermal bridges (Default value 0.200 * total exposed area)							42.5000 (36)
Point Thermal bridges						(36a) =	0.0000
Total fabric heat loss						(33) + (36) + (36a) =	120.1912 (37)

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

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	52.6579	51.6254	50.5929	45.4391	44.4382	39.7788	39.7788	38.9160	41.5735	44.4382	46.4629	48.5279	(38)
Heat transfer coeff	172.8492	171.8166	170.7841	165.6304	164.6295	159.9701	159.9701	159.1072	161.7648	164.6295	166.6541	168.7191	(39)
Average = Sum(39)m / 12 =												165.5437	
HLP	3.2009	3.1818	3.1627	3.0672	3.0487	2.9624	2.9624	2.9464	2.9956	3.0487	3.0862	3.1244	(40)
HLP (average)												3.0656	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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

Assumed occupancy													1.8080	(42)
Hot water usage for mixer showers	68.1672	67.1428	65.6500	62.7939	60.6861	58.3355	56.9994	58.4809	60.1049	62.6287	65.5462	67.9061	(42a)	
Hot water usage for baths	23.5745	23.2244	22.7314	21.8223	21.1416	20.3868	19.9791	20.4687	21.0018	21.8094	22.7372	23.4948	(42b)	
Hot water usage for other uses	33.1458	31.9405	30.7352	29.5299	28.3246	27.1193	27.1193	28.3246	29.5299	30.7352	31.9405	33.1458	(42c)	
Average daily hot water use (litres/day)													114.8377	(43)
Daily hot water use	124.8875	122.3077	119.1166	114.1460	110.1523	105.8416	104.0978	107.2742	110.6366	115.1733	120.2239	124.5467	(44)	
Energy conte	197.7913	174.1645	183.0778	156.2602	148.2861	130.1446	125.8973	132.8279	136.4259	156.2891	171.2810	195.0100	(45)	
Energy content (annual)													1907.4558	
Distribution loss (46)m = 0.15 x (45)m	29.6687	26.1247	27.4617	23.4390	22.2429	19.5217	18.8846	19.9242	20.4639	23.4434	25.6922	29.2515	(46)	
Water storage loss:													210.0000	(47)
Store volume													2.0000	(48)
a) If manufacturer declared loss factor is known (kWh/day):													0.5400	(49)
Temperature factor from Table 2b													1.0800	(55)
Enter (49) or (54) in (55)														
Total storage loss	33.4800	30.2400	33.4800	32.4000	33.4800	32.4000	33.4800	33.4800	32.4000	33.4800	32.4000	33.4800	(56)	
If cylinder contains dedicated solar storage	33.4800	30.2400	33.4800	32.4000	33.4800	32.4000	33.4800	33.4800	32.4000	33.4800	32.4000	33.4800	(57)	
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)	
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)	
Total heat required for water heating calculated for each month	254.5337	225.4157	239.8202	211.1722	205.0285	185.0566	182.6397	189.5703	191.3379	213.0315	226.1930	251.7524	(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	254.5337	225.4157	239.8202	211.1722	205.0285	185.0566	182.6397	189.5703	191.3379	213.0315	226.1930	251.7524	(64)	
12Total per year (kWh/year)													2575.5518	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =													0.0000	(64a)
Heat gains from water heating, kWh/month	111.1595	98.9107	106.2673	95.8861	94.6991	87.2027	87.2548	89.5592	89.2912	97.3600	100.8805	110.2347	(65)	

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	90.4002	90.4002	90.4002	90.4002	90.4002	90.4002	90.4002	90.4002	90.4002	90.4002	90.4002	90.4002	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	79.4935	88.0107	79.4935	82.1433	79.4935	82.1433	79.4935	79.4935	82.1433	79.4935	82.1433	79.4935	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	157.6049	159.2403	155.1190	146.3453	135.2701	124.8610	117.9070	116.2716	120.3929	129.1666	140.2418	150.6509	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.0400	32.0400	32.0400	32.0400	32.0400	32.0400	32.0400	32.0400	32.0400	32.0400	32.0400	32.0400	(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)	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	(71)
Water heating gains (Table 5)	149.4080	147.1885	142.8324	133.1752	127.2837	121.1148	117.2779	120.3753	124.0156	130.8603	140.1119	148.1650	(72)
Total internal gains	436.6264	444.5596	427.5650	411.7839	392.1674	378.2392	364.7986	366.2604	376.6718	389.6404	412.6170	428.4295	(73)

#### 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W							
North	5.7000	10.6334	0.6300	0.7000	0.7700	18.5233 (74)							
East	1.6000	19.6403	0.6300	0.7000	0.7700	9.6037 (76)							
South	5.4000	46.7521	0.6300	0.7000	0.7700	77.1554 (78)							
West	0.8000	19.6403	0.6300	0.7000	0.7700	4.8019 (80)							
North	0.9000	16.7973	0.6300	0.8000	1.0000	6.8573 (82)							
East	3.5000	26.0000	0.6300	0.8000	1.0000	41.2776 (82)							
South	0.9000	42.0754	0.6300	0.8000	1.0000	17.1768 (82)							
Solar gains	175.3961	320.5434	492.8998	696.0049	853.2468	878.3639	833.8983	712.5429	562.9860	369.2554	214.1358	147.4344	(83)
Total gains	612.0225	765.1029	920.4647	1107.7888	1245.4142	1256.6031	1198.6969	1078.8033	939.6578	758.8958	626.7528	575.8638	(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			

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tau	8.6781	8.7302	8.7830	9.0563	9.1114	9.3768	9.3768	9.4276	9.2727	9.1114	9.0007	8.8905
alpha	1.5785	1.5820	1.5855	1.6038	1.6074	1.6251	1.6251	1.6285	1.6182	1.6074	1.6000	1.5927
util living area	0.9306	0.9017	0.8582	0.7802	0.6784	0.5547	0.4516	0.4970	0.6701	0.8290	0.9068	0.9360 (86)
MIT	17.1169	17.4865	18.0997	18.9393	19.6823	20.2671	20.5449	20.4877	20.0032	19.0251	17.9495	17.0853 (87)
Th 2	18.6529	18.6619	18.6709	18.7168	18.7259	18.7689	18.7689	18.7770	18.7522	18.7259	18.7075	18.6891 (88)
util rest of house	0.9150	0.8800	0.8256	0.7274	0.5935	0.4210	0.2609	0.3065	0.5483	0.7746	0.8823	0.9217 (89)
MIT 2	15.4023	15.7659	16.3632	17.1830	17.8530	18.3554	18.5308	18.5162	18.1733	17.3026	16.2587	15.3949 (90)
Living area fraction										FLA = Living area / (4) =		
MIT	15.8468	16.2120	16.8134	17.6383	18.3273	18.8510	19.0530	19.0273	18.6477	17.7492	16.6971	15.8331 (92)
Temperature adjustment												0.0000
adjusted MIT	15.8468	16.2120	16.8134	17.6383	18.3273	18.8510	19.0530	19.0273	18.6477	17.7492	16.6971	15.8331 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.8874	0.8475	0.7902	0.6953	0.5752	0.4268	0.2895	0.3322	0.5411	0.7426	0.8511	0.8954 (94)
Useful gains	543.0820	648.4490	727.3504	770.2618	716.4114	536.3303	346.9888	358.4173	508.4876	563.5346	533.4526	515.6390 (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	1995.8554	1943.5852	1761.3625	1447.3333	1091.0412	680.0308	392.3996	418.0253	735.6597	1176.9661	1599.3890	1962.7339 (97)
Space heating kWh	1080.8635	870.3315	769.3050	487.4915	278.7246	0.0000	0.0000	0.0000	0.0000	456.3930	767.4742	1076.6387 (98a)
Space heating requirement - total per year (kWh/year)												5787.2220
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	1080.8635	870.3315	769.3050	487.4915	278.7246	0.0000	0.0000	0.0000	0.0000	456.3930	767.4742	1076.6387 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												5787.2220
Space heating per m2												(98c) / (4) = 107.1708 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												219.3000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	1080.8635	870.3315	769.3050	487.4915	278.7246	0.0000	0.0000	0.0000	0.0000	456.3930	767.4742	1076.6387 (98)
Space heating efficiency (main heating system 1)	219.3000	219.3000	219.3000	219.3000	219.3000	0.0000	0.0000	0.0000	0.0000	219.3000	219.3000	219.3000 (210)
Space heating fuel (main heating system)	492.8698	396.8680	350.8003	222.2943	127.0974	0.0000	0.0000	0.0000	0.0000	208.1136	349.9654	490.9433 (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	254.5337	225.4157	239.8202	211.1722	205.0285	185.0566	182.6397	189.5703	191.3379	213.0315	226.1930	251.7524 (64)
Efficiency of water heater (217)m	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000 (216)
Fuel for water heating, kWh/month	133.6837	118.3906	125.9560	110.9098	107.6830	97.1936	95.9242	99.5642	100.4926	111.8863	118.7989	132.2229 (219)
Space cooling fuel requirement												
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (231)
Lighting	16.8998	13.5577	12.2072	8.9435	6.9082	5.6441	6.3019	8.1914	10.6399	13.9601	15.7679	17.3695 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)
Annual totals kWh/year												
Space heating fuel - main system 1												2638.9521 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												190.4000
Water heating fuel used												1352.7058 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
Total electricity for the above, kWh/year												0.0000 (231)
Electricity for lighting (calculated in Appendix L)												136.3911 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												0.0000 (233)
Wind generation												0.0000 (234)
Hydro-electric generation (Appendix N)												0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)												0.0000 (235)
Appendix Q - special features												
Energy saved or generated												-0.0000 (236)
Energy used												0.0000 (237)
Total delivered energy for all uses												4128.0490 (238)

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## 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	2638.9521	0.1543	407.2460 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1352.7058	0.1408	190.5081 (264)
Space and water heating			597.7541 (265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (267)
Energy for lighting	136.3911	0.1443	19.6855 (268)
Total CO2, kg/year			617.4395 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			11.4300 (273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	2638.9521	1.5713	4146.6691 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1352.7058	1.5208	2057.1314 (278)
Space and water heating			6203.8005 (279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (281)
Energy for lighting	136.3911	1.5338	209.2012 (282)
Total Primary energy kWh/year			6413.0018 (286)
Dwelling Primary energy Rate (DPER)			118.7600 (287)

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

### 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	54.0000 (1b)	x 2.6000 (2b)	= 140.4000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	54.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 140.4000 (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	2 * 10 = 20.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	20.0000 / (5) = 0.1425 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3925 (18)
Number of sides sheltered	1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.3630 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate												
Effective ac	0.4628	0.4538	0.4447	0.3993	0.3902	0.3449	0.3449	0.3358	0.3630	0.3902	0.4084	0.4265 (22b)
	0.6071	0.6030	0.5989	0.5797	0.5761	0.5595	0.5595	0.5564	0.5659	0.5761	0.5834	0.5910 (25)

### 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
TER Opaque door			2.0000	1.0000	2.0000		(26)
TER Opening Type (Uw = 1.20)			8.2700	1.1450	9.4695		(27)
Rooflights (N)			0.5500	1.5918	0.8755		(27a)
Rooflights (S)			0.5500	1.5918	0.8755		(27a)
Roof Glazing			2.1400	1.5918	3.4064		(27a)
Floor			54.0000	0.1300	7.0200		(28a)
Wall (uninsulated)	3.5000		3.5000	0.1800	0.6300		(29a)
Wall (upgrade)	48.0000	2.2400	45.7600	0.1800	8.2368		(29a)
Wall (new)	43.0000	8.0300	34.9700	0.1800	6.2946		(29a)
Roof	58.0000	1.1000	56.9000	0.1100	6.2590		(30)
Roof (flat)	6.0000	2.1400	3.8600	0.1100	0.4246		(30)
Total net area of external elements Aum(A, m <sup>2</sup> )			212.5000				(31)



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Fabric heat loss, W/K = Sum (A x U) (26)...(30) + (32) = 45.4918 (33)

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

Thermal bridges (User defined value 0.050 \* total exposed area) 10.6250 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 56.1168 (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	28.1288	27.9361	27.7472	26.8599	26.6939	25.9212	25.9212	25.7781	26.2188	26.6939	27.0297	27.3808
Average = Sum(39)m / 12 =	84.2455	84.0528	83.8639	82.9767	82.8107	82.0380	82.0380	81.8949	82.3356	82.8107	83.1465	83.4976

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.5601	1.5565	1.5530	1.5366	1.5335	1.5192	1.5192	1.5166	1.5247	1.5335	1.5398	1.5463
HLP (average)												1.5366
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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

Assumed occupancy 1.8080 (42)

Hot water usage for mixer showers 54.5338 53.7143 52.5200 50.2351 48.5489 46.6684 45.5995 46.7847 48.0839 50.1030 52.4370 54.3248 (42a)

Hot water usage for baths 23.5745 23.2244 22.7314 21.8223 21.1416 20.3868 19.9791 20.4687 21.0018 21.8094 22.7372 23.4948 (42b)

Hot water usage for other uses 33.1458 31.9405 30.7352 29.5299 28.3246 27.1193 27.1193 28.3246 29.5299 30.7352 31.9405 33.1458 (42c)

Average daily hot water use (litres/day) 102.2682 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	111.2541	108.8791	105.9866	101.5873	98.0150	94.1745	92.6979	95.5780	98.6156	102.6476	107.1147	110.9655
Energy conte	176.1993	155.0424	162.8974	139.0679	131.9471	115.7985	112.1101	118.3456	121.6029	139.2918	152.6045	173.7451
Energy content (annual)												1698.6526
Distribution loss (46)m = 0.15 x (45)m	26.4299	23.2564	24.4346	20.8602	19.7921	17.3698	16.8165	17.7518	18.2404	20.8938	22.8907	26.0618
Water storage loss:												210.0000
Store volume												1.7016
a) If manufacturer declared loss factor is known (kWh/day):												0.5400
Temperature factor from Table 2b												0.9188
Enter (49) or (54) in (55)												
Total storage loss	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842
If cylinder contains dedicated solar storage	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842
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
Total heat required for water heating calculated for each month	227.9459	201.7813	214.6440	189.1452	183.6937	165.8759	163.8567	170.0921	171.6802	191.0384	202.6818	225.4917
WWHRS	-24.9306	-22.0488	-23.0882	-19.1180	-17.8173	-15.2464	-14.2910	-15.1971	-15.7745	-18.5964	-21.0674	-24.4689
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	203.0153	179.7325	191.5558	170.0273	165.8764	150.6295	149.5657	154.8951	155.9057	172.4420	181.6144	201.0228
12Total per year (kWh/year)												2076.2825
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =												0.0000
Heat gains from water heating, kWh/month	99.9835	88.9427	95.5607	86.3020	85.2697	78.5649	78.6739	80.7472	80.4948	87.7118	90.8029	99.1675

## 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	79.4808	87.9966	79.4808	82.1301	79.4808	82.1301	79.4808	79.4808	82.1301	79.4808	82.1301	79.4808
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	157.6049	159.2403	155.1190	146.3453	135.2701	124.8610	117.9070	116.2716	120.3929	129.1666	140.2418	150.6509
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.0400	32.0400	32.0400	32.0400	32.0400	32.0400	32.0400	32.0400	32.0400	32.0400	32.0400	32.0400
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000
Losses e.g. evaporation (negative values) (Table 5)	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201
Water heating gains (Table 5)	134.3865	132.3552	128.4418	119.8638	114.6098	109.1179	105.7445	108.5311	111.7984	117.8922	126.1151	133.2897
Total internal gains	424.5921	432.7121	416.1616	401.4593	382.4807	366.2290	353.2523	354.4035	364.4414	379.6596	401.6070	416.5414

## 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North	3.4900	10.6334	0.6300	0.7000	0.7700	11.3415
East	0.9800	19.6403	0.6300	0.7000	0.7700	5.8823
South	3.3100	46.7521	0.6300	0.7000	0.7700	47.2934
West	0.4900	19.6403	0.6300	0.7000	0.7700	2.9411
North	0.5500	16.7973	0.6300	0.7000	1.0000	3.6668
East	2.1400	26.0000	0.6300	0.7000	1.0000	22.0835
South	0.5500	42.0754	0.6300	0.7000	1.0000	9.1848
Solar gains	102.3934	186.2493	284.4754	399.2270	487.7133	501.4540
Total gains	526.9855	618.9614	700.6369	800.6864	870.1940	867.6830

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## 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												
Utilisation factor for gains for living area, nil,m (see Table 9a)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	17.8051	17.8459	17.8861	18.0774	18.1136	18.2842	18.2842	18.3162	18.2181	18.1136	18.0404	17.9646
alpha	2.1870	2.1897	2.1924	2.2052	2.2076	2.2189	2.2189	2.2211	2.2145	2.2076	2.2027	2.1976
util living area	0.9236	0.8933	0.8472	0.7616	0.6453	0.5073	0.3935	0.4359	0.6206	0.8039	0.8952	0.9301 (86)
MIT	17.9575	18.3509	18.9374	19.6873	20.3046	20.7159	20.8843	20.8512	20.5293	19.7200	18.7228	17.8948 (87)
Th 2	19.6427	19.6454	19.6480	19.6602	19.6624	19.6731	19.6731	19.6751	19.6690	19.6624	19.6578	19.6530 (88)
util rest of house	0.9117	0.8771	0.8236	0.7246	0.5889	0.4257	0.2885	0.3286	0.5420	0.7643	0.8765	0.9191 (89)
MIT 2	16.2042	16.6931	17.4175	18.3261	19.0349	19.4722	19.6183	19.5991	19.3034	18.3953	17.1743	16.1304 (90)
Living area fraction									fLA = Living area / (4) =			
MIT	16.6588	17.1229	17.8116	18.6790	19.3641	19.7947	19.9466	19.9238	19.6212	18.7387	17.5758	16.5879 (92)
Temperature adjustment												0.0000
adjusted MIT	16.6588	17.1229	17.8116	18.6790	19.3641	19.7947	19.9466	19.9238	19.6212	18.7387	17.5758	16.5879 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.8743	0.8364	0.7830	0.6926	0.5749	0.4337	0.3114	0.3501	0.5388	0.7307	0.8370	0.8831 (94)
Useful gains	460.7191	517.7278	548.5948	554.5354	500.2420	376.3388	258.2903	266.9017	370.9851	433.7696	440.6458	443.9465 (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	1041.1721	1027.3671	948.6331	811.4289	634.6697	426.1596	274.5454	288.5771	454.5921	673.9753	871.0229	1034.3558 (97)
Space heating kWh	431.8570	342.4776	297.6285	184.9633	100.0142	0.0000	0.0000	0.0000	0.0000	178.7130	309.8715	439.2645 (98a)
Space heating requirement - total per year (kWh/year)												2284.7897
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	431.8570	342.4776	297.6285	184.9633	100.0142	0.0000	0.0000	0.0000	0.0000	178.7130	309.8715	439.2645 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2284.7897
Space heating per m2										(98c) / (4) =		42.3109 (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 %)												92.3000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement	431.8570	342.4776	297.6285	184.9633	100.0142	0.0000	0.0000	0.0000	0.0000	178.7130	309.8715	439.2645 (98)
Space heating efficiency (main heating system 1)	92.3000	92.3000	92.3000	92.3000	92.3000	0.0000	0.0000	0.0000	0.0000	92.3000	92.3000	92.3000 (210)
Space heating fuel (main heating system)	467.8840	371.0483	322.4578	200.3936	108.3577	0.0000	0.0000	0.0000	0.0000	193.6219	335.7221	475.9096 (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	203.0153	179.7325	191.5558	170.0273	165.8764	150.6295	149.5657	154.8951	155.9057	172.4420	181.6144	201.0228 (64)
Efficiency of water heater (217)m	85.7089	85.4819	85.0442	84.2490	82.9628	79.8000	79.8000	79.8000	79.8000	84.1400	85.2473	79.8000 (216)
Fuel for water heating, kWh/month	236.8660	210.2581	225.2427	201.8152	199.9407	188.7588	187.4257	194.1041	195.3706	204.9465	213.0442	234.3927 (219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041 (231)
Lighting	16.5145	13.2486	11.9289	8.7396	6.7507	5.5154	6.1582	8.0047	10.3973	13.6418	15.4084	16.9735 (232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-42.6906	-56.6010	-76.6237	-81.0623	-83.4600	-76.6389	-75.7543	-73.4128	-68.7522	-62.2715	-45.6727	-37.3530 (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	-36.3761	-74.6754	-145.1213	-213.3473	-277.7646	-277.4570	-274.1057	-233.9433	-174.0634	-105.0571	-47.9825	-28.8986 (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												2475.3951 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												79.8000
Water heating fuel used												2492.1653 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
Total electricity for the above, kWh/year												86.0000 (231)
Electricity for lighting (calculated in Appendix L)												133.2817 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-2669.0853 (233)

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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	2517.7568 (238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	2475.3951	0.2100	519.8330 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2492.1653	0.2100	523.3547 (264)
Space and water heating			1043.1877 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	133.2817	0.1443	19.2367 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-780.2931	0.1359	-106.0162
PV Unit electricity exported	-1888.7922	0.1265	-239.0198
Total			-345.0361 (269)
Total CO2, kg/year			729.3175 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			13.5100 (273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	2475.3951	1.1300	2797.1965 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2492.1653	1.1300	2816.1468 (278)
Space and water heating			5613.3432 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	133.2817	1.5338	204.4320 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-780.2931	1.5022	-1172.1652
PV Unit electricity exported	-1888.7922	0.4645	-877.4231
Total			-2049.5883 (283)
Total Primary energy kWh/year			3898.2877 (286)
Target Primary Energy Rate (TPER)			72.1900 (287)

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

### 1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	54.0000 (1b)	x 2.6000 (2b)	= 140.4000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	54.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	140.4000 (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	2 * 10 =	20.0000 (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) =	20.0000 / (5) =	0.1425 (8)
Pressure test	No	
Pressure Test Method	Blower Door	
Measured/design AP50	15.0000 (17)	
Infiltration rate	0.8925 (18)	
Number of sides sheltered	1 (19)	
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.8255 (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	1.0525	1.0319	1.0113	0.9081	0.8874	0.7842	0.7842	0.7636	0.8255	0.8874	0.9287	0.9700 (22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)												0.0000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =												0.0000 (23c)
Effective ac	1.0525	1.0319	1.0113	0.9123	0.8938	0.8075	0.8075	0.7915	0.8407	0.8938	0.9312	0.9704 (25)

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### 3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K						
Doors			2.0000	1.4000	2.8000			(26)					
Windows (Uw = 1.40)			13.5000	1.3258	17.8977			(27)					
Rooflights (N)			0.9000	1.3258	1.1932			(27a)					
Rooflights (S)			0.9000	1.3258	1.1932			(27a)					
Roof Glazing			3.5000	1.3258	4.6402			(27a)					
Floor			54.0000	0.2500	13.5000			(28a)					
Wall (uninsulated)	3.5000		3.5000	2.5000	8.7500			(29a)					
Wall (upgrade)	48.0000	3.6500	44.3500	0.3000	13.3050			(29a)					
Wall (new)	43.0000	11.8500	31.1500	0.1800	5.6070			(29a)					
Roof	58.0000	1.8000	56.2000	0.1500	8.4300			(30)					
Roof (flat)	6.0000	3.5000	2.5000	0.1500	0.3750			(30)					
Total net area of external elements Aum(A, m2)			212.5000					(31)					
Fabric heat loss, W/K = Sum (A x U)					(26) ... (30) + (32) =	77.6912		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								100.0000 (35)					
Thermal bridges (Default value 0.200 * total exposed area)								42.5000 (36)					
Point Thermal bridges								0.0000 (36a)					
Total fabric heat loss								(33) + (36) + (36a) = 120.1912 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan 48.7660	Feb 47.8098	Mar 46.8536	Apr 42.2684	May 41.4100	Jun 37.4139	Jul 37.4139	Aug 36.6738	Sep 38.9531	Oct 41.4100	Nov 43.1466	Dec 44.9621	(38)
Heat transfer coeff	168.9572	168.0010	167.0448	162.4596	161.6012	157.6051	157.6051	156.8651	159.1443	161.6012	163.3378	165.1533	(39)
Average = Sum(39)m / 12 =												162.4480	
HLP	Jan 3.1288	Feb 3.1111	Mar 3.0934	Apr 3.0085	May 2.9926	Jun 2.9186	Jul 2.9186	Aug 2.9049	Sep 2.9471	Oct 2.9926	Nov 3.0248	Dec 3.0584	(40)
HLP (average)												3.0083	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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

Assumed occupancy													1.8080 (42)
Hot water usage for mixer showers													0.0000 (42a)
Hot water usage for baths	23.5745	23.2244	22.7314	21.8223	21.1416	20.3868	19.9791	20.4687	21.0018	21.8094	22.7372	23.4948	(42b)
Hot water usage for other uses	33.1458	31.9405	30.7352	29.5299	28.3246	27.1193	27.1193	28.3246	29.5299	30.7352	31.9405	33.1458	(42c)
Average daily hot water use (litres/day)													51.9898 (43)
Daily hot water use	Jan 56.7203	Feb 55.1649	Mar 53.4666	Apr 51.3522	May 49.4662	Jun 47.5061	Jul 47.0984	Aug 48.7933	Sep 50.5317	Oct 52.5446	Nov 54.6777	Dec 56.6406	(44)
Energy conte	89.8311	78.5541	82.1761	70.2986	66.5910	58.4143	56.9614	60.4163	62.3106	71.3025	77.8984	88.6855	(45)
Energy content (annual)													863.4398
Distribution loss (46)m = 0.15 x (45)m													0.0000 (46)
Water storage loss:													0.0000 (46)
Total storage loss													0.0000 (56)
If cylinder contains dedicated solar storage													0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
WWHRS	76.3564	66.7710	69.8497	59.7538	56.6023	49.6521	48.4172	51.3538	52.9640	60.6072	66.2136	75.3827	(62)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	76.3564	66.7710	69.8497	59.7538	56.6023	49.6521	48.4172	51.3538	52.9640	60.6072	66.2136	75.3827	(64)
Total per year (kWh/year)													733.9239 (64)
Electric shower(s)	43.6725	38.9125	42.4910	40.5486	41.3095	39.4053	40.7188	41.3095	40.5486	42.4910	41.6920	43.6725	(64a)
Heat gains from water heating, kWh/month	30.0072	26.4209	28.0852	25.0756	24.4780	22.2644	22.2840	23.1658	23.3782	25.7745	26.9764	29.7638	(65)

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

Metabolic gains (Table 5), Watts													
(66)m	90.4002	90.4002	90.4002	90.4002	90.4002	90.4002	90.4002	90.4002	90.4002	90.4002	90.4002	90.4002	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
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	(69)
Losses e.g. evaporation (negative values) (Table 5)	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	(71)
Water heating gains (Table 5)													
Total internal gains	40.3323	39.3168	37.7489	34.8272	32.9005	30.9227	29.9516	31.1369	32.4697	34.6432	37.4672	40.0051	(72)
	327.5507	336.6878	322.4815	313.4359	297.7842	288.0471	277.4722	277.0221	285.1259	293.4234	309.9724	320.2696	(73)

### 6. Solar gains

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[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North	5.7000	10.6334	0.6300	0.7000	0.7700	18.5233 (74)
East	1.6000	19.6403	0.6300	0.7000	0.7700	9.6037 (76)
South	5.4000	46.7521	0.6300	0.7000	0.7700	77.1554 (78)
West	0.8000	19.6403	0.6300	0.7000	0.7700	4.8019 (80)
North	0.9000	16.7973	0.6300	0.8000	1.0000	6.8573 (82)
East	3.5000	26.0000	0.6300	0.8000	1.0000	41.2776 (82)
South	0.9000	42.0754	0.6300	0.8000	1.0000	17.1768 (82)

Solar gains	175.3961	320.5434	492.8998	696.0049	853.2468	878.3639	833.8983	712.5429	562.9860	369.2554	214.1358	147.4344 (83)
Total gains	502.9468	657.2312	815.3813	1009.4408	1151.0310	1166.4110	1111.3706	989.5650	848.1119	662.6787	524.1082	467.7040 (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	8.8780	8.9285	8.9796	9.2331	9.2821	9.5175	9.5175	9.5624	9.4254	9.2821	9.1834	9.0825
alpha	1.5919	1.5952	1.5986	1.6155	1.6188	1.6345	1.6345	1.6375	1.6284	1.6188	1.6122	1.6055
util living area	0.9466	0.9187	0.8763	0.7991	0.6976	0.5748	0.4714	0.5209	0.6967	0.8529	0.9260	0.9518 (86)
MIT	15.9211	16.4312	17.2709	18.4161	19.4336	20.2291	20.6135	20.5286	19.8521	18.5037	17.0365	15.8699 (87)
Th 2	18.6870	18.6955	18.7040	18.7458	18.7537	18.7912	18.7912	18.7983	18.7767	18.7537	18.7377	18.7211 (88)
util rest of house	0.9343	0.9003	0.8472	0.7495	0.6151	0.4414	0.2775	0.3277	0.5786	0.8043	0.9060	0.9408 (89)
MIT 2	14.4410	14.9422	15.7606	16.8665	17.7873	18.4593	18.7071	18.6796	18.2029	16.9977	15.5713	14.4085 (90)
Living area fraction	14.8247	15.3283	16.1522	17.2683	18.2141	18.9181	19.2013	19.1590	18.6305	17.3881	15.9512	14.7874 (92)
Temperature adjustment												0.0000
adjusted MIT	14.8247	15.3283	16.1522	17.2683	18.2141	18.9181	19.2013	19.1590	18.6305	17.3881	15.9512	14.7874 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9002	0.8581	0.7998	0.7058	0.5903	0.4506	0.3197	0.3657	0.5686	0.7611	0.8664	0.9089 (94)
Useful gains	452.7321	563.9594	652.1025	712.4388	679.4742	525.5620	355.3379	361.9276	482.2074	504.3590	454.0864	425.0925 (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	1778.2254	1751.9590	1612.3474	1359.5080	1052.6849	680.5568	409.9843	432.7880	721.0020	1096.9683	1445.7349	1748.5399 (97)
Space heating kWh	986.1670	798.3358	714.4222	465.8898	277.6687	0.0000	0.0000	0.0000	0.0000	440.9013	713.9869	984.6448 (98a)
Space heating requirement - total per year (kWh/year)												5382.0165
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	986.1670	798.3358	714.4222	465.8898	277.6687	0.0000	0.0000	0.0000	0.0000	440.9013	713.9869	984.6448 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												5382.0165
Space heating per m2										(98c) / (4) =		99.6670 (99)

## 8c. Space cooling requirement

Calculated for June, July and August. See Table 10b	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	1481.4880	1166.2778	1192.1746	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.5683	0.6284	0.5867	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	841.8814	732.9238	699.4662	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1255.0791	1196.8681	1069.1791	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	297.5024	345.1746	275.0664	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction									fc = cooled area / (4) =			1.0000 (105)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	74.3756	86.2937	68.7666	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												229.4358 (107)
Energy for space heating												99.6670 (99)
Energy for space cooling												4.2488 (108)
Total												103.9158 (109)
Fabric Energy Efficiency (DFEE)												103.9 (109)

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

## 1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	54.0000 (1b)	x 2.6000 (2b)	= 140.4000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	54.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	140.4000 (5)

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## 2. Ventilation rate

													m3 per hour
Number of open chimneys												0 * 80 =	0.0000 (6a)
Number of open flues												0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire												0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler												0 * 20 =	0.0000 (6d)
Number of flues attached to other heater												0 * 35 =	0.0000 (6e)
Number of blocked chimneys												0 * 20 =	0.0000 (6f)
Number of intermittent extract fans												2 * 10 =	20.0000 (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) =												20.0000 / (5) =	0.1425 (8)
Pressure test												Yes	
Pressure Test Method												Blower Door	
Measured/design AP50												5.0000 (17)	
Infiltration rate												0.3925 (18)	
Number of sides sheltered												1 (19)	
Shelter factor												(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor												(21) = (18) x (20) =	0.3630 (21)
													(22)
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind factor	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Adj infilt rate	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
	0.4628	0.4538	0.4447	0.3993	0.3902	0.3449	0.3449	0.3358	0.3630	0.3902	0.4084	0.4265	(22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)													0.0000 (23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =													0.0000 (23c)
Effective ac	0.6071	0.6030	0.5989	0.5797	0.5761	0.5595	0.5595	0.5564	0.5659	0.5761	0.5834	0.5910	(25)

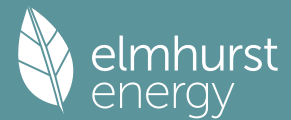
## 3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K						
TER Opaque door			2.0000	1.0000	2.0000			(26)					
TER Opening Type (Uw = 1.20)			8.2700	1.1450	9.4695			(27)					
Rooflights (N)			0.5500	1.5918	0.8755			(27a)					
Rooflights (S)			0.5500	1.5918	0.8755			(27a)					
Roof Glazing			2.1400	1.5918	3.4064			(27a)					
Floor			54.0000	0.1300	7.0200			(28a)					
Wall (uninsulated)	3.5000		3.5000	0.1800	0.6300			(29a)					
Wall (upgrade)	48.0000	2.2400	45.7600	0.1800	8.2368			(29a)					
Wall (new)	43.0000	8.0300	34.9700	0.1800	6.2946			(29a)					
Roof	58.0000	1.1000	56.9000	0.1100	6.2590			(30)					
Roof (flat)	6.0000	2.1400	3.8600	0.1100	0.4246			(30)					
Total net area of external elements Aum(A, m2)			212.5000					(31)					
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	45.4918		(33)					
								(35)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K												100.0000 (35)	
Thermal bridges (User defined value 0.050 * total exposed area)												10.6250 (36)	
Point Thermal bridges												(36a) =	
Total fabric heat loss												(33) + (36) + (36a) =	56.1168 (37)
													(38)
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	28.1288	27.9361	27.7472	26.8599	26.6939	25.9212	25.9212	25.7781	26.2188	26.6939	27.0297	27.3808	(38)
Average = Sum(39)m / 12 =	84.2455	84.0528	83.8639	82.9767	82.8107	82.0380	82.0380	81.8949	82.3356	82.8107	83.1465	83.4976	(39)
													82.9759
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP (average)	1.5601	1.5565	1.5530	1.5366	1.5335	1.5192	1.5192	1.5166	1.5247	1.5335	1.5398	1.5463	(40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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

Assumed occupancy													1.8080 (42)	
Hot water usage for mixer showers												0.0000 (42a)		
Hot water usage for baths	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42b)	
Hot water usage for other uses	23.5745	23.2244	22.7314	21.8223	21.1416	20.3868	19.9791	20.4687	21.0018	21.8094	22.7372	23.4948	(42c)	
Average daily hot water use (litres/day)	33.1458	31.9405	30.7352	29.5299	28.3246	27.1193	27.1193	28.3246	29.5299	30.7352	31.9405	33.1458	(42c)	
													51.9898 (43)	
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Energy conte	56.7203	55.1649	53.4666	51.3522	49.4662	47.5061	47.0984	48.7933	50.5317	52.5446	54.6777	56.6406	(44)	
Energy content (annual)	89.8311	78.5541	82.1761	70.2986	66.5910	58.4143	56.9614	60.4163	62.3106	71.3025	77.8984	88.6855	(45)	
Distribution loss (46)m = 0.15 x (45)m													Total = Sum(45)m =	863.4398
Water storage loss:													0.0000 (46)	
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)	
If cylinder contains dedicated solar storage													0.0000 (47)	
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(47)	
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	(48)	
Total heat required for water heating calculated for each month	76.3564	66.7710	69.8497	59.7538	56.6023	49.6521	48.4172	51.3538	52.9640	60.6072	66.2136	75.3827	(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)	

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Output from w/h	76.3564	66.7710	69.8497	59.7538	56.6023	49.6521	48.4172	51.3538	52.9640	60.6072	66.2136	75.3827 (64)
12Total per year (kWh/year)	Total per year (kWh/year) = Sum(64)m =											733.9239 (64)
Electric shower(s)	43.6725	38.9125	42.4910	40.5486	41.3095	39.4053	40.7188	41.3095	40.5486	42.4910	41.6920	43.6725 (64a)
	Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =											496.7719 (64a)
Heat gains from water heating, kWh/month	30.0072	26.4209	28.0852	25.0756	24.4780	22.2644	22.2840	23.1658	23.3782	25.7745	26.9764	29.7638 (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	90.4002	90.4002	90.4002	90.4002	90.4002	90.4002	90.4002	90.4002	90.4002	90.4002	90.4002	90.4002 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	79.4808	87.9966	79.4808	82.1301	79.4808	82.1301	79.4808	79.4808	82.1301	79.4808	82.1301	79.4808 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	157.6049	159.2403	155.1190	146.3453	135.2701	124.8610	117.9070	116.2716	120.3929	129.1666	140.2418	150.6509 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.0400	32.0400	32.0400	32.0400	32.0400	32.0400	32.0400	32.0400	32.0400	32.0400	32.0400	32.0400 (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)	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201 (71)
Water heating gains (Table 5)	40.3323	39.3168	37.7489	34.8272	32.9005	30.9227	29.9516	31.1369	32.4697	34.6432	37.4672	40.0051 (72)
Total internal gains	327.5380	336.6737	322.4687	313.4227	297.7714	288.0339	277.4595	277.0093	285.1127	293.4106	309.9592	320.2568 (73)

## 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W						
North	3.4900	10.6334	0.6300	0.7000	0.7700	11.3415 (74)						
East	0.9800	19.6403	0.6300	0.7000	0.7700	5.8823 (76)						
South	3.3100	46.7521	0.6300	0.7000	0.7700	47.2934 (78)						
West	0.4900	19.6403	0.6300	0.7000	0.7700	2.9411 (80)						
North	0.5500	16.7973	0.6300	0.7000	1.0000	3.6668 (82)						
East	2.1400	26.0000	0.6300	0.7000	1.0000	22.0835 (82)						
South	0.5500	42.0754	0.6300	0.7000	1.0000	9.1848 (82)						
Solar gains	102.3934	186.2493	284.4754	399.2270	487.7133	501.4540	476.3110	408.0315	324.0547	214.0107	124.8426	86.1810 (83)
Total gains	429.9314	522.9230	606.9441	712.6498	785.4847	789.4878	753.7704	685.0408	609.1674	507.4212	434.8018	406.4378 (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	17.8051	17.8459	17.8861	18.0774	18.1136	18.2842	18.2842	18.3162	18.2181	18.1136	18.0404	17.9646
alpha	2.1870	2.1897	2.1924	2.2052	2.2076	2.2189	2.2189	2.2211	2.2145	2.2076	2.2027	2.1976
util living area	0.9468	0.9196	0.8775	0.7956	0.6814	0.5418	0.4252	0.4732	0.6646	0.8436	0.9243	0.9524 (86)
MIT	17.6941	18.1124	18.7354	19.5445	20.2170	20.6742	20.8644	20.8238	20.4542	19.5560	18.4919	17.6275 (87)
Th 2	19.6427	19.6454	19.6480	19.6602	19.6624	19.6731	19.6731	19.6751	19.6690	19.6624	19.6578	19.6530 (88)
util rest of house	0.9380	0.9067	0.8574	0.7614	0.6262	0.4582	0.3143	0.3603	0.5870	0.8091	0.9098	0.9445 (89)
MIT 2	16.7024	17.1123	17.7186	18.4937	19.1042	19.4907	19.6222	19.6035	19.3316	18.5294	17.5001	16.6433 (90)
Living area fraction	fLA = Living area / (4) =											0.2593 (91)
MIT	16.9595	17.3716	17.9822	18.7662	19.3927	19.7976	19.9442	19.9198	19.6226	18.7955	17.7572	16.8985 (92)
Temperature adjustment												0.0000
adjusted MIT	16.9595	17.3716	17.9822	18.7662	19.3927	19.7976	19.9442	19.9198	19.6226	18.7955	17.7572	16.8985 (93)

## 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9134	0.8774	0.8257	0.7342	0.6137	0.4667	0.3384	0.3828	0.5839	0.7811	0.8818	0.9214 (94)
Useful gains	392.6866	458.7940	501.1301	523.2416	482.0751	368.4316	255.0811	262.2430	355.7041	396.3282	383.3897	374.4778 (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	1066.5054	1048.2716	962.9408	818.6620	637.0395	426.3975	274.3538	288.2574	454.7102	678.6776	886.1094	1060.2949 (97)
Space heating kWh	501.3212	396.1289	343.5872	212.7027	115.2935	0.0000	0.0000	0.0000	0.0000	210.0680	361.9582	510.2479 (98a)
Space heating requirement - total per year (kWh/year)												2651.3076
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	501.3212	396.1289	343.5872	212.7027	115.2935	0.0000	0.0000	0.0000	0.0000	210.0680	361.9582	510.2479 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2651.3076
Space heating per m2												(98c) / (4) = 49.0983 (99)

## 8c. Space cooling requirement

Calculated for June, July and August. See Table 10b												
Ext. temp.	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	771.1568	607.0809	622.4009	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7228	0.7829	0.7477	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	557.3756	475.2925	465.3534	0.0000	0.0000	0.0000	0.0000 (102)

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Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	851.5709	813.8276	742.0557	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	211.8206	251.8701	205.8665	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	1.0000 (105)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	52.9552	62.9675	51.4666	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												167.3893 (107)
Energy for space heating												49.0983 (99)
Energy for space cooling												3.0998 (108)
Total												52.1981 (109)
Fabric Energy Efficiency (TFEE)												52.2 (109)

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

1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	54.0000 (1b)	x 2.6000 (2b)	= 140.4000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	54.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 140.4000 (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	3 * 10 = 30.0000 (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)	30.0000 / (5) = 0.2137 (8)
Pressure test	No
Pressure Test Method	Blower Door
Measured/design AP50	15.0000 (17)
Infiltration rate	0.9637 (18)
Number of sides sheltered	1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.8914 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate												
Effective ac	1.1365	1.1142	1.0920	0.9805	0.9583	0.8468	0.8468	0.8245	0.8914	0.9583	1.0028	1.0474 (22b)
	1.1365	1.1142	1.0920	0.9807	0.9591	0.8586	0.8586	0.8399	0.8973	0.9591	1.0028	1.0474 (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					
Doors			2.0000	1.4000	2.8000		(26)					
Windows (Uw = 1.40)			13.5000	1.3258	17.8977		(27)					
Rooflights (N)			0.9000	1.3258	1.1932		(27a)					
Rooflights (S)			0.9000	1.3258	1.1932		(27a)					
Roof Glazing			3.5000	1.3258	4.6402		(27a)					
Floor			54.0000	0.2500	13.5000		(28a)					
Wall (uninsulated)	3.5000		3.5000	2.5000	8.7500		(29a)					
Wall (upgrade)	48.0000	3.6500	44.3500	0.3000	13.3050		(29a)					
Wall (new)	43.0000	11.8500	31.1500	0.1800	5.6070		(29a)					
Roof	58.0000	1.8000	56.2000	0.1500	8.4300		(30)					
Roof (flat)	6.0000	3.5000	2.5000	0.1500	0.3750		(30)					
Total net area of external elements Aum(A, m2)			212.5000				(31)					
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	77.6912	(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000 (35)					
Thermal bridges (Default value 0.200 * total exposed area)							42.5000 (36)					
Point Thermal bridges						(36a) =	0.0000					
Total fabric heat loss						(33) + (36) + (36a) =	120.1912 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 52.6579	Feb 51.6254	Mar 50.5929	Apr 45.4391	May 44.4382	Jun 39.7788	Jul 39.7788	Aug 38.9160	Sep 41.5735	Oct 44.4382	Nov 46.4629	Dec 48.5279 (38)
Heat transfer coeff	172.8492	171.8166	170.7841	165.6304	164.6295	159.9701	159.9701	159.1072	161.7648	164.6295	166.6541	168.7191 (39)
Average = Sum(39)m / 12 =												165.5437
HLP	Jan 3.2009	Feb 3.1818	Mar 3.1627	Apr 3.0672	May 3.0487	Jun 2.9624	Jul 2.9624	Aug 2.9464	Sep 2.9956	Oct 3.0487	Nov 3.0862	Dec 3.1244 (40)
HLP (average)												3.0656
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31



# Full SAP Calculation Printout



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

-----													
Assumed occupancy													
											1.8080 (42)		
Hot water usage for mixer showers												67.9061 (42a)	
68.1672	67.1428	65.6500	62.7939	60.6861	58.3355	56.9994	58.4809	60.1049	62.6287	65.5462	67.9061	(42a)	
Hot water usage for baths												23.4948 (42b)	
23.5745	23.2244	22.7314	21.8223	21.1416	20.3868	19.9791	20.4687	21.0018	21.8094	22.7372	23.4948	(42b)	
Hot water usage for other uses												33.1458 (42c)	
33.1458	31.9405	30.7352	29.5299	28.3246	27.1193	27.1193	28.3246	29.5299	30.7352	31.9405	33.1458	(42c)	
Average daily hot water use (litres/day)												114.8377 (43)	
-----													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	124.8875	122.3077	119.1166	114.1460	110.1523	105.8416	104.0978	107.2742	110.6366	115.1733	120.2239	124.5467	(44)
Energy content	197.7913	174.1645	183.0778	156.2602	148.2861	130.1446	125.8973	132.8279	136.4259	156.2891	171.2810	195.0100	(45)
Energy content (annual)												Total = Sum(45)m = 1907.4558	
Distribution loss (46)m = 0.15 x (45)m													
29.6687	26.1247	27.4617	23.4390	22.2429	19.5217	18.8846	19.9242	20.4639	23.4434	25.6922	29.2515	(46)	
Water storage loss:													
Store volume												210.0000 (47)	
a) If manufacturer declared loss factor is known (kWh/day):												2.0000 (48)	
Temperature factor from Table 2b												0.5400 (49)	
Enter (49) or (54) in (55)												1.0800 (55)	
Total storage loss													
33.4800	30.2400	33.4800	32.4000	33.4800	32.4000	33.4800	33.4800	33.4800	32.4000	33.4800	32.4000	33.4800	(56)
If cylinder contains dedicated solar storage													
33.4800	30.2400	33.4800	32.4000	33.4800	32.4000	33.4800	33.4800	33.4800	32.4000	33.4800	32.4000	33.4800	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
254.5337	225.4157	239.8202	211.1722	205.0285	185.0566	182.6397	189.5703	191.3379	213.0315	226.1930	251.7524	(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	254.5337	225.4157	239.8202	211.1722	205.0285	185.0566	182.6397	189.5703	191.3379	213.0315	226.1930	251.7524	(64)
											Total per year (kWh/year) = Sum(64)m = 2575.5518 (64)		
Electric shower(s)													
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
											Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 0.0000 (64a)		
Heat gains from water heating, kWh/month	111.1595	98.9107	106.2673	95.8861	94.6991	87.2027	87.2548	89.5592	89.2912	97.3600	100.8805	110.2347	(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	
108.4802	108.4802	108.4802	108.4802	108.4802	108.4802	108.4802	108.4802	108.4802	108.4802	108.4802	108.4802	108.4802	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	19.3076	17.1488	13.9464	10.5583	7.8924	6.6631	7.1998	9.3585	12.5610	15.9490	18.6149	19.8442	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	235.2311	237.6721	231.5209	218.4259	201.8957	186.3597	175.9807	173.5397	179.6908	192.7859	209.3161	224.8521	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560	(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)	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	(71)
Water heating gains (Table 5)	149.4080	147.1885	142.8324	133.1752	127.2837	121.1148	117.2779	120.3753	124.0156	130.8603	140.1119	148.1650	(72)
Total internal gains	487.7628	485.8255	472.1157	445.9754	420.8879	397.9537	384.2744	387.0895	400.0835	423.4113	451.8589	476.6774	(73)

## 6. Solar gains

[Jan]	Area	Solar flux	g	FF	Access	Gains							
	m <sup>2</sup>	Table 6a	Specific data	Specific data	factor	W							
		W/m <sup>2</sup>	or Table 6b	or Table 6c	Table 6d								
North	5.7000	10.6334	0.6300	0.7000	0.7700	18.5233 (74)							
East	1.6000	19.6403	0.6300	0.7000	0.7700	9.6037 (76)							
South	5.4000	46.7521	0.6300	0.7000	0.7700	77.1554 (78)							
West	0.8000	19.6403	0.6300	0.7000	0.7700	4.8019 (80)							
North	0.9000	16.7973	0.6300	0.8000	1.0000	6.8573 (82)							
East	3.5000	26.0000	0.6300	0.8000	1.0000	41.2776 (82)							
South	0.9000	42.0754	0.6300	0.8000	1.0000	17.1768 (82)							
-----													
Solar gains	175.3961	320.5434	492.8998	696.0049	853.2468	878.3639	833.8983	712.5429	562.9860	369.2554	214.1358	147.4344	(83)
Total gains	663.1588	806.3689	965.0155	1141.9803	1274.1347	1276.3176	1218.1727	1099.6324	963.0695	792.6667	665.9947	624.1117	(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	8.6781	8.7302	8.7830	9.0563	9.1114	9.3768	9.3768	9.4276	9.2727	9.1114	9.0007	8.8905	
alpha	1.5785	1.5820	1.5855	1.6038	1.6074	1.6251	1.6251	1.6285	1.6182	1.6074	1.6000	1.5927	
util living area	0.9227	0.8949	0.8499	0.7730	0.6718	0.5497	0.4467	0.4910	0.6628	0.8201	0.8991	0.9286	(86)
MIT	17.1845	17.5372	18.1484	18.9696	19.7006	20.2749	20.5496	20.4940	20.0177	19.0599	17.9995	17.1512	(87)
Th 2	18.6529	18.6619	18.6709	18.7168	18.7259	18.7689	18.7689	18.7770	18.7522	18.7259	18.7075	18.6891	(88)
util rest of house	0.9056	0.8719	0.8160	0.7192	0.5864	0.4163	0.2573	0.3017	0.5405	0.7640	0.8730	0.9128	(89)
MIT 2	15.4670	15.8137	16.4074	17.2085	17.8662	18.3594	18.5320	18.5181	18.1822	17.3320	16.3053	15.4582	(90)
Living area fraction												fLA = Living area / (4) = 0.2593 (91)	

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MIT	15.9123	16.2605	16.8588	17.6651	18.3417	18.8560	19.0551	19.0304	18.6581	17.7800	16.7445	15.8971 (92)
Temperature adjustment												0.0000
adjusted MIT	15.9123	16.2605	16.8588	17.6651	18.3417	18.8560	19.0551	19.0304	18.6581	17.7800	16.7445	15.8971 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.8763	0.8386	0.7803	0.6875	0.5688	0.4225	0.2858	0.3275	0.5341	0.7322	0.8409	0.8849 (94)
Useful gains	581.1351	676.2206	752.9963	785.1436	724.6705	539.2262	348.1734	360.1470	514.3430	580.4300	560.0159	552.2706 (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	2007.1681	1951.9248	1769.1164	1451.7681	1093.4277	680.8295	392.7389	418.5150	737.3408	1182.0314	1607.3001	1973.5222 (97)
Space heating kWh	1060.9686	857.2733	755.9933	479.9696	274.3553	0.0000	0.0000	0.0000	0.0000	447.5915	754.0447	1057.4112 (98a)
Space heating requirement - total per year (kWh/year)												5687.6075
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	1060.9686	857.2733	755.9933	479.9696	274.3553	0.0000	0.0000	0.0000	0.0000	447.5915	754.0447	1057.4112 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												5687.6075
Space heating per m2										(98c) / (4) =		105.3261 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												219.3000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement	1060.9686	857.2733	755.9933	479.9696	274.3553	0.0000	0.0000	0.0000	0.0000	447.5915	754.0447	1057.4112 (98)
Space heating efficiency (main heating system 1)	219.3000	219.3000	219.3000	219.3000	219.3000	0.0000	0.0000	0.0000	0.0000	219.3000	219.3000	219.3000 (210)
Space heating fuel (main heating system)	483.7978	390.9135	344.7302	218.8644	125.1050	0.0000	0.0000	0.0000	0.0000	204.1001	343.8416	482.1756 (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	254.5337	225.4157	239.8202	211.1722	205.0285	185.0566	182.6397	189.5703	191.3379	213.0315	226.1930	251.7524 (64)
Efficiency of water heater	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000 (216)
Fuel for water heating, kWh/month	133.6837	118.3906	125.9560	110.9098	107.6830	97.1936	95.9242	99.5642	100.4926	111.8863	118.7989	132.2229 (219)
Space cooling fuel requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (231)
Lighting	16.8998	13.5577	12.2072	8.9435	6.9082	5.6441	6.3019	8.1914	10.6399	13.9601	15.7679	17.3695 (232)
Electricity generated by PVs (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)
Annual totals kWh/year												
Space heating fuel - main system 1												2593.5283 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												190.4000
Water heating fuel used												1352.7058 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
Total electricity for the above, kWh/year												0.0000 (231)
Electricity for lighting (calculated in Appendix L)												136.3911 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												0.0000 (233)
Wind generation												0.0000 (234)
Hydro-electric generation (Appendix N)												0.0000 (235a)
Electricity generated - Micro CHP (Appendix N)												0.0000 (235)
Appendix Q - special features												
Energy saved or generated												-0.0000 (236)
Energy used												0.0000 (237)
Total delivered energy for all uses												4082.6252 (238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	2593.5283	16.4900	427.6728 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1352.7058	16.4900	223.0612 (247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000 (247a)

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Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (249)
Energy for lighting	136.3911	16.4900	22.4909 (250)
Additional standing charges			0.0000 (251)
Total energy cost			673.2249 (255)

## 11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600 (256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	2.4481 (257)
SAP value		60.3165
SAP rating (Section 12)		60 (258)
SAP band		D

## 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	2593.5283	0.1543	400.2327 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1352.7058	0.1408	190.5081 (264)
Space and water heating			590.7408 (265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (267)
Energy for lighting	136.3911	0.1443	19.6855 (268)
Total CO2, kg/year			610.4262 (272)
CO2 emissions per m2			11.3000 (273)
EI value			91.7377
EI rating			92 (274)
EI band			A

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

### 1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	54.0000 (1b)	x 2.6000 (2b)	= 140.4000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	54.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	140.4000 (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	3 * 10 =	30.0000 (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) =	30.0000 / (5) =	0.2137 (8)
Pressure test		No
Pressure Test Method		Blower Door
Measured/design AP50		15.0000 (17)
Infiltration rate		0.9637 (18)
Number of sides sheltered		1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.8914 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.7000	4.4000	4.5000	4.2000	4.2000	3.9000	3.9000	3.7000	3.7000	4.0000	4.0000	4.3000 (22)
Wind factor	1.1750	1.1000	1.1250	1.0500	1.0500	0.9750	0.9750	0.9250	0.9250	1.0000	1.0000	1.0750 (22a)
Adj infilt rate	1.0474	0.9805	1.0028	0.9360	0.9360	0.8691	0.8691	0.8245	0.8245	0.8914	0.8914	0.9583 (22b)
Effective ac	1.0474	0.9807	1.0028	0.9380	0.9380	0.8777	0.8777	0.8399	0.8399	0.8973	0.8973	0.9591 (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
Doors			2.0000	1.4000	2.8000		(26)
Windows (Uw = 1.40)			13.5000	1.3258	17.8977		(27)
Rooflights (N)			0.9000	1.3258	1.1932		(27a)
Rooflights (S)			0.9000	1.3258	1.1932		(27a)
Roof Glazing			3.5000	1.3258	4.6402		(27a)
Floor			54.0000	0.2500	13.5000		(28a)
Wall (uninsulated)	3.5000		3.5000	2.5000	8.7500		(29a)
Wall (upgrade)	48.0000	3.6500	44.3500	0.3000	13.3050		(29a)

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Wall (new)	43.0000	11.8500	31.1500	0.1800	5.6070		(29a)
Roof	58.0000	1.8000	56.2000	0.1500	8.4300		(30)
Roof (flat)	6.0000	3.5000	2.5000	0.1500	0.3750		(30)
Total net area of external elements Aum(A, m2)			212.5000				(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		77.6912		(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000 (35)
Thermal bridges (Default value 0.200 * total exposed area)							42.5000 (36)
Point Thermal bridges							0.0000 (36a) =
Total fabric heat loss							(33) + (36) + (36a) = 120.1912 (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	48.5279	45.4391	46.4629	43.4603	43.4603	40.6647	40.6647	38.9160	38.9160	41.5735	41.5735	44.4382 (38)
Average = Sum(39)m / 12 =	168.7191	165.6304	166.6541	163.6516	163.6516	160.8559	160.8559	159.1072	159.1072	161.7648	161.7648	164.6295 (39)

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	3.1244	3.0672	3.0862	3.0306	3.0306	2.9788	2.9788	2.9464	2.9464	2.9956	2.9956	3.0487 (40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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

Assumed occupancy													1.8080 (42)
Hot water usage for mixer showers	68.1672	67.1428	65.6500	62.7939	60.6861	58.3355	56.9994	58.4809	60.1049	62.6287	65.5462	67.9061 (42a)	
Hot water usage for baths	23.5745	23.2244	22.7314	21.8223	21.1416	20.3868	19.9791	20.4687	21.0018	21.8094	22.7372	23.4948 (42b)	
Hot water usage for other uses	33.1458	31.9405	30.7352	29.5299	28.3246	27.1193	27.1193	28.3246	29.5299	30.7352	31.9405	33.1458 (42c)	
Average daily hot water use (litres/day)													114.8377 (43)
Daily hot water use	124.8875	122.3077	119.1166	114.1460	110.1523	105.8416	104.0978	107.2742	110.6366	115.1733	120.2239	124.5467 (44)	
Energy conte	197.7913	174.1645	183.0778	156.2602	148.2861	130.1446	125.8973	132.8279	136.4259	156.2891	171.2810	195.0100 (45)	
Energy content (annual)													Total = Sum(45)m = 1907.4558
Distribution loss (46)m = 0.15 x (45)m	29.6687	26.1247	27.4617	23.4390	22.2429	19.5217	18.8846	19.9242	20.4639	23.4434	25.6922	29.2515 (46)	
Water storage loss:													210.0000 (47)
Store volume													2.0000 (48)
a) If manufacturer declared loss factor is known (kWh/day):													0.5400 (49)
Temperature factor from Table 2b													1.0800 (55)
Enter (49) or (54) in (55)													
Total storage loss	33.4800	30.2400	33.4800	32.4000	33.4800	32.4000	33.4800	33.4800	32.4000	33.4800	32.4000	33.4800 (56)	
If cylinder contains dedicated solar storage	33.4800	30.2400	33.4800	32.4000	33.4800	32.4000	33.4800	33.4800	32.4000	33.4800	32.4000	33.4800 (57)	
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)	
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)	
Total heat required for water heating calculated for each month	254.5337	225.4157	239.8202	211.1722	205.0285	185.0566	182.6397	189.5703	191.3379	213.0315	226.1930	251.7524 (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	254.5337	225.4157	239.8202	211.1722	205.0285	185.0566	182.6397	189.5703	191.3379	213.0315	226.1930	251.7524 (64)	
Total per year (kWh/year) = Sum(64)m =													2575.5518 (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	111.1595	98.9107	106.2673	95.8861	94.6991	87.2027	87.2548	89.5592	89.2912	97.3600	100.8805	110.2347 (65)	

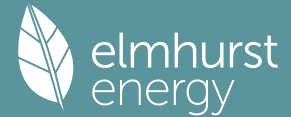
## 5. Internal gains (see Table 5 and 5a)

Metabolic gains (Table 5), Watts												
(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	19.3076	17.1488	13.9464	10.5583	7.8924	6.6631	7.1998	9.3585	12.5610	15.9490	18.6149	19.8442 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	235.2311	237.6721	231.5209	218.4259	201.8957	186.3597	175.9807	173.5397	179.6908	192.7859	209.3161	224.8521 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560 (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)	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201 (71)
Water heating gains (Table 5)	149.4080	147.1885	142.8324	133.1752	127.2837	121.1148	117.2779	120.3753	124.0156	130.8603	140.1119	148.1650 (72)
Total internal gains	487.7628	485.8255	472.1157	445.9754	420.8879	397.9537	384.2744	387.0895	400.0835	423.4113	451.8589	476.6774 (73)

## 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b g	Specific data or Table 6c FF	Access factor Table 6d	Gains W
North	5.7000	12.7350	0.6300	0.7000	0.7700	22.1843 (74)
East	1.6000	23.7652	0.6300	0.7000	0.7700	11.6207 (76)
South	5.4000	53.8987	0.6300	0.7000	0.7700	88.9496 (78)
West	0.8000	23.7652	0.6300	0.7000	0.7700	5.8104 (80)
North	0.9000	20.0333	0.6300	0.8000	1.0000	8.1784 (82)
East	3.5000	32.0000	0.6300	0.8000	1.0000	50.8032 (82)
South	0.9000	50.0836	0.6300	0.8000	1.0000	20.4461 (82)

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Solar gains	207.9927	339.0362	526.6271	773.9077	891.7373	1005.7867	917.2940	799.7287	633.9352	407.4715	250.3801	168.9394 (83)
Total gains	695.7555	824.8617	998.7428	1219.8831	1312.6252	1403.7404	1301.5684	1186.8183	1034.0187	830.8828	702.2390	645.6168 (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	8.8905	9.0563	9.0007	9.1658	9.1658	9.3251	9.3251	9.4276	9.4276	9.2727	9.2727	9.1114
alpha	1.5927	1.6038	1.6000	1.6111	1.6111	1.6217	1.6217	1.6285	1.6285	1.6182	1.6182	1.6074
util living area	0.9124	0.8850	0.8346	0.7463	0.6487	0.5005	0.4211	0.4463	0.6243	0.7972	0.8815	0.9192 (86)
MIT	17.4331	17.7625	18.3574	19.1484	19.8125	20.3771	20.5775	20.5577	20.1332	19.2441	18.3032	17.4397 (87)
Th 2	18.6891	18.7168	18.7075	18.7348	18.7348	18.7606	18.7606	18.7770	18.7770	18.7522	18.7522	18.7259 (88)
util rest of house	0.8928	0.8599	0.7973	0.6874	0.5576	0.3606	0.2334	0.2525	0.4947	0.7338	0.8502	0.9009 (89)
MIT 2	15.7338	16.0684	16.6305	17.3803	17.9650	18.4137	18.5335	18.5447	18.2831	17.5177	16.6284	15.7659 (90)
Living area fraction	fLA = Living area / (4) =											0.2593 (91)
MIT	16.1744	16.5076	17.0782	17.8387	18.4440	18.9227	19.0634	19.0666	18.7628	17.9653	17.0626	16.1998 (92)
Temperature adjustment												0.0000
adjusted MIT	16.1744	16.5076	17.0782	17.8387	18.4440	18.9227	19.0634	19.0666	18.7628	17.9653	17.0626	16.1998 (93)

## 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.8620	0.8261	0.7619	0.6582	0.5435	0.3724	0.2628	0.2822	0.4937	0.7041	0.8170	0.8714 (94)
Useful gains	599.7565	681.3956	760.9567	802.9741	713.3796	522.7053	342.0802	334.8608	510.4924	585.0047	573.7345	562.5714 (95)
Ext temp.	4.9000	5.4000	7.0000	9.3000	12.1000	15.0000	16.7000	16.7000	14.4000	11.1000	7.9000	5.0000 (96)
Heat loss rate W	1902.2060	1839.7595	1679.5722	1397.3708	1038.2013	630.9955	380.1670	376.5394	694.1507	1110.5688	1482.1813	1843.8220 (97)
Space heating kWh	969.0224	778.4206	683.4500	427.9657	241.6673	0.0000	0.0000	0.0000	0.0000	391.0198	654.0817	953.2505 (98a)
Space heating requirement - total per year (kWh/year)												5098.8778
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	969.0224	778.4206	683.4500	427.9657	241.6673	0.0000	0.0000	0.0000	0.0000	391.0198	654.0817	953.2505 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												5098.8778
Space heating per m2												(98c) / (4) = 94.4237 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												219.3000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	969.0224	778.4206	683.4500	427.9657	241.6673	0.0000	0.0000	0.0000	0.0000	391.0198	654.0817	953.2505 (98)
Space heating efficiency (main heating system 1)	219.3000	219.3000	219.3000	219.3000	219.3000	0.0000	0.0000	0.0000	0.0000	219.3000	219.3000	219.3000 (210)
Space heating fuel (main heating system)	441.8707	354.9569	311.6507	195.1508	110.1994	0.0000	0.0000	0.0000	0.0000	178.3036	298.2589	434.6787 (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	254.5337	225.4157	239.8202	211.1722	205.0285	185.0566	182.6397	189.5703	191.3379	213.0315	226.1930	251.7524 (64)
Efficiency of water heater	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000 (216)
Fuel for water heating, kWh/month	133.6837	118.3906	125.9560	110.9098	107.6830	97.1936	95.9242	99.5642	100.4926	111.8863	118.7989	132.2229 (219)
Space cooling fuel requirement												
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (231)
Lighting	16.8998	13.5577	12.2072	8.9435	6.9082	5.6441	6.3019	8.1914	10.6399	13.9601	15.7679	17.3695 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)												
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)												
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)
Annual totals kWh/year												
Space heating fuel - main system 1												2325.0697 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												190.4000
Water heating fuel used												1352.7058 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
Total electricity for the above, kWh/year												0.0000 (231)
Electricity for lighting (calculated in Appendix L)												136.3911 (232)

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

PV generation	0.0000	(233)
Wind generation	0.0000	(234)
Hydro-electric generation (Appendix N)	0.0000	(235a)
Electricity generated - Micro CHP (Appendix N)	0.0000	(235)
Appendix Q - special features		
Energy saved or generated	-0.0000	(236)
Energy used	0.0000	(237)
Total delivered energy for all uses	3814.1666	(238)

## 10a. Fuel costs - using BEDF prices (538)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	2325.0697	25.1600	584.9875 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1352.7058	25.1600	340.3408 (247)
Energy for instantaneous electric shower(s)	0.0000	25.1600	0.0000 (247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (249)
Energy for lighting	136.3911	25.1600	34.3160 (250)
Additional standing charges			0.0000 (251)
Total energy cost			959.6443 (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	2325.0697	0.1544	359.0925 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1352.7058	0.1408	190.5081 (264)
Space and water heating			549.6005 (265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (267)
Energy for lighting	136.3911	0.1443	19.6855 (268)
Total CO2, kg/year			569.2860 (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	2325.0697	1.5718	3654.5193 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1352.7058	1.5208	2057.1314 (278)
Space and water heating			5711.6507 (279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (281)
Energy for lighting	136.3911	1.5338	209.2012 (282)
Total Primary energy kWh/year			5920.8520 (286)

## SAP 10 EPC IMPROVEMENTS

CB5601

Current energy efficiency rating: D 60  
Current environmental impact rating: A 92

N Solar water heating		Recommended
U Solar photovoltaic panels		Recommended
V2 Wind turbine		Recommended

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 2.7	-£ 81	-40 kg (7.0%)
U Solar photovoltaic panels	+ 8.0	-£ 218	-118 kg (22.3%)
V2 Wind turbine	+ 24.1	-£ 620	-343 kg (83.4%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£81	0.74 kg/m <sup>2</sup>	D 63 A 92
Solar photovoltaic panels	£218	2.19 kg/m <sup>2</sup>	C 71 A 94
Wind turbine	£620	6.35 kg/m <sup>2</sup>	A 95 A 98
<b>Total Savings</b>	<b>£919</b>	<b>9.28 kg/m<sup>2</sup></b>	

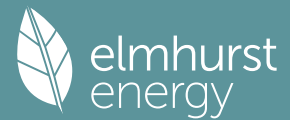
Potential energy efficiency rating: A 95  
Potential environmental impact rating: A 98

Fuel prices for cost data on this page from database revision number 538 TEST (29 Feb 2024)  
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	£960	£879	£81
Space heating	£585	£606	-£21
Water heating	£340	£239	£101
Lighting	£34	£34	£0
Generated (PV)	-£0	-£218	£218
Generated (wind)	-£0	-£620	£620
<b>Total cost of fuels</b>	<b>£960</b>	<b>£41</b>	<b>£919</b>
<b>Total cost of uses</b>	<b>£959</b>	<b>£41</b>	<b>£918</b>
Delivered energy	71 kWh/m <sup>2</sup>	3 kWh/m <sup>2</sup>	68 kWh/m <sup>2</sup>
Carbon dioxide emissions	0.6 tonnes	0.1 tonnes	0.5 tonnes
CO2 emissions per m <sup>2</sup>	11 kg/m <sup>2</sup>	1 kg/m <sup>2</sup>	9 kg/m <sup>2</sup>
Primary energy	110 kWh/m <sup>2</sup>	8 kWh/m <sup>2</sup>	102 kWh/m <sup>2</sup>

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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	54.0000 (1b)	x 2.6000 (2b)	= 140.4000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	54.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 140.4000 (5)

## 2. Ventilation rate

		Air changes per hour
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	3 * 10 =	30.0000 (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) =	30.0000 / (5) =	0.2137 (8)
Pressure test		No
Pressure Test Method		Blower Door
Measured/design AP50		15.0000 (17)
Infiltration rate		0.9637 (18)
Number of sides sheltered		1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.8914 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate												
Effective ac	1.1365	1.1142	1.0920	0.9805	0.9583	0.8468	0.8468	0.8245	0.8914	0.9583	1.0028	1.0474 (22b)
	1.1365	1.1142	1.0920	0.9807	0.9591	0.8586	0.8586	0.8399	0.8973	0.9591	1.0028	1.0474 (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
Doors			2.0000	1.4000	2.8000		(26)
Windows (Uw = 1.40)			13.5000	1.3258	17.8977		(27)
Rooflights (N)			0.9000	1.3258	1.1932		(27a)
Rooflights (S)			0.9000	1.3258	1.1932		(27a)
Roof Glazing			3.5000	1.3258	4.6402		(27a)
Floor			54.0000	0.2500	13.5000		(28a)
Wall (uninsulated)	3.5000		3.5000	2.5000	8.7500		(29a)
Wall (upgrade)	48.0000	3.6500	44.3500	0.3000	13.3050		(29a)
Wall (new)	43.0000	11.8500	31.1500	0.1800	5.6070		(29a)
Roof	58.0000	1.8000	56.2000	0.1500	8.4300		(30)
Roof (flat)	6.0000	3.5000	2.5000	0.1500	0.3750		(30)
Total net area of external elements Aum(A, m <sup>2</sup> )			212.5000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	77.6912	(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							100.0000 (35)
Thermal bridges (Default value 0.200 * total exposed area)							42.5000 (36)
Point Thermal bridges						(36a) =	0.0000
Total fabric heat loss						(33) + (36) + (36a) =	120.1912 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	52.6579	51.6254	50.5929	45.4391	44.4382	39.7788	39.7788	38.9160	41.5735	44.4382	46.4629	48.5279 (38)
Heat transfer coeff	172.8492	171.8166	170.7841	165.6304	164.6295	159.9701	159.9701	159.1072	161.7648	164.6295	166.6541	168.7191 (39)
Average = Sum(39)m / 12 =												165.5437
HLP	3.2009	3.1818	3.1627	3.0672	3.0487	2.9624	2.9624	2.9464	2.9956	3.0487	3.0862	3.1244 (40)
HLP (average)												3.0656
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												1.8080 (42)
Hot water usage for mixer showers	68.1672	67.1428	65.6500	62.7939	60.6861	58.3355	56.9994	58.4809	60.1049	62.6287	65.5462	67.9061 (42a)
Hot water usage for baths	23.5745	23.2244	22.7314	21.8223	21.1416	20.3868	19.9791	20.4687	21.0018	21.8094	22.7372	23.4948 (42b)

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Hot water usage for other uses	33.1458	31.9405	30.7352	29.5299	28.3246	27.1193	27.1193	28.3246	29.5299	30.7352	31.9405	33.1458 (42c)
Average daily hot water use (litres/day)												114.8377 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	124.8875	122.3077	119.1166	114.1460	110.1523	105.8416	104.0978	107.2742	110.6366	115.1733	120.2239	124.5467 (44)
Energy content (annual)	197.7913	174.1645	183.0778	156.2602	148.2861	130.1446	125.8973	132.8279	136.4259	156.2891	171.2810	195.0100 (45)
Distribution loss (46)m = 0.15 x (45)m												Total = Sum(45)m = 1907.4558
	29.6687	26.1247	27.4617	23.4390	22.2429	19.5217	18.8846	19.9242	20.4639	23.4434	25.6922	29.2515 (46)
Water storage loss:												210.0000 (47)
Store volume												2.0000 (48)
a) If manufacturer declared loss factor is known (kWh/day):												0.5400 (49)
Temperature factor from Table 2b												1.0800 (55)
Enter (49) or (54) in (55)												
Total storage loss	33.4800	30.2400	33.4800	32.4000	33.4800	32.4000	33.4800	33.4800	32.4000	33.4800	32.4000	33.4800 (56)
If cylinder contains dedicated solar storage	33.4800	30.2400	33.4800	32.4000	33.4800	32.4000	33.4800	33.4800	32.4000	33.4800	32.4000	33.4800 (57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624 (59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
Total heat required for water heating calculated for each month	254.5337	225.4157	238.4244	204.4186	192.2342	172.4499	169.6128	177.4738	185.9351	211.6358	226.1930	251.7524 (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												614.0409 (H24)
Heat delivered to space heating												0.0000 (H29)
Solar input												614.0409
Solar input	-0.0000	-16.2232	-57.9097	-79.2573	-103.0121	-94.9271	-94.2167	-82.6036	-57.2757	-28.6155	-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	254.5337	209.1925	180.5147	125.1613	89.2221	77.5228	75.3961	94.8702	128.6594	183.0202	226.1930	251.7524 (64)
												Total per year (kWh/year) = Sum(64)m = 1896.0385 (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	111.1595	98.9107	105.1507	90.4832	84.4636	77.1173	76.8332	79.8820	84.9689	96.2434	100.8805	110.2347 (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	108.4802	108.4802	108.4802	108.4802	108.4802	108.4802	108.4802	108.4802	108.4802	108.4802	108.4802	108.4802 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	19.3076	17.1488	13.9464	10.5583	7.8924	6.6631	7.1998	9.3585	12.5610	15.9490	18.6149	19.8442 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	235.2311	237.6721	231.5209	218.4259	201.8957	186.3597	175.9807	173.5397	179.6908	192.7859	209.3161	224.8521 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560 (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)	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201 (71)
Water heating gains (Table 5)	149.4080	147.1885	141.3316	125.6712	113.5263	107.1074	103.2705	107.3683	118.0124	129.3595	140.1119	148.1650 (72)
Total internal gains	487.7628	485.8255	470.6149	438.4714	407.1306	383.9463	370.2669	374.0826	394.0803	421.9105	451.8589	476.6774 (73)
-----												
6. Solar gains												
[Jan]	Area	Solar flux	g	FF	Access	Gains						
	m2	Table 6a	Specific data	Specific data	factor	W						
		W/m2	or Table 6b	or Table 6c	Table 6d							
North	5.7000	10.6334	0.6300	0.7000	0.7700	18.5233 (74)						
East	1.6000	19.6403	0.6300	0.7000	0.7700	9.6037 (76)						
South	5.4000	46.7521	0.6300	0.7000	0.7700	77.1554 (78)						
West	0.8000	19.6403	0.6300	0.7000	0.7700	4.8019 (80)						
North	0.9000	16.7973	0.6300	0.8000	1.0000	6.8573 (82)						
East	3.5000	26.0000	0.6300	0.8000	1.0000	41.2776 (82)						
South	0.9000	42.0754	0.6300	0.8000	1.0000	17.1768 (82)						
Solar gains	175.3961	320.5434	492.8998	696.0049	853.2468	878.3639	833.8983	712.5429	562.9860	369.2554	214.1358	147.4344 (83)
Total gains	663.1588	806.3689	963.5147	1134.4763	1260.3774	1262.3101	1204.1653	1086.6255	957.0663	791.1659	665.9947	624.1117 (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	8.6781	8.7302	8.7830	9.0563	9.1114	9.3768	9.3768	9.4276	9.2727	9.1114	9.0007	8.8905
alpha	1.5785	1.5820	1.5855	1.6038	1.6074	1.6251	1.6251	1.6285	1.6182	1.6074	1.6000	1.5927
util living area	0.9227	0.8949	0.8502	0.7745	0.6750	0.5532	0.4503	0.4947	0.6647	0.8205	0.8991	0.9286 (86)
MIT	17.1845	17.5372	18.1468	18.9630	19.6919	20.2693	20.5463	20.4901	20.0140	19.0584	17.9995	17.1512 (87)
Th 2	18.6529	18.6619	18.6709	18.7168	18.7259	18.7689	18.7689	18.7770	18.7522	18.7259	18.7075	18.6891 (88)



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util rest of house	0.9056	0.8719	0.8163	0.7210	0.5898	0.4196	0.2599	0.3047	0.5425	0.7645	0.8730	0.9128 (89)
MIT 2	15.4670	15.8137	16.4059	17.2030	17.8599	18.3565	18.5311	18.5169	18.1800	17.3307	16.3053	15.4582 (90)
Living area fraction									fLA = Living area / (4) =			0.2593 (91)
MIT	15.9123	16.2605	16.8573	17.6593	18.3349	18.8524	19.0536	19.0285	18.6555	17.7786	16.7445	15.8971 (92)
Temperature adjustment												0.0000
adjusted MIT	15.9123	16.2605	16.8573	17.6593	18.3349	18.8524	19.0536	19.0285	18.6555	17.7786	16.7445	15.8971 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8763	0.8386	0.7806	0.6892	0.5718	0.4255	0.2884	0.3304	0.5359	0.7327	0.8409	0.8849	(94)
Useful gains	581.1351	676.2206	752.1438	781.9086	720.7400	537.1756	347.3250	359.0736	512.8578	579.6900	560.0159	552.2706	(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	2007.1681	1951.9248	1768.8586	1450.8046	1092.2927	680.2641	392.4959	418.2111	736.9148	1181.8096	1607.3001	1973.5222	(97)
Space heating kWh	1060.9686	857.2733	756.4358	481.6051	276.4352	0.0000	0.0000	0.0000	0.0000	447.9770	754.0447	1057.4112	(98a)
Space heating requirement - total per year (kWh/year)												5692.1509	
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	1060.9686	857.2733	756.4358	481.6051	276.4352	0.0000	0.0000	0.0000	0.0000	447.9770	754.0447	1057.4112	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												5692.1509	
Space heating per m2												105.4102	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000 (201)
Fraction of space heat from main system(s)													1.0000 (202)
Efficiency of main space heating system 1 (in %)													219.3000 (206)
Efficiency of main space heating system 2 (in %)													0.0000 (207)
Efficiency of secondary/supplementary heating system, %													0.0000 (208)
Space heating requirement	1060.9686	857.2733	756.4358	481.6051	276.4352	0.0000	0.0000	0.0000	0.0000	447.9770	754.0447	1057.4112	(98)
Space heating efficiency (main heating system 1)	219.3000	219.3000	219.3000	219.3000	219.3000	0.0000	0.0000	0.0000	0.0000	219.3000	219.3000	219.3000	(210)
Space heating fuel (main heating system)	483.7978	390.9135	344.9320	219.6102	126.0534	0.0000	0.0000	0.0000	0.0000	204.2759	343.8416	482.1756	(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	254.5337	209.1925	180.5147	125.1613	89.2221	77.5228	75.3961	94.8702	128.6594	183.0202	226.1930	251.7524	(64)
Efficiency of water heater (217)m	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	(216)
Fuel for water heating, kWh/month	133.6837	109.8700	94.8082	65.7360	46.8603	40.7157	39.5988	49.8268	67.5732	96.1241	118.7989	132.2229	(219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)
Pumps and Fa	6.7945	6.1370	6.7945	6.5753	6.7945	6.5753	6.7945	6.7945	6.5753	6.7945	6.5753	6.7945	(231)
Lighting	16.8998	13.5577	12.2072	8.9435	6.9082	5.6441	6.3019	8.1914	10.6399	13.9601	15.7679	17.3695	(232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-39.2294	-59.0102	-88.6258	-100.0493	-102.1771	-77.1241	-76.0418	-73.3867	-67.2605	-66.3546	-43.9155	-33.4858	(233a)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	-212.5732	-192.0016	-212.5732	-205.7160	-212.5732	-202.6175	-199.6450	-209.9464	-205.7160	-212.5732	-205.7160	-212.5732	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity) (233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1													2595.6000 (211)
Space heating fuel - main system 2													0.0000 (213)
Space heating fuel - secondary													0.0000 (215)
Efficiency of water heater													190.4000
Water heating fuel used													995.8185 (219)
Space cooling fuel													0.0000 (221)
Electricity for pumps and fans:													
pump for solar water heating													80.0000 (230g)
Total electricity for the above, kWh/year													80.0000 (231)
Electricity for lighting (calculated in Appendix L)													136.3911 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation													-826.6608 (233)
Wind generation													-3575.5408 (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													496.9241 (238)

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

Fuel Fuel price Fuel cost

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	kWh/year	p/kWh	£/year
Space heating - main system 1	2595.6000	16.4900	428.0144 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	995.8185	16.4900	164.2105 (247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000 (247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (249)
Pump for solar water heating	80.0000	16.4900	13.1920 (249)
Energy for lighting	136.3911	16.4900	22.4909 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-826.6608	16.4900	-136.3164
PV Unit electricity exported	0.0000	5.5900	0.0000
Total			-136.3164 (252)
Wind Turbine electricity used in dwelling	-2484.2248	16.4900	-409.6487
Wind Turbine electricity exported	0.0000	5.5900	0.0000
Total			-409.6487 (252)
Total energy cost			81.9428 (255)

## 11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600 (256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	0.2980 (257)
SAP value		95.1698
SAP rating (Section 12)		95 (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	2595.6000	0.1543	400.5193 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	995.8185	0.1457	145.1308 (264)
Space and water heating			545.6502 (265)
Pumps, fans and electric keep-hot	80.0000	0.1387	11.0970 (267)
Energy for lighting	136.3911	0.1443	19.6855 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-826.6608	0.1360	-112.4245
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-112.4245 (269)
Wind Turbine electricity used in dwelling	-2484.2248	0.1389	-345.0790
Wind Turbine electricity exported	0.0000	0.0000	0.0000
Total			-345.0790 (269)
Total CO2, kg/year			118.9291 (272)
CO2 emissions per m2			2.2000 (273)
EI value			98.3903
EI rating			98 (274)
EI band			A

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

### 1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	54.0000 (1b)	2.6000 (2b)	140.4000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	54.0000		140.4000 (4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 140.4000 (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	3 * 10 =	30.0000 (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) =	30.0000 / (5) =	0.2137 (8)
Pressure test		No
Pressure Test Method		Blower Door
Measured/design AP50		15.0000 (17)
Infiltration rate		0.9637 (18)
Number of sides sheltered		1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.8914 (21)

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

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Wind speed	4.7000	4.4000	4.5000	4.2000	4.2000	3.9000	3.9000	3.7000	3.7000	4.0000	4.0000	4.3000 (22)
Wind factor	1.1750	1.1000	1.1250	1.0500	1.0500	0.9750	0.9750	0.9250	0.9250	1.0000	1.0000	1.0750 (22a)
Adj infilt rate												
Effective ac	1.0474	0.9805	1.0028	0.9360	0.9360	0.8691	0.8691	0.8245	0.8245	0.8914	0.8914	0.9583 (22b)
	1.0474	0.9807	1.0028	0.9380	0.9380	0.8777	0.8777	0.8399	0.8399	0.8973	0.8973	0.9591 (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
Doors			2.0000	1.4000	2.8000		(26)
Windows (Uw = 1.40)			13.5000	1.3258	17.8977		(27)
Rooflights (N)			0.9000	1.3258	1.1932		(27a)
Rooflights (S)			0.9000	1.3258	1.1932		(27a)
Roof Glazing			3.5000	1.3258	4.6402		(27a)
Floor			54.0000	0.2500	13.5000		(28a)
Wall (uninsulated)	3.5000		3.5000	2.5000	8.7500		(29a)
Wall (upgrade)	48.0000	3.6500	44.3500	0.3000	13.3050		(29a)
Wall (new)	43.0000	11.8500	31.1500	0.1800	5.6070		(29a)
Roof	58.0000	1.8000	56.2000	0.1500	8.4300		(30)
Roof (flat)	6.0000	3.5000	2.5000	0.1500	0.3750		(30)
Total net area of external elements Aum(A, m2)			212.5000				(31)
Fabric heat loss, W/K = Sum (A x U)					77.6912		(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K												100.0000 (35)
Thermal bridges (Default value 0.200 * total exposed area)												42.5000 (36)
Point Thermal bridges												0.0000 (36a)
Total fabric heat loss												120.1912 (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	48.5279	45.4391	46.4629	43.4603	43.4603	40.6647	40.6647	38.9160	38.9160	41.5735	41.5735	44.4382 (38)
Average = Sum(39)m / 12 =	168.7191	165.6304	166.6541	163.6516	163.6516	160.8559	160.8559	159.1072	159.1072	161.7648	161.7648	164.6295 (39)

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	3.1244	3.0672	3.0862	3.0306	3.0306	2.9788	2.9788	2.9464	2.9464	2.9956	2.9956	3.0487 (40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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

Assumed occupancy													1.8080 (42)
Hot water usage for mixer showers													
	68.1672	67.1428	65.6500	62.7939	60.6861	58.3355	56.9994	58.4809	60.1049	62.6287	65.5462	67.9061 (42a)	
Hot water usage for baths													
	23.5745	23.2244	22.7314	21.8223	21.1416	20.3868	19.9791	20.4687	21.0018	21.8094	22.7372	23.4948 (42b)	
Hot water usage for other uses													
	33.1458	31.9405	30.7352	29.5299	28.3246	27.1193	27.1193	28.3246	29.5299	30.7352	31.9405	33.1458 (42c)	
Average daily hot water use (litres/day)													114.8377 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy conte	124.8875	122.3077	119.1166	114.1460	110.1523	105.8416	104.0978	107.2742	110.6366	115.1733	120.2239	124.5467 (44)	
Energy content (annual)	197.7913	174.1645	183.0778	156.2602	148.2861	130.1446	125.8973	132.8279	136.4259	156.2891	171.2810	195.0100 (45)	
Distribution loss (46)m = 0.15 x (45)m													Total = Sum(45)m = 1907.4558
Water storage loss:	29.6687	26.1247	27.4617	23.4390	22.2429	19.5217	18.8846	19.9242	20.4639	23.4434	25.6922	29.2515 (46)	
Store volume													210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													2.0000 (48)
Temperature factor from Table 2b													0.5400 (49)
Enter (49) or (54) in (55)													1.0800 (55)
Total storage loss													
	33.4800	30.2400	33.4800	32.4000	33.4800	32.4000	33.4800	33.4800	32.4000	33.4800	32.4000	33.4800 (56)	
If cylinder contains dedicated solar storage													
	33.4800	30.2400	33.4800	32.4000	33.4800	32.4000	33.4800	33.4800	32.4000	33.4800	32.4000	33.4800 (57)	
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624 (59)	
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)	
Total heat required for water heating calculated for each month													
	254.5337	225.4157	238.4244	204.4186	192.2342	172.4499	169.6128	177.4738	185.9351	211.6358	226.1930	251.7524 (62)	
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63a)	
FV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000 (63b)	
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													701.5191 (H24)
Heat delivered to space heating													0.0000 (H29)
Solar input													701.5191
Solar input	-0.6496	-20.0464	-64.6169	-90.5908	-107.8285	-109.2906	-103.7937	-94.4146	-68.2859	-36.6270	-5.3752	-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 (63a)	
Output from w/h	253.8841	205.3693	173.8075	113.8278	84.4057	63.1592	65.8190	83.0592	117.6492	175.0088	220.8179	251.7524 (64)	
													Total per year (kWh/year) = Sum(64)m = 1808.5602 (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	111.1595	98.9107	105.1507	90.4832	84.4636	77.1173	76.8332	79.8820	84.9689	96.2434	100.8805	110.2347 (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	108.4802	108.4802	108.4802	108.4802	108.4802	108.4802	108.4802	108.4802	108.4802	108.4802	108.4802	108.4802	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	19.3076	17.1488	13.9464	10.5583	7.8924	6.6631	7.1998	9.3585	12.5610	15.9490	18.6149	19.8442	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	235.2311	237.6721	231.5209	218.4259	201.8957	186.3597	175.9807	173.5397	179.6908	192.7859	209.3161	224.8521	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560	(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)	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	(71)
Water heating gains (Table 5)	149.4080	147.1885	141.3316	125.6712	113.5263	107.1074	103.2705	107.3683	118.0124	129.3595	140.1119	148.1650	(72)
Total internal gains	487.7628	485.8255	470.6149	438.4714	407.1306	383.9463	370.2669	374.0826	394.0803	421.9105	451.8589	476.6774	(73)

## 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	g	Specific data or Table 6c	FF	Access Factor Table 6d	Gains W					
North	5.7000	12.7350	0.6300	0.7000	0.7700	0.7700	22.1843	(74)					
East	1.6000	23.7652	0.6300	0.7000	0.7700	0.7700	11.6207	(76)					
South	5.4000	53.8987	0.6300	0.7000	0.7700	0.7700	88.9496	(78)					
West	0.8000	23.7652	0.6300	0.7000	0.7700	0.7700	5.8104	(80)					
North	0.9000	20.0333	0.6300	0.8000	1.0000	1.0000	8.1784	(82)					
East	3.5000	32.0000	0.6300	0.8000	1.0000	1.0000	50.8032	(82)					
South	0.9000	50.0836	0.6300	0.8000	1.0000	1.0000	20.4461	(82)					
Solar gains	207.9927	339.0362	526.6271	773.9077	891.7373	1005.7867	917.2940	799.7287	633.9352	407.4715	250.3801	168.9394	(83)
Total gains	695.7555	824.8617	997.2420	1212.3791	1298.8679	1389.7330	1287.5610	1173.8113	1028.0155	829.3820	702.2390	645.6168	(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)	0.9124	0.8850	0.8349	0.7479	0.6519	0.5036	0.4243	0.4497	0.6261	0.7976	0.8815	0.9192	(86)
MIT	17.4331	17.7625	18.3558	19.1423	19.8045	20.3727	20.5746	20.5546	20.1300	19.2427	18.3032	17.4397	(87)
Th 2	18.6891	18.7168	18.7075	18.7348	18.7348	18.7606	18.7606	18.7770	18.7770	18.7522	18.7522	18.7259	(88)
util rest of house	0.8928	0.8599	0.7976	0.6892	0.5610	0.3634	0.2356	0.2549	0.4966	0.7343	0.8502	0.9009	(89)
MIT 2	15.7338	16.0684	16.6291	17.3753	17.9594	18.4117	18.5328	18.5439	18.2813	17.5166	16.6284	15.7659	(90)
Living area fraction	16.1744	16.5076	17.0767	17.8334	18.4378	18.9201	19.0621	19.0652	18.7606	17.9641	17.0626	16.1998	(92)
MIT	16.1744	16.5076	17.0767	17.8334	18.4378	18.9201	19.0621	19.0652	18.7606	17.9641	17.0626	16.1998	(93)
Temperature adjustment												0.0000	
adjusted MIT	16.1744	16.5076	17.0767	17.8334	18.4378	18.9201	19.0621	19.0652	18.7606	17.9641	17.0626	16.1998	(93)

## 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	599.7565	681.3956	760.1491	800.0364	709.8280	521.1640	341.3788	334.0974	509.2510	584.3267	573.7345	562.5714	(95)
Ext temp.	4.9000	5.4000	7.0000	9.3000	12.1000	15.0000	16.7000	16.7000	14.4000	11.1000	7.9000	5.0000	(96)
Heat loss rate W	1902.2060	1839.7595	1679.3296	1396.5046	1037.1860	630.5744	379.9640	376.3194	693.8008	1110.3673	1482.1813	1843.8220	(97)
Space heating kWh	969.0224	778.4206	683.8703	429.4570	243.5543	0.0000	0.0000	0.0000	0.0000	391.3742	654.0817	953.2505	(98a)
Space heating requirement - total per year (kWh/year)												5103.0310	
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	969.0224	778.4206	683.8703	429.4570	243.5543	0.0000	0.0000	0.0000	0.0000	391.3742	654.0817	953.2505	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												5103.0310	
Space heating per m2										(98c) / (4) =		94.5006	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Fraction of space heat from main system(s)	219.3000	219.3000	219.3000	219.3000	219.3000	0.0000	0.0000	0.0000	0.0000	219.3000	219.3000	219.3000	(201)
Efficiency of main space heating system 1 (in %)	441.8707	354.9569	311.8424	195.8308	111.0599	0.0000	0.0000	0.0000	0.0000	178.4652	298.2589	434.6787	(211)
Space heating efficiency (main heating system 1)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)
Space heating fuel (main heating system)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
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	(214)
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	(215)
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)

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Water heating requirement	253.8841	205.3693	173.8075	113.8278	84.4057	63.1592	65.8190	83.0592	117.6492	175.0088	220.8179	251.7524 (64)
Efficiency of water heater (217)m	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000 (216)
Fuel for water heating, kWh/month	133.3425	107.8620	91.2855	59.7835	44.3307	33.1719	34.5688	43.6235	61.7905	91.9164	115.9758	132.2229 (217)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	6.7945	6.1370	6.7945	6.5753	6.7945	6.7945	6.7945	6.7945	6.7945	6.7945	6.7945	6.7945 (231)
Lighting	16.8998	13.5577	12.2072	8.9435	6.9082	5.6441	6.3019	8.1914	10.6399	13.9601	15.7679	17.3695 (232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-45.3177	-61.2221	-91.6399	-104.5102	-102.0548	-79.5468	-77.7695	-76.0283	-70.8598	-70.2646	-49.5490	-37.6154 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	-212.5732	-192.0016	-212.5732	-205.7160	-212.5732	-195.0736	-194.6150	-203.7432	-205.7160	-212.5732	-205.7160	-212.5732 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity) (233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235d)
Annual totals kWh/year												
Space heating fuel - main system 1												2326.9635 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												190.4000
Water heating fuel used												949.8741 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
pump for solar water heating												80.0000 (230g)
Total electricity for the above, kWh/year												80.0000 (231)
Electricity for lighting (calculated in Appendix L)												136.3911 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-866.3781 (233)
Wind generation												-3575.5408 (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												161.4029 (238)

## 10a. Fuel costs - using BEDF prices (538)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2326.9635	25.1600	585.4640	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	949.8741	25.1600	238.9883	(247)
Energy for instantaneous electric shower(s)	0.0000	25.1600	0.0000	(247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(249)
Pump for solar water heating	80.0000	25.1600	20.1280	(249)
Energy for lighting	136.3911	25.1600	34.3160	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-866.3781	25.1600	-217.9807	
PV Unit electricity exported	0.0000	5.8100	0.0000	
Total			-217.9807	(252)
Wind Turbine electricity used in dwelling	-2465.4477	25.1600	-620.3066	
Wind Turbine electricity exported	0.0000	5.8100	0.0000	
Total			-620.3066	(252)
Total energy cost			40.6090	(255)

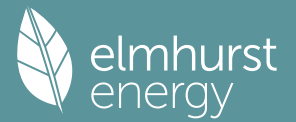
## 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2326.9635	0.1544	359.3546	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	949.8741	0.1465	139.1675	(264)
Space and water heating			498.5221	(265)
Pumps, fans and electric keep-hot	80.0000	0.1387	11.0970	(267)
Energy for lighting	136.3911	0.1443	19.6855	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-866.3781	0.1363	-118.1267	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-118.1267	(269)
Wind Turbine electricity used in dwelling	-2465.4477	0.1391	-342.9207	
Wind Turbine electricity exported	0.0000	0.0000	0.0000	
Total			-342.9207	(269)
Total CO2, kg/year			68.2572	(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	2326.9635	1.5717	3657.3830	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	949.8741	1.5420	1464.6984	(278)
Space and water heating			5122.0814	(279)
Pumps, fans and electric keep-hot	80.0000	1.5128	121.0240	(281)
Energy for lighting	136.3911	1.5338	209.2012	(282)

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Energy saving/generation technologies			
PV Unit electricity used in dwelling	-866.3781	1.5040	-1303.0694
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-1303.0694 (283)
Wind Turbine electricity used in dwelling	-2465.4477	1.5142	-3733.2208
Wind Turbine electricity exported	0.0000	0.0000	0.0000
Total			-3733.2208 (283)
Total Primary energy kWh/year			416.0164 (286)

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Property Reference	CB5601	Issued on Date	19/03/2024
Assessment Reference	CB5602	Prop Type Ref	CB-56
Property	The Hill, Ham Link, Burrington, North Somerset, BS40 7AR		
SAP Rating	65 D	DER	9.83
TER	13.51		
Environmental	93 A	% DER < TER	27.24
CO <sub>2</sub> Emissions (t/year)	0.47	DFEE	103.92
TFEE	52.20		
Compliance Check	See BREL	% DFEE < TFEE	-99.08
% DPER < TPER	-45.30	DPER	104.89
TPER	72.19		
Assessor Details	Mr. Joe Solti	Assessor ID	5122-0001
Client	WD Architects, .		

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

## 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	54.0000 (1b)	2.6000 (2b)	140.4000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	54.0000		140.4000 (4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 140.4000 (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	3 * 10 = 30.0000 (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) =	30.0000 / (5) = 0.2137 (8)
Pressure test	No
Pressure Test Method	Blower Door
Measured/design AP50	15.0000 (17)
Infiltration rate	0.9637 (18)
Number of sides sheltered	1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.8914 (21)

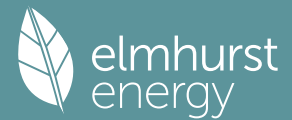
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	1.1365	1.1142	1.0920	0.9805	0.9583	0.8468	0.8468	0.8245	0.8914	0.9583	1.0028	1.0474 (22b)
Effective ac	1.1365	1.1142	1.0920	0.9807	0.9591	0.8586	0.8586	0.8399	0.8973	0.9591	1.0028	1.0474 (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
Doors			2.0000	1.4000	2.8000		(26)
Windows (Uw = 1.40)			13.5000	1.3258	17.8977		(27)
Rooflights (N)			0.9000	1.3258	1.1932		(27a)
Rooflights (S)			0.9000	1.3258	1.1932		(27a)
Roof Glazing			3.5000	1.3258	4.6402		(27a)
Floor			54.0000	0.2500	13.5000		(28a)
Wall (uninsulated)			3.5000	2.5000	8.7500		(29a)
Wall (upgrade)	48.0000	3.6500	44.3500	0.3000	13.3050		(29a)
Wall (new)	43.0000	11.8500	31.1500	0.1800	5.6070		(29a)
Roof	58.0000	1.8000	56.2000	0.1500	8.4300		(30)
Roof (flat)	6.0000	3.5000	2.5000	0.1500	0.3750		(30)
Total net area of external elements Aum (A, m <sup>2</sup> )			212.5000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 77.6912		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							100.0000 (35)
Thermal bridges (Default value 0.200 * total exposed area)							42.5000 (36)
Point Thermal bridges						(36a) =	0.0000
Total fabric heat loss						(33) + (36) + (36a) =	120.1912 (37)

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

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	52.6579	51.6254	50.5929	45.4391	44.4382	39.7788	39.7788	38.9160	41.5735	44.4382	46.4629	48.5279	(38)
Heat transfer coeff	172.8492	171.8166	170.7841	165.6304	164.6295	159.9701	159.9701	159.1072	161.7648	164.6295	166.6541	168.7191	(39)
Average = Sum(39)m / 12 =												165.5437	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	3.2009	3.1818	3.1627	3.0672	3.0487	2.9624	2.9624	2.9464	2.9956	3.0487	3.0862	3.1244	(40)
HLP (average)												3.0656	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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

Assumed occupancy													1.8080	(42)
Hot water usage for mixer showers	68.1672	67.1428	65.6500	62.7939	60.6861	58.3355	56.9994	58.4809	60.1049	62.6287	65.5462	67.9061	(42a)	
Hot water usage for baths	23.5745	23.2244	22.7314	21.8223	21.1416	20.3868	19.9791	20.4687	21.0018	21.8094	22.7372	23.4948	(42b)	
Hot water usage for other uses	33.1458	31.9405	30.7352	29.5299	28.3246	27.1193	27.1193	28.3246	29.5299	30.7352	31.9405	33.1458	(42c)	
Average daily hot water use (litres/day)												114.8377	(43)	
Daily hot water use	124.8875	122.3077	119.1166	114.1460	110.1523	105.8416	104.0978	107.2742	110.6366	115.1733	120.2239	124.5467	(44)	
Energy conte	197.7913	174.1645	183.0778	156.2602	148.2861	130.1446	125.8973	132.8279	136.4259	156.2891	171.2810	195.0100	(45)	
Energy content (annual)												1907.4558		
Distribution loss (46)m = 0.15 x (45)m	29.6687	26.1247	27.4617	23.4390	22.2429	19.5217	18.8846	19.9242	20.4639	23.4434	25.6922	29.2515	(46)	
Water storage loss:												210.0000	(47)	
Store volume												2.0000	(48)	
a) If manufacturer declared loss factor is known (kWh/day):												0.5400	(49)	
Temperature factor from Table 2b												1.0800	(55)	
Enter (49) or (54) in (55)												0.5400	(49)	
Total storage loss	33.4800	30.2400	33.4800	32.4000	33.4800	32.4000	33.4800	33.4800	32.4000	33.4800	32.4000	33.4800	(56)	
If cylinder contains dedicated solar storage	33.4800	30.2400	33.4800	32.4000	33.4800	32.4000	33.4800	33.4800	32.4000	33.4800	32.4000	33.4800	(57)	
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)	
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)	
Total heat required for water heating calculated for each month	254.5337	225.4157	239.8202	211.1722	205.0285	185.0566	182.6397	189.5703	191.3379	213.0315	226.1930	251.7524	(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	254.5337	225.4157	239.8202	211.1722	205.0285	185.0566	182.6397	189.5703	191.3379	213.0315	226.1930	251.7524	(64)	
12Total per year (kWh/year)												2575.5518	(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	111.1595	98.9107	106.2673	95.8861	94.6991	87.2027	87.2548	89.5592	89.2912	97.3600	100.8805	110.2347	(65)	

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts	90.4002	90.4002	90.4002	90.4002	90.4002	90.4002	90.4002	90.4002	90.4002	90.4002	90.4002	90.4002	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	79.4935	88.0107	79.4935	82.1433	79.4935	82.1433	79.4935	79.4935	82.1433	79.4935	82.1433	79.4935	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	157.6049	159.2403	155.1190	146.3453	135.2701	124.8610	117.9070	116.2716	120.3929	129.1666	140.2418	150.6509	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.0400	32.0400	32.0400	32.0400	32.0400	32.0400	32.0400	32.0400	32.0400	32.0400	32.0400	32.0400	(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)	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	(71)
Water heating gains (Table 5)	149.4080	147.1885	142.8324	133.1752	127.2837	121.1148	117.2779	120.3753	124.0156	130.8603	140.1119	148.1650	(72)
Total internal gains	436.6264	444.5596	427.5650	411.7839	392.1674	378.2392	364.7986	366.2604	376.6718	389.6404	412.6170	428.4295	(73)

#### 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W							
North	5.7000	10.6334	0.6300	0.7000	0.7700	18.5233 (74)							
East	1.6000	19.6403	0.6300	0.7000	0.7700	9.6037 (76)							
South	5.4000	46.7521	0.6300	0.7000	0.7700	77.1554 (78)							
West	0.8000	19.6403	0.6300	0.7000	0.7700	4.8019 (80)							
North	0.9000	16.7973	0.6300	0.8000	1.0000	6.8573 (82)							
East	3.5000	26.0000	0.6300	0.8000	1.0000	41.2776 (82)							
South	0.9000	42.0754	0.6300	0.8000	1.0000	17.1768 (82)							
Solar gains	175.3961	320.5434	492.8998	696.0049	853.2468	878.3639	833.8983	712.5429	562.9860	369.2554	214.1358	147.4344	(83)
Total gains	612.0225	765.1029	920.4647	1107.7888	1245.4142	1256.6031	1198.6969	1078.8033	939.6578	758.8958	626.7528	575.8638	(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		



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tau	8.6781	8.7302	8.7830	9.0563	9.1114	9.3768	9.3768	9.4276	9.2727	9.1114	9.0007	8.8905
alpha	1.5785	1.5820	1.5855	1.6038	1.6074	1.6251	1.6251	1.6285	1.6182	1.6074	1.6000	1.5927
util living area	0.9306	0.9017	0.8582	0.7802	0.6784	0.5547	0.4516	0.4970	0.6701	0.8290	0.9068	0.9360 (86)
MIT	17.1169	17.4865	18.0997	18.9393	19.6823	20.2671	20.5449	20.4877	20.0032	19.0251	17.9495	17.0853 (87)
Th 2	18.6529	18.6619	18.6709	18.7168	18.7259	18.7689	18.7689	18.7770	18.7522	18.7259	18.7075	18.6891 (88)
util rest of house	0.9150	0.8800	0.8256	0.7274	0.5935	0.4210	0.2609	0.3065	0.5483	0.7746	0.8823	0.9217 (89)
MIT 2	15.4023	15.7659	16.3632	17.1830	17.8530	18.3554	18.5308	18.5162	18.1733	17.3026	16.2587	15.3949 (90)
Living area fraction									FLA = Living area / (4) =			
MIT	15.8468	16.2120	16.8134	17.6383	18.3273	18.8510	19.0530	19.0273	18.6477	17.7492	16.6971	15.8331 (92)
Temperature adjustment												0.0000
adjusted MIT	15.8468	16.2120	16.8134	17.6383	18.3273	18.8510	19.0530	19.0273	18.6477	17.7492	16.6971	15.8331 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.8874	0.8475	0.7902	0.6953	0.5752	0.4268	0.2895	0.3322	0.5411	0.7426	0.8511	0.8954 (94)
Useful gains	543.0820	648.4490	727.3504	770.2618	716.4114	536.3303	346.9888	358.4173	508.4876	563.5346	533.4526	515.6390 (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	1995.8554	1943.5852	1761.3625	1447.3333	1091.0412	680.0308	392.3996	418.0253	735.6597	1176.9661	1599.3890	1962.7339 (97)
Space heating kWh	1080.8635	870.3315	769.3050	487.4915	278.7246	0.0000	0.0000	0.0000	0.0000	456.3930	767.4742	1076.6387 (98a)
Space heating requirement - total per year (kWh/year)												5787.2220
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	1080.8635	870.3315	769.3050	487.4915	278.7246	0.0000	0.0000	0.0000	0.0000	456.3930	767.4742	1076.6387 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												5787.2220
Space heating per m2												(98c) / (4) = 107.1708 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												219.3000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	1080.8635	870.3315	769.3050	487.4915	278.7246	0.0000	0.0000	0.0000	0.0000	456.3930	767.4742	1076.6387 (98)
Space heating efficiency (main heating system 1)	219.3000	219.3000	219.3000	219.3000	219.3000	0.0000	0.0000	0.0000	0.0000	219.3000	219.3000	219.3000 (210)
Space heating fuel (main heating system)	492.8698	396.8680	350.8003	222.2943	127.0974	0.0000	0.0000	0.0000	0.0000	208.1136	349.9654	490.9433 (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	254.5337	225.4157	239.8202	211.1722	205.0285	185.0566	182.6397	189.5703	191.3379	213.0315	226.1930	251.7524 (64)
Efficiency of water heater (217)m	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000 (216)
Fuel for water heating, kWh/month	133.6837	118.3906	125.9560	110.9098	107.6830	97.1936	95.9242	99.5642	100.4926	111.8863	118.7989	132.2229 (219)
Space cooling fuel requirement												
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (231)
Lighting	16.8998	13.5577	12.2072	8.9435	6.9082	5.6441	6.3019	8.1914	10.6399	13.9601	15.7679	17.3695 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-12.2683	-21.5851	-39.0558	-52.5977	-61.8836	-54.0299	-52.9436	-46.8428	-36.6030	-27.0675	-14.5776	-10.0323 (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	-1.6594	-4.5423	-12.3695	-25.1623	-40.9670	-49.6501	-48.2999	-37.2589	-23.0130	-8.2873	-2.5296	-1.2170 (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												2638.9521 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												190.4000
Water heating fuel used												1352.7058 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
Total electricity for the above, kWh/year												0.0000 (231)
Electricity for lighting (calculated in Appendix L)												136.3911 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-684.4435 (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												3443.6055 (238)

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## 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	2638.9521	0.1543	407.2460 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1352.7058	0.1408	190.5081 (264)
Space and water heating			597.7541 (265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (267)
Energy for lighting	136.3911	0.1443	19.6855 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-429.4873	0.1320	-56.7089
PV Unit electricity exported	-254.9563	0.1177	-30.0014
Total			-86.7104 (269)
Total CO2, kg/year			530.7292 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			9.8300 (273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	2638.9521	1.5713	4146.6691 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1352.7058	1.5208	2057.1314 (278)
Space and water heating			6203.8005 (279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (281)
Energy for lighting	136.3911	1.5338	209.2012 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-429.4873	1.4879	-639.0213
PV Unit electricity exported	-254.9563	0.4313	-109.9732
Total			-748.9945 (283)
Total Primary energy kWh/year			5664.0073 (286)
Dwelling Primary energy Rate (DPER)			104.8900 (287)

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

### 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	54.0000 (1b)	x 2.6000 (2b)	= 140.4000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	54.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 140.4000 (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	2 * 10 =	20.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	20.0000 / (5) = 0.1425 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3925 (18)
Number of sides sheltered		1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3630 (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 infltr rate	0.4628	0.4538	0.4447	0.3993	0.3902	0.3449	0.3449	0.3358	0.3630	0.3902	0.4084	0.4265 (22b)
Effective ac	0.6071	0.6030	0.5989	0.5797	0.5761	0.5595	0.5595	0.5564	0.5659	0.5761	0.5834	0.5910 (25)

### 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
TER Opaque door			2.0000	1.0000	2.0000		(26)
TER Opening Type (Uw = 1.20)			8.2700	1.1450	9.4695		(27)

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Rooflights (N)				0.5500		1.5918		0.8755					(27a)
Rooflights (S)				0.5500		1.5918		0.8755					(27a)
Roof Glazing				2.1400		1.5918		3.4064					(27a)
Floor				54.0000		0.1300		7.0200					(28a)
Wall (uninsulated)			3.5000			3.5000		0.1800					(29a)
Wall (upgrade)			48.0000	2.2400		45.7600		0.1800					(29a)
Wall (new)			43.0000	8.0300		34.9700		0.1800					(29a)
Roof			58.0000	1.1000		56.9000		0.1100					(30)
Roof (flat)			6.0000	2.1400		3.8600		0.1100					(30)
Total net area of external elements Aum(A, m2)						212.5000							(31)
Fabric heat loss, W/K = Sum (A x U)								(26)...(30) + (32) =				45.4918	(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K													100.0000 (35)
Thermal bridges (User defined value 0.050 * total exposed area)													10.6250 (36)
Point Thermal bridges													0.0000 (36a) =
Total fabric heat loss													(33) + (36) + (36a) = 56.1168 (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	28.1288	27.9361	27.7472	26.8599	26.6939	25.9212	25.9212	25.7781	26.2188	26.6939	27.0297	27.3808	(38)
Average = Sum(39)m / 12 =	84.2455	84.0528	83.8639	82.9767	82.8107	82.0380	82.0380	81.8949	82.3356	82.8107	83.1465	83.4976	(39)
													82.9759
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP (average)	1.5601	1.5565	1.5530	1.5366	1.5335	1.5192	1.5192	1.5166	1.5247	1.5335	1.5398	1.5463	(40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	1.5366 (40)
													31

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

Assumed occupancy													1.8080 (42)
Hot water usage for mixer showers	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for baths	54.5338	53.7143	52.5200	50.2351	48.5489	46.6684	45.5995	46.7847	48.0839	50.1030	52.4370	54.3248	(42a)
Hot water usage for other uses	23.5745	23.2244	22.7314	21.8223	21.1416	20.3868	19.9791	20.4687	21.0018	21.8094	22.7372	23.4948	(42b)
Average daily hot water use (litres/day)	33.1458	31.9405	30.7352	29.5299	28.3246	27.1193	27.1193	28.3246	29.5299	30.7352	31.9405	33.1458	(42c)
Daily hot water use	111.2541	108.8791	105.9866	101.5873	98.0150	94.1745	92.6979	95.5780	98.6156	102.6476	107.1147	110.9655	(44)
Energy content (annual)	176.1993	155.0424	162.8974	139.0679	131.9471	115.7985	112.1101	118.3456	121.6029	139.2918	152.6045	173.7451	(45)
Distribution loss (46)m = 0.15 x (45)m	26.4299	23.2564	24.4346	20.8602	19.7921	17.3698	16.8165	17.7518	18.2404	20.8938	22.8907	26.0618	(46)
Water storage loss:													210.0000 (47)
Store volume													1.7016 (48)
a) If manufacturer declared loss factor is known (kWh/day):													0.5400 (49)
Temperature factor from Table 2b													0.9188 (55)
Enter (49) or (54) in (55)													
Total storage loss	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(56)
If cylinder contains dedicated solar storage	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	227.9459	201.7813	214.6440	189.1452	183.6937	165.8759	163.8567	170.0921	171.6802	191.0384	202.6818	225.4917	(62)
WWHS	-24.9306	-22.0488	-23.0882	-19.1180	-17.8173	-15.2464	-14.2910	-15.1971	-15.7745	-18.5964	-21.0674	-24.4689	(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)
FGHS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	203.0153	179.7325	191.5558	170.0273	165.8764	150.6295	149.5657	154.8951	155.9057	172.4420	181.6144	201.0228	(64)
Total per year (kWh/year)													2076.2825 (64)
Electric shower(s)													2076 (64)
Heat gains from water heating, kWh/month	99.9835	88.9427	95.5607	86.3020	85.2697	78.5649	78.6739	80.7472	80.4948	87.7118	90.8029	99.1675	(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	90.4002	90.4002	90.4002	90.4002	90.4002	90.4002	90.4002	90.4002	90.4002	90.4002	90.4002	90.4002	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	79.4808	87.9966	79.4808	82.1301	79.4808	82.1301	79.4808	79.4808	82.1301	79.4808	82.1301	79.4808	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	157.6049	159.2403	155.1190	146.3453	135.2701	124.8610	117.9070	116.2716	120.3929	129.1666	140.2418	150.6509	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.0400	32.0400	32.0400	32.0400	32.0400	32.0400	32.0400	32.0400	32.0400	32.0400	32.0400	32.0400	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	(71)
Water heating gains (Table 5)	134.3865	132.3552	128.4418	119.8638	114.6098	109.1179	105.7445	108.5311	111.7984	117.8922	126.1151	133.2897	(72)
Total internal gains	424.5921	432.7121	416.1616	401.4593	382.4807	366.2290	353.2523	354.4035	364.4414	379.6596	401.6070	416.5414	(73)

## 6. Solar gains

[Jan]		Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North		3.4900	10.6334	0.6300	0.7000	0.7700	11.3415 (74)
East		0.9800	19.6403	0.6300	0.7000	0.7700	5.8823 (76)

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South	3.3100	46.7521	0.6300	0.7000	0.7700	47.2934 (78)
West	0.4900	19.6403	0.6300	0.7700	2.9411 (80)	
North	0.5500	16.7973	0.6300	1.0000	3.6668 (82)	
East	2.1400	26.0000	0.6300	0.7000	22.0835 (82)	
South	0.5500	42.0754	0.6300	0.7000	1.0000	9.1848 (82)

Solar gains	102.3934	186.2493	284.4754	399.2270	487.7133	501.4540	476.3110	408.0315	324.0547	214.0107	124.8426	86.1810 (83)
Total gains	526.9855	618.9614	700.6369	800.6864	870.1940	867.6830	829.5633	762.4350	688.4961	593.6702	526.4496	502.7224 (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	17.8051	17.8459	17.8861	18.0774	18.1136	18.2842	18.2842	18.3162	18.2181	18.1136	18.0404	17.9646
alpha	2.1870	2.1897	2.1924	2.2052	2.2076	2.2189	2.2189	2.2211	2.2145	2.2076	2.2027	2.1976
util living area	0.9236	0.8933	0.8472	0.7616	0.6453	0.5073	0.3935	0.4359	0.6206	0.8039	0.8952	0.9301 (86)
MIT	17.9575	18.3509	18.9374	19.6873	20.3046	20.7159	20.8843	20.8512	20.5293	19.7200	18.7228	17.8948 (87)
Th 2	19.6427	19.6454	19.6480	19.6602	19.6624	19.6731	19.6731	19.6751	19.6690	19.6624	19.6578	19.6530 (88)
util rest of house	0.9117	0.8771	0.8236	0.7246	0.5889	0.4257	0.2885	0.3286	0.5420	0.7643	0.8765	0.9191 (89)
MIT 2	16.2042	16.6931	17.4175	18.3261	19.0349	19.4722	19.6183	19.5991	19.3034	18.3953	17.1743	16.1304 (90)
Living area fraction	16.6588	17.1229	17.8116	18.6790	19.3641	19.7947	19.9466	19.9238	19.6212	18.7387	17.5758	16.5879 (92)
MIT	16.6588	17.1229	17.8116	18.6790	19.3641	19.7947	19.9466	19.9238	19.6212	18.7387	17.5758	16.5879 (93)
Temperature adjustment												0.0000
adjusted MIT	16.6588	17.1229	17.8116	18.6790	19.3641	19.7947	19.9466	19.9238	19.6212	18.7387	17.5758	16.5879 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.8743	0.8364	0.7830	0.6926	0.5749	0.4337	0.3114	0.3501	0.5388	0.7307	0.8370	0.8831 (94)
Useful gains	460.7191	517.7278	548.5948	554.5354	500.2420	376.3388	258.2903	266.9017	370.9851	433.7696	440.6458	443.9465 (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	1041.1721	1027.3671	948.6331	811.4289	634.6697	426.1596	274.5454	288.5771	454.5921	673.9753	871.0229	1034.3558 (97)
Space heating kWh	431.8570	342.4776	297.6285	184.9633	100.0142	0.0000	0.0000	0.0000	0.0000	178.7130	309.8715	439.2645 (98a)
Space heating requirement - total per year (kWh/year)												2284.7897
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	431.8570	342.4776	297.6285	184.9633	100.0142	0.0000	0.0000	0.0000	0.0000	178.7130	309.8715	439.2645 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2284.7897
Space heating per m2												(98c) / (4) = 42.3109 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												
Fraction of space heat from main system(s)												
Efficiency of main space heating system 1 (in %)												
Efficiency of main space heating system 2 (in %)												
Efficiency of secondary/supplementary heating system, %												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	431.8570	342.4776	297.6285	184.9633	100.0142	0.0000	0.0000	0.0000	0.0000	178.7130	309.8715	439.2645 (98)
Space heating efficiency (main heating system 1)	92.3000	92.3000	92.3000	92.3000	92.3000	0.0000	0.0000	0.0000	0.0000	92.3000	92.3000	92.3000 (210)
Space heating fuel (main heating system)	467.8840	371.0483	322.4578	200.3936	108.3577	0.0000	0.0000	0.0000	0.0000	193.6219	335.7221	475.9096 (211)
Space heating efficiency (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (212)
Space heating fuel (main heating system 2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (213)
Space heating fuel (secondary)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (215)
Water heating												
Water heating requirement	203.0153	179.7325	191.5558	170.0273	165.8764	150.6295	149.5657	154.8951	155.9057	172.4420	181.6144	201.0228 (64)
Efficiency of water heater (217)m	85.7089	85.4819	85.0442	84.2490	82.9628	79.8000	79.8000	79.8000	79.8000	84.1400	85.2473	79.8000 (216)
Fuel for water heating, kWh/month	236.8660	210.2581	225.2427	201.8152	199.9407	188.7588	187.4257	194.1041	195.3706	204.9465	213.0442	234.3927 (219)
Space cooling fuel requirement												
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	7.3041	6.5973	7.3041	7.0685	7.3041	7.0685	7.3041	7.3041	7.0685	7.3041	7.0685	7.3041 (231)
Lighting	16.5145	13.2486	11.9289	8.7396	6.7507	5.5154	6.1582	8.0047	10.3973	13.6418	15.4084	16.9735 (232)
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-42.6906	-56.6010	-76.6237	-81.0623	-83.4600	-76.6389	-75.7543	-73.4128	-68.7522	-62.2715	-45.6727	-37.3530 (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	-36.3761	-74.6754	-145.1213	-213.3473	-277.7646	-277.4570	-274.1057	-233.9433	-174.0634	-105.0571	-47.9825	-28.8986 (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												2475.3951 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)

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Efficiency of water heater	79.8000
Water heating fuel used	2492.1653 (219)
Space cooling fuel	0.0000 (221)
Electricity for pumps and fans:	
Total electricity for the above, kWh/year	86.0000 (231)
Electricity for lighting (calculated in Appendix L)	133.2817 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV generation	-2669.0853 (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	2517.7568 (238)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	2475.3951	0.2100	519.8330 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	2492.1653	0.2100	523.3547 (264)
Space and water heating			1043.1877 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	133.2817	0.1443	19.2367 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-780.2931	0.1359	-106.0162
PV Unit electricity exported	-1888.7922	0.1265	-239.0198
Total			-345.0361 (269)
Total CO2, kg/year			729.3175 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			13.5100 (273)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	2475.3951	1.1300	2797.1965 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	2492.1653	1.1300	2816.1468 (278)
Space and water heating			5613.3432 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	133.2817	1.5338	204.4320 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-780.2931	1.5022	-1172.1652
PV Unit electricity exported	-1888.7922	0.4645	-877.4231
Total			-2049.5883 (283)
Total Primary energy kWh/year			3898.2877 (286)
Target Primary Energy Rate (TPER)			72.1900 (287)

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

### 1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	54.0000 (1b)	2.6000 (2b)	140.4000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	54.0000		140.4000 (4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 140.4000 (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	2 * 10 = 20.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	20.0000 / (5) = 0.1425 (8)
Pressure test	No
Pressure Test Method	Blower Door
Measured/design AP50	15.0000 (17)
Infiltration rate	0.8925 (18)
Number of sides sheltered	1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] = 0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) = 0.8255 (21)

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate													
	1.0525	1.0319	1.0113	0.9081	0.8874	0.7842	0.7842	0.7636	0.8255	0.8874	0.9287	0.9700	(22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)													
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =													
Effective ac	1.0525	1.0319	1.0113	0.9123	0.8938	0.8075	0.8075	0.7915	0.8407	0.8938	0.9312	0.9704	(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						
Doors			2.0000	1.4000	2.8000			(26)					
Windows (Uw = 1.40)			13.5000	1.3258	17.8977			(27)					
Rooflights (N)			0.9000	1.3258	1.1932			(27a)					
Rooflights (S)			0.9000	1.3258	1.1932			(27a)					
Roof Glazing			3.5000	1.3258	4.6402			(27a)					
Floor			54.0000	0.2500	13.5000			(28a)					
Wall (uninsulated)	3.5000		3.5000	2.5000	8.7500			(29a)					
Wall (upgrade)	48.0000	3.6500	44.3500	0.3000	13.3050			(29a)					
Wall (new)	43.0000	11.8500	31.1500	0.1800	5.6070			(29a)					
Roof	58.0000	1.8000	56.2000	0.1500	8.4300			(30)					
Roof (flat)	6.0000	3.5000	2.5000	0.1500	0.3750			(30)					
Total net area of external elements Aum(A, m2)			212.5000					(31)					
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	77.6912		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K													
Thermal bridges (Default value 0.200 * total exposed area)													
Point Thermal bridges								(36a) =					
Total fabric heat loss								(33) + (36) + (36a) =					
								120.1912	(37)				
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	48.7660	47.8098	46.8536	42.2684	41.4100	37.4139	37.4139	36.6738	38.9531	41.4100	43.1466	44.9621	(38)
Heat transfer coeff	168.9572	168.0010	167.0448	162.4596	161.6012	157.6051	157.6051	156.8651	159.1443	161.6012	163.3378	165.1533	(39)
Average = Sum(39)m / 12 =												162.4480	
HLP	3.1288	3.1111	3.0934	3.0085	2.9926	2.9186	2.9186	2.9049	2.9471	2.9926	3.0248	3.0584	(40)
HLP (average)												3.0083	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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

Assumed occupancy													1.8080	(42)
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usage for baths	23.5745	23.2244	22.7314	21.8223	21.1416	20.3868	19.9791	20.4687	21.0018	21.8094	22.7372	23.4948	23.4948	(42b)
Hot water usage for other uses	33.1458	31.9405	30.7352	29.5299	28.3246	27.1193	27.1193	28.3246	29.5299	30.7352	31.9405	33.1458	33.1458	(42c)
Average daily hot water use (litres/day)													51.9898	(43)
Daily hot water use	56.7203	55.1649	53.4666	51.3522	49.4662	47.5061	47.0984	48.7933	50.5317	52.5446	54.6777	56.6406	56.6406	(44)
Energy conte	89.8311	78.5541	82.1761	70.2986	66.5910	58.4143	56.9614	60.4163	62.3106	71.3025	77.8984	88.6855	88.6855	(45)
Energy content (annual)													863.4398	
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:														
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	76.3564	66.7710	69.8497	59.7538	56.6023	49.6521	48.4172	51.3538	52.9640	60.6072	66.2136	75.3827	75.3827	(62)
WWHRs	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
FV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRs	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	76.3564	66.7710	69.8497	59.7538	56.6023	49.6521	48.4172	51.3538	52.9640	60.6072	66.2136	75.3827	75.3827	(64)
12Total per year (kWh/year)													733.9239	(64)
Electric shower(s)	43.6725	38.9125	42.4910	40.5486	41.3095	39.4053	40.7188	41.3095	40.5486	42.4910	41.6920	43.6725	43.6725	(64a)
Total Energy used by instantaneous electric shower (s) = Sum(64a)m =													496.7719	(64a)
Heat gains from water heating, kWh/month	30.0072	26.4209	28.0852	25.0756	24.4780	22.2644	22.2840	23.1658	23.3782	25.7745	26.9764	29.7638	29.7638	(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	90.4002	90.4002	90.4002	90.4002	90.4002	90.4002	90.4002	90.4002	90.4002	90.4002	90.4002	90.4002	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	79.4935	88.0107	79.4935	82.1433	79.4935	82.1433	79.4935	79.4935	82.1433	79.4935	82.1433	79.4935	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	157.6049	159.2403	155.1190	146.3453	135.2701	124.8610	117.9070	116.2716	120.3929	129.1666	140.2418	150.6509	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.0400	32.0400	32.0400	32.0400	32.0400	32.0400	32.0400	32.0400	32.0400	32.0400	32.0400	32.0400	(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)	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	(71)
Water heating gains (Table 5)													

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Total internal gains	40.3323	39.3168	37.7489	34.8272	32.9005	30.9227	29.9516	31.1369	32.4697	34.6432	37.4672	40.0051 (72)
	327.5507	336.6878	322.4815	313.4359	297.7842	288.0471	277.4722	277.0221	285.1259	293.4234	309.9724	320.2696 (73)

## 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North	5.7000	10.6334	0.6300	0.7000	0.7700	18.5233 (74)
East	1.6000	19.6403	0.6300	0.7000	0.7700	9.6037 (76)
South	5.4000	46.7521	0.6300	0.7000	0.7700	77.1554 (78)
West	0.8000	19.6403	0.6300	0.7000	0.7700	4.8019 (80)
North	0.9000	16.7973	0.6300	0.8000	1.0000	6.8573 (82)
East	3.5000	26.0000	0.6300	0.8000	1.0000	41.2776 (82)
South	0.9000	42.0754	0.6300	0.8000	1.0000	17.1768 (82)

Solar gains	175.3961	320.5434	492.8998	696.0049	853.2468	878.3639	833.8983	712.5429	562.9860	369.2554	214.1358	147.4344 (83)
Total gains	502.9468	657.2312	815.3813	1009.4408	1151.0310	1166.4110	1111.3706	989.5650	848.1119	662.6787	524.1082	467.7040 (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	8.8780	8.9285	8.9796	9.2331	9.2821	9.5175	9.5175	9.5624	9.4254	9.2821	9.1834	9.0825
alpha	1.5919	1.5952	1.5986	1.6155	1.6188	1.6345	1.6345	1.6375	1.6284	1.6188	1.6122	1.6055
util living area	0.9466	0.9187	0.8763	0.7991	0.6976	0.5748	0.4714	0.5209	0.6967	0.8529	0.9260	0.9518 (86)
MIT	15.9211	16.4312	17.2709	18.4161	19.4336	20.2291	20.6135	20.5286	19.8521	18.5037	17.0365	15.8699 (87)
Th 2	18.6870	18.6955	18.7040	18.7458	18.7537	18.7912	18.7912	18.7983	18.7767	18.7537	18.7377	18.7211 (88)
util rest of house	0.9343	0.9003	0.8472	0.7495	0.6151	0.4414	0.2775	0.3277	0.5786	0.8043	0.9060	0.9408 (89)
MIT 2	14.4410	14.9422	15.7606	16.8665	17.7873	18.4593	18.7071	18.6796	18.2029	16.9977	15.5713	14.4085 (90)
Living area fraction	14.8247	15.3283	16.1522	17.2683	18.2141	18.9181	19.2013	19.1590	18.6305	17.3881	15.9512	14.7874 (92)
MIT	14.8247	15.3283	16.1522	17.2683	18.2141	18.9181	19.2013	19.1590	18.6305	17.3881	15.9512	14.7874 (92)
Temperature adjustment												0.0000
adjusted MIT	14.8247	15.3283	16.1522	17.2683	18.2141	18.9181	19.2013	19.1590	18.6305	17.3881	15.9512	14.7874 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9002	0.8581	0.7998	0.7058	0.5903	0.4506	0.3197	0.3657	0.5686	0.7611	0.8664	0.9089 (94)
Useful gains	452.7321	563.9594	652.1025	712.4388	679.4742	525.5620	355.3379	361.9276	482.2074	504.3590	454.0864	425.0925 (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	1778.2254	1751.9590	1612.3474	1359.5080	1052.6849	680.5568	409.9843	432.7880	721.0020	1096.9683	1445.7349	1748.5399 (97)
Space heating kWh	986.1670	798.3358	714.4222	465.8898	277.6687	0.0000	0.0000	0.0000	0.0000	440.9013	713.9869	984.6448 (98a)
Space heating requirement - total per year (kWh/year)												5382.0165
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	986.1670	798.3358	714.4222	465.8898	277.6687	0.0000	0.0000	0.0000	0.0000	440.9013	713.9869	984.6448 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												5382.0165
Space heating per m2										(98c) / (4) =		99.6670 (99)

## 8c. Space cooling requirement

Calculated for June, July and August. See Table 10b												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	1481.4880	1166.2778	1192.1746	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.5683	0.6284	0.5867	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	841.8814	732.9238	699.4662	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1255.0791	1196.8681	1069.1791	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	297.5024	345.1746	275.0664	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction									fc = cooled area / (4) =			1.0000 (105)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	74.3756	86.2937	68.7666	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												229.4358 (107)
Energy for space heating												99.6670 (99)
Energy for space cooling												4.2488 (108)
Total												103.9158 (109)
Fabric Energy Efficiency (DFEE)												103.9 (109)

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## 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	54.0000 (1b)	2.6000 (2b)	140.4000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	54.0000		140.4000 (4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	140.4000 (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	2 * 10 =	20.0000	(7a)										
Number of passive vents	0 * 10 =	0.0000	(7b)										
Number of flueless gas fires	0 * 40 =	0.0000	(7c)										
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =		20.0000 / (5) =	0.1425 (8)										
Pressure test		Yes											
Pressure Test Method		Blower Door											
Measured/design AP50		5.0000	(17)										
Infiltration rate		0.3925	(18)										
Number of sides sheltered		1	(19)										
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)										
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3630	(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	0.4628	0.4538	0.4447	0.3993	0.3902	0.3449	0.3449	0.3358	0.3630	0.3902	0.4084	0.4265	(22b)
If exhaust air heat pump using Appendix N, (23b) = (23a) x Fmv (equation (N5)), otherwise (23b) = (23a)													
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =													
Effective ac	0.6071	0.6030	0.5989	0.5797	0.5761	0.5595	0.5595	0.5564	0.5659	0.5761	0.5834	0.5910	(25)

## 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K						
TER Opaque door			2.0000	1.0000	2.0000		(26)						
TER Opening Type (Uw = 1.20)			8.2700	1.1450	9.4695		(27)						
Rooflights (N)			0.5500	1.5918	0.8755		(27a)						
Rooflights (S)			0.5500	1.5918	0.8755		(27a)						
Roof Glazing			2.1400	1.5918	3.4064		(27a)						
Floor			54.0000	0.1300	7.0200		(28a)						
Wall (uninsulated)	3.5000		3.5000	0.1800	0.6300		(29a)						
Wall (upgrade)	48.0000	2.2400	45.7600	0.1800	8.2368		(29a)						
Wall (new)	43.0000	8.0300	34.9700	0.1800	6.2946		(29a)						
Roof	58.0000	1.1000	56.9000	0.1100	6.2590		(30)						
Roof (flat)	6.0000	2.1400	3.8600	0.1100	0.4246		(30)						
Total net area of external elements Aum(A, m <sup>2</sup> )			212.5000				(31)						
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =	45.4918			(33)						
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							100.0000	(35)					
Thermal bridges (User defined value 0.050 * total exposed area)							10.6250	(36)					
Point Thermal bridges							(36a) =	0.0000					
Total fabric heat loss							(33) + (36) + (36a) =	56.1168 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)													
(38)m	Jan 28.1288	Feb 27.9361	Mar 27.7472	Apr 26.8599	May 26.6939	Jun 25.9212	Jul 25.9212	Aug 25.7781	Sep 26.2188	Oct 26.6939	Nov 27.0297	Dec 27.3808	(38)
Heat transfer coeff	84.2455	84.0528	83.8639	82.9767	82.8107	82.0380	82.0380	81.8949	82.3356	82.8107	83.1465	83.4976	(39)
Average = Sum(39)m / 12 =												82.9759	
HLP	Jan 1.5601	Feb 1.5565	Mar 1.5530	Apr 1.5366	May 1.5335	Jun 1.5192	Jul 1.5192	Aug 1.5166	Sep 1.5247	Oct 1.5335	Nov 1.5398	Dec 1.5463	(40)
HLP (average)												1.5366	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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

Assumed occupancy												1.8080	(42)
Hot water usage for mixer showers												0.0000	(42a)
Hot water usage for baths	23.5745	23.2244	22.7314	21.8223	21.1416	20.3868	19.9791	20.4687	21.0018	21.8094	22.7372	23.4948	(42b)
Hot water usage for other uses	33.1458	31.9405	30.7352	29.5299	28.3246	27.1193	27.1193	28.3246	29.5299	30.7352	31.9405	33.1458	(42c)
Average daily hot water use (litres/day)												51.9898	(43)
Daily hot water use	Jan 56.7203	Feb 55.1649	Mar 53.4666	Apr 51.3522	May 49.4662	Jun 47.5061	Jul 47.0984	Aug 48.7933	Sep 50.5317	Oct 52.5446	Nov 54.6777	Dec 56.6406	(44)
Energy conte	89.8311	78.5541	82.1761	70.2986	66.5910	58.4143	56.9614	60.4163	62.3106	71.3025	77.8984	88.6855	(45)
Energy content (annual)												Total = Sum(45)m =	863.4398
Distribution loss (46)m = 0.15 x (45)m												0.0000	(46)
Water storage loss:												0.0000	(46)
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)



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If cylinder contains dedicated solar storage												
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)	
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)	
Total heat required for water heating calculated for each month												
WWHRS	76.3564	66.7710	69.8497	59.7538	56.6023	49.6521	48.4172	51.3538	52.9640	60.6072	66.2136	75.3827 (62)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63a)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63b)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63c)
Output from w/h	76.3564	66.7710	69.8497	59.7538	56.6023	49.6521	48.4172	51.3538	52.9640	60.6072	66.2136	75.3827 (64)
										Total per year (kWh/year) = Sum(64)m =		733.9239 (64)
												734 (64)
12Total per year (kWh/year)												
Electric shower(s)	43.6725	38.9125	42.4910	40.5486	41.3095	39.4053	40.7188	41.3095	40.5486	42.4910	41.6920	43.6725 (64a)
										Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =		496.7719 (64a)
Heat gains from water heating, kWh/month												
	30.0072	26.4209	28.0852	25.0756	24.4780	22.2644	22.2840	23.1658	23.3782	25.7745	26.9764	29.7638 (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
	90.4002	90.4002	90.4002	90.4002	90.4002	90.4002	90.4002	90.4002	90.4002	90.4002	90.4002	90.4002 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	79.4808	87.9966	79.4808	82.1301	79.4808	82.1301	79.4808	79.4808	82.1301	79.4808	82.1301	79.4808 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	157.6049	159.2403	155.1190	146.3453	135.2701	124.8610	117.9070	116.2716	120.3929	129.1666	140.2418	150.6509 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.0400	32.0400	32.0400	32.0400	32.0400	32.0400	32.0400	32.0400	32.0400	32.0400	32.0400	32.0400 (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)	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201 (71)
Water heating gains (Table 5)	40.3323	39.3168	37.7489	34.8272	32.9005	30.9227	29.9516	31.1369	32.4697	34.6432	37.4672	40.0051 (72)
Total internal gains	327.5380	336.6737	322.4687	313.4227	297.7714	288.0339	277.4595	277.0093	285.1127	293.4106	309.9592	320.2568 (73)

## 6. Solar gains

[Jan]	Area	Solar flux	g	FF	Access	Gains						
	m2	Table 6a	Specific data	Specific data	factor	W						
		W/m2	or Table 6b	or Table 6c	Table 6d							
North	3.4900	10.6334	0.6300	0.7000	0.7700	11.3415 (74)						
East	0.9800	19.6403	0.6300	0.7000	0.7700	5.8823 (76)						
South	3.3100	46.7521	0.6300	0.7000	0.7700	47.2934 (78)						
West	0.4900	19.6403	0.6300	0.7000	0.7700	2.9411 (80)						
North	0.5500	16.7973	0.6300	0.7000	1.0000	3.6668 (82)						
East	2.1400	26.0000	0.6300	0.7000	1.0000	22.0835 (82)						
South	0.5500	42.0754	0.6300	0.7000	1.0000	9.1848 (82)						
Solar gains	102.3934	186.2493	284.4754	399.2270	487.7133	501.4540	476.3110	408.0315	324.0547	214.0107	124.8426	86.1810 (83)
Total gains	429.9314	522.9230	606.9441	712.6498	785.4847	789.4878	753.7704	685.0408	609.1674	507.4212	434.8018	406.4378 (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	17.8051	17.8459	17.8861	18.0774	18.1136	18.2842	18.2842	18.3162	18.2181	18.1136	18.0404	17.9646
alpha	2.1870	2.1897	2.1924	2.2052	2.2076	2.2189	2.2189	2.2211	2.2145	2.2076	2.2027	2.1976
util living area	0.9468	0.9196	0.8775	0.7956	0.6814	0.5418	0.4252	0.4732	0.6646	0.8436	0.9243	0.9524 (86)
MIT	17.6941	18.1124	18.7354	19.5445	20.2170	20.6742	20.8644	20.8238	20.4542	19.5560	18.4919	17.6275 (87)
Th 2	19.6427	19.6454	19.6480	19.6602	19.6624	19.6731	19.6731	19.6751	19.6690	19.6624	19.6578	19.6530 (88)
util rest of house	0.9380	0.9067	0.8574	0.7614	0.6262	0.4582	0.3143	0.3603	0.5870	0.8091	0.9098	0.9445 (89)
MIT 2	16.7024	17.1123	17.7186	18.4937	19.1042	19.4907	19.6222	19.6035	19.3316	18.5294	17.5001	16.6433 (90)
Living area fraction	FLA = Living area / (4) =											
MIT	16.9595	17.3716	17.9822	18.7662	19.3927	19.7976	19.9442	19.9198	19.6226	18.7955	17.7572	16.8985 (92)
Temperature adjustment	0.0000											
adjusted MIT	16.9595	17.3716	17.9822	18.7662	19.3927	19.7976	19.9442	19.9198	19.6226	18.7955	17.7572	16.8985 (93)

## 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9134	0.8774	0.8257	0.7342	0.6137	0.4667	0.3384	0.3828	0.5839	0.7811	0.8818	0.9214 (94)
Useful gains	392.6866	458.7940	501.1301	523.2416	482.0751	368.4316	255.0811	262.2430	355.7041	396.3282	383.3897	374.4778 (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	1066.5054	1048.2716	962.9408	818.6620	637.0395	426.3975	274.3538	288.2574	454.7102	678.6776	886.1094	1060.2949 (97)
Space heating kWh	501.3212	396.1289	343.5872	212.7027	115.2935	0.0000	0.0000	0.0000	0.0000	210.0680	361.9582	510.2479 (98a)
Space heating requirement - total per year (kWh/year)	2651.3076											
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	501.3212	396.1289	343.5872	212.7027	115.2935	0.0000	0.0000	0.0000	0.0000	210.0680	361.9582	510.2479 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)	2651.3076											
Space heating per m2	(98c) / (4) =											
	49.0983 (99)											

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## 8c. Space cooling requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000
Heat loss rate W												
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	771.1568	607.0809	622.4009	0.0000	0.0000	0.0000	0.0000 (100)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.7228	0.7829	0.7477	0.0000	0.0000	0.0000	0.0000 (101)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	557.3756	475.2925	465.3534	0.0000	0.0000	0.0000	0.0000 (102)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	211.8206	251.8701	205.8665	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction									fc = cooled area / (4) =			1.0000 (105)
Intermittency factor (Table 10b)	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500	0.2500 (106)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	52.9552	62.9675	51.4666	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												167.3893 (107)
Energy for space heating												49.0983 (99)
Energy for space cooling												3.0998 (108)
Total												52.1981 (109)
Fabric Energy Efficiency (TFEE)												52.2 (109)

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

## 1. Overall dwelling characteristics

	Area (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	54.0000 (1b)	2.6000 (2b)	140.4000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	54.0000		140.4000 (4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 140.4000 (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	3 * 10 =	30.0000 (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) =	30.0000 / (5) =	0.2137 (8)
Pressure test	No	
Pressure Test Method	Blower Door	
Measured/design AP50		15.0000 (17)
Infiltration rate		0.9637 (18)
Number of sides sheltered		1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.8914 (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												
	1.1365	1.1142	1.0920	0.9805	0.9583	0.8468	0.8468	0.8245	0.8914	0.9583	1.0028	1.0474 (22b)
Effective ac	1.1365	1.1142	1.0920	0.9807	0.9591	0.8586	0.8586	0.8399	0.8973	0.9591	1.0028	1.0474 (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
Doors			2.0000	1.4000	2.8000		(26)
Windows (Uw = 1.40)			13.5000	1.3258	17.8977		(27)
Rooflights (N)			0.9000	1.3258	1.1932		(27a)
Rooflights (S)			0.9000	1.3258	1.1932		(27a)
Roof Glazing			3.5000	1.3258	4.6402		(27a)
Floor			54.0000	0.2500	13.5000		(28a)
Wall (uninsulated)	3.5000		3.5000	2.5000	8.7500		(29a)
Wall (upgrade)	48.0000	3.6500	44.3500	0.3000	13.3050		(29a)
Wall (new)	43.0000	11.8500	31.1500	0.1800	5.6070		(29a)
Roof	58.0000	1.8000	56.2000	0.1500	8.4300		(30)
Roof (flat)	6.0000	3.5000	2.5000	0.1500	0.3750		(30)
Total net area of external elements Aum (A, m <sup>2</sup> )			212.5000				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	77.6912	(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							100.0000 (35)
Thermal bridges (Default value 0.200 * total exposed area)							42.5000 (36)
Point Thermal bridges						(36a) =	0.0000
Total fabric heat loss						(33) + (36) + (36a) =	120.1912 (37)
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)							

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	52.6579	51.6254	50.5929	45.4391	44.4382	39.7788	39.7788	38.9160	41.5735	44.4382	46.4629	48.5279	(38)
Heat transfer coeff	172.8492	171.8166	170.7841	165.6304	164.6295	159.9701	159.9701	159.1072	161.7648	164.6295	166.6541	168.7191	(39)
Average = Sum(39)m / 12 =												165.5437	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	3.2009	3.1818	3.1627	3.0672	3.0487	2.9624	2.9624	2.9464	2.9956	3.0487	3.0862	3.1244	(40)
HLP (average)												3.0656	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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

Assumed occupancy													1.8080	(42)
Hot water usage for mixer showers														
68.1672	67.1428	65.6500	62.7939	60.6861	58.3355	56.9994	58.4809	60.1049	62.6287	65.5462	67.9061	67.9061	(42a)	
Hot water usage for baths														
23.5745	23.2244	22.7314	21.8223	21.1416	20.3868	19.9791	20.4687	21.0018	21.8094	22.7372	23.4948	23.4948	(42b)	
Hot water usage for other uses														
33.1458	31.9405	30.7352	29.5299	28.3246	27.1193	27.1193	28.3246	29.5299	30.7352	31.9405	33.1458	33.1458	(42c)	
Average daily hot water use (litres/day)													114.8377	(43)
Daily hot water use														
124.8875	122.3077	119.1166	114.1460	110.1523	105.8416	104.0978	107.2742	110.6366	115.1733	120.2239	124.5467	124.5467	(44)	
Energy conte	197.7913	174.1645	183.0778	156.2602	148.2861	130.1446	125.8973	132.8279	136.4259	156.2891	171.2810	195.0100	(45)	
Energy content (annual)													1907.4558	
Distribution loss (46)m = 0.15 x (45)m														
29.6687	26.1247	27.4617	23.4390	22.2429	19.5217	18.8846	19.9242	20.4639	23.4434	25.6922	29.2515	29.2515	(46)	
Water storage loss:														
Store volume													210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):													2.0000	(48)
Temperature factor from Table 2b													0.5400	(49)
Enter (49) or (54) in (55)													1.0800	(55)
Total storage loss														
33.4800	30.2400	33.4800	32.4000	33.4800	32.4000	33.4800	33.4800	32.4000	33.4800	32.4000	33.4800	33.4800	(56)	
If cylinder contains dedicated solar storage														
33.4800	30.2400	33.4800	32.4000	33.4800	32.4000	33.4800	33.4800	32.4000	33.4800	32.4000	33.4800	33.4800	(57)	
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(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														
254.5337	225.4157	239.8202	211.1722	205.0285	185.0566	182.6397	189.5703	191.3379	213.0315	226.1930	251.7524	251.7524	(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														
254.5337	225.4157	239.8202	211.1722	205.0285	185.0566	182.6397	189.5703	191.3379	213.0315	226.1930	251.7524	251.7524	(64)	
Electric shower(s)														
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)	
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =													0.0000	(64a)
Heat gains from water heating, kWh/month														
111.1595	98.9107	106.2673	95.8861	94.6991	87.2027	87.2548	89.5592	89.2912	97.3600	100.8805	110.2347	110.2347	(65)	

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

Metabolic gains (Table 5), Watts													
(66)m	108.4802	108.4802	108.4802	108.4802	108.4802	108.4802	108.4802	108.4802	108.4802	108.4802	108.4802	108.4802	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
19.3076	17.1488	13.9464	10.5583	7.8924	6.6631	7.1998	9.3585	12.5610	15.9490	18.6149	19.8442	19.8442	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
235.2311	237.6721	231.5209	218.4259	201.8957	186.3597	175.9807	173.5397	179.6908	192.7859	209.3161	224.8521	224.8521	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
47.6560	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560	(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)													
-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	(71)
Water heating gains (Table 5)													
149.4080	147.1885	142.8324	133.1752	127.2837	121.1148	117.2779	120.3753	124.0156	130.8603	140.1119	148.1650	148.1650	(72)
Total internal gains	487.7628	485.8255	472.1157	445.9754	420.8879	397.9537	384.2744	387.0895	400.0835	423.4113	451.8589	476.6774	(73)

#### 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North	5.7000	10.6334	0.6300	0.7000	0.7700	18.5233 (74)
East	1.6000	19.6403	0.6300	0.7700	0.7700	9.6037 (76)
South	5.4000	46.7521	0.6300	0.7000	0.7700	77.1554 (78)
West	0.8000	19.6403	0.6300	0.7000	0.7700	4.8019 (80)
North	0.9000	16.7973	0.6300	0.8000	1.0000	6.8573 (82)
East	3.5000	26.0000	0.6300	0.8000	1.0000	41.2776 (82)
South	0.9000	42.0754	0.6300	0.8000	1.0000	17.1768 (82)

Solar gains	175.3961	320.5434	492.8998	696.0049	853.2468	878.3639	833.8983	712.5429	562.9860	369.2554	214.1358	147.4344	(83)
Total gains	663.1588	806.3689	965.0155	1141.9803	1274.1347	1276.3176	1218.1727	1099.6324	963.0695	792.6667	665.9947	624.1117	(84)

#### 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)													21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)														
tau	8.6781	8.7302	8.7830	9.0563	9.1114	9.3768	9.3768	9.4276	9.2727	9.1114	9.0007	8.8905		

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alpha	1.5785	1.5820	1.5855	1.6038	1.6074	1.6251	1.6251	1.6285	1.6182	1.6074	1.6000	1.5927
util living area	0.9227	0.8949	0.8499	0.7730	0.6718	0.5497	0.4467	0.4910	0.6628	0.8201	0.8991	0.9286 (86)
MIT	17.1845	17.5372	18.1484	18.9696	19.7006	20.2749	20.5496	20.4940	20.0177	19.0599	17.9995	17.1512 (87)
Th 2	18.6529	18.6619	18.6709	18.7168	18.7259	18.7689	18.7689	18.7770	18.7522	18.7259	18.7075	18.6891 (88)
util rest of house	0.9056	0.8719	0.8160	0.7192	0.5864	0.4163	0.2573	0.3017	0.5405	0.7640	0.8730	0.9128 (89)
MIT 2	15.4670	15.8137	16.4074	17.2085	17.8662	18.3594	18.5320	18.5181	18.1822	17.3320	16.3053	15.4582 (90)
Living area fraction	15.9123	16.2605	16.8588	17.6651	18.3417	18.8560	19.0551	19.0304	18.6581	17.7800	16.7445	15.8971 (92)
MIT	15.9123	16.2605	16.8588	17.6651	18.3417	18.8560	19.0551	19.0304	18.6581	17.7800	16.7445	15.8971 (92)
Temperature adjustment												0.0000
adjusted MIT	15.9123	16.2605	16.8588	17.6651	18.3417	18.8560	19.0551	19.0304	18.6581	17.7800	16.7445	15.8971 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.8763	0.8386	0.7803	0.6875	0.5688	0.4225	0.2858	0.3275	0.5341	0.7322	0.8409	0.8849 (94)
Useful gains	581.1351	676.2206	752.9963	785.1436	724.6705	539.2262	348.1734	360.1470	514.3430	580.4300	560.0159	552.2706 (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	2007.1681	1951.9248	1769.1164	1451.7681	1093.4277	680.8295	392.7389	418.5150	737.3408	1182.0314	1607.3001	1973.5222 (97)
Space heating kWh	1060.9686	857.2733	755.9933	479.9696	274.3553	0.0000	0.0000	0.0000	0.0000	447.5915	754.0447	1057.4112 (98a)
Space heating requirement - total per year (kWh/year)												5687.6075
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	1060.9686	857.2733	755.9933	479.9696	274.3553	0.0000	0.0000	0.0000	0.0000	447.5915	754.0447	1057.4112 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												5687.6075
Space heating per m2												(98c) / (4) = 105.3261 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												219.3000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	1060.9686	857.2733	755.9933	479.9696	274.3553	0.0000	0.0000	0.0000	0.0000	447.5915	754.0447	1057.4112 (98)
Space heating efficiency (main heating system 1)	219.3000	219.3000	219.3000	219.3000	219.3000	0.0000	0.0000	0.0000	0.0000	219.3000	219.3000	219.3000 (210)
Space heating fuel (main heating system)	483.7978	390.9135	344.7302	218.8644	125.1050	0.0000	0.0000	0.0000	0.0000	204.1001	343.8416	482.1756 (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	254.5337	225.4157	239.8202	211.1722	205.0285	185.0566	182.6397	189.5703	191.3379	213.0315	226.1930	251.7524 (64)
Efficiency of water heater (217)m	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000 (216)
Fuel for water heating, kWh/month	133.6837	118.3906	125.9560	110.9098	107.6830	97.1936	95.9242	99.5642	100.4926	111.8863	118.7989	132.2229 (219)
Space cooling fuel requirement												
(221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (231)
Lighting	16.8998	13.5577	12.2072	8.9435	6.9082	5.6441	6.3019	8.1914	10.6399	13.9601	15.7679	17.3695 (232)
Electricity generated by PVs (Appendix M) (negative quantity)	-12.2596	-21.5671	-39.0063	-52.5274	-61.8049	-54.0299	-52.9436	-46.8428	-36.6030	-27.0373	-14.5663	-10.0260 (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)	-1.6681	-4.5602	-12.4190	-25.2326	-41.0457	-49.6501	-48.2999	-37.2589	-23.0130	-8.3176	-2.5409	-1.2233 (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												2593.5283 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												190.4000
Water heating fuel used												1352.7058 (219)
Space cooling fuel												0.0000 (221)
Electricity for pumps and fans:												
Total electricity for the above, kWh/year												0.0000 (231)
Electricity for lighting (calculated in Appendix L)												136.3911 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-684.4435 (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												3398.1816 (238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2593.5283	16.4900	427.6728	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1352.7058	16.4900	223.0612	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(249)
Energy for lighting	136.3911	16.4900	22.4909	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-429.2143	16.4900	-70.7774	
PV Unit electricity exported	-255.2293	5.5900	-14.2673	
Total			-85.0447	(252)
Total energy cost			588.1801	(255)

## 11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600	(256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	2.1388	(257)
SAP value		65.3295	
SAP rating (Section 12)		65	(258)
SAP band		D	

## 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	2593.5283	0.1543	400.2327	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1352.7058	0.1408	190.5081	(264)
Space and water heating			590.7408	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	136.3911	0.1443	19.6855	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-429.2143	0.1320	-56.6698	
PV Unit electricity exported	-255.2293	0.1177	-30.0434	
Total			-86.7132	(269)
Total CO2, kg/year			523.7130	(272)
CO2 emissions per m2			9.7000	(273)
EI value			92.9114	
EI rating			93	(274)
EI band			A	

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

### 1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)	
Ground floor	54.0000	2.6000	140.4000	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	54.0000			(4)
Dwelling volume			140.4000	(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	3 * 10 =	30.0000	(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) =	30.0000 / (5) =	0.2137	(8)
Pressure test		No	
Pressure Test Method		Blower Door	
Measured/design AP50		15.0000	(17)
Infiltration rate		0.9637	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.8914	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.7000	4.4000	4.5000	4.2000	4.2000	3.9000	3.9000	3.7000	3.7000	4.0000	4.0000	4.3000
Wind factor	1.1750	1.1000	1.1250	1.0500	1.0500	0.9750	0.9750	0.9250	0.9250	1.0000	1.0000	1.0750

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Adj infilt rate	1.0474	0.9805	1.0028	0.9360	0.9360	0.8691	0.8691	0.8245	0.8245	0.8914	0.8914	0.9583 (22b)
Effective ac	1.0474	0.9807	1.0028	0.9380	0.9380	0.8777	0.8777	0.8399	0.8399	0.8973	0.8973	0.9591 (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					
Doors			2.0000	1.4000	2.8000			(26)				
Windows (Uw = 1.40)			13.5000	1.3258	17.8977			(27)				
Rooflights (N)			0.9000	1.3258	1.1932			(27a)				
Rooflights (S)			0.9000	1.3258	1.1932			(27a)				
Roof Glazing			3.5000	1.3258	4.6402			(27a)				
Floor			54.0000	0.2500	13.5000			(28a)				
Wall (uninsulated)	3.5000		3.5000	2.5000	8.7500			(29a)				
Wall (upgrade)	48.0000	3.6500	44.3500	0.3000	13.3050			(29a)				
Wall (new)	43.0000	11.8500	31.1500	0.1800	5.6070			(29a)				
Roof	58.0000	1.8000	56.2000	0.1500	8.4300			(30)				
Roof (flat)	6.0000	3.5000	2.5000	0.1500	0.3750			(30)				
Total net area of external elements Aum(A, m2)			212.5000					(31)				
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	77.6912		(33)				
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								100.0000 (35)				
Thermal bridges (Default value 0.200 * total exposed area)								42.5000 (36)				
Point Thermal bridges								0.0000 (36a) =				
Total fabric heat loss								(33) + (36) + (36a) = 120.1912 (37)				
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 48.5279	Feb 45.4391	Mar 46.4629	Apr 43.4603	May 43.4603	Jun 40.6647	Jul 40.6647	Aug 38.9160	Sep 38.9160	Oct 41.5735	Nov 41.5735	Dec 44.4382 (38)
Heat transfer coeff	168.7191	165.6304	166.6541	163.6516	163.6516	160.8559	160.8559	159.1072	159.1072	161.7648	161.7648	164.6295 (39)
Average = Sum(39)m / 12 =												163.0327
HLP	Jan 3.1244	Feb 3.0672	Mar 3.0862	Apr 3.0306	May 3.0306	Jun 2.9788	Jul 2.9788	Aug 2.9464	Sep 2.9464	Oct 2.9956	Nov 2.9956	Dec 3.0487 (40)
HLP (average)												3.0191
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

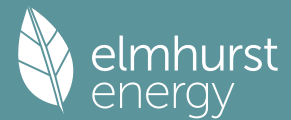
### 4. Water heating energy requirements (kWh/year)

Assumed occupancy													1.8080 (42)
Hot water usage for mixer showers	68.1672	67.1428	65.6500	62.7939	60.6861	58.3355	56.9994	58.4809	60.1049	62.6287	65.5462	67.9061	42a) 67.9061
Hot water usage for baths	23.5745	23.2244	22.7314	21.8223	21.1416	20.3868	19.9791	20.4687	21.0018	21.8094	22.7372	23.4948	42b) 23.4948
Hot water usage for other uses	33.1458	31.9405	30.7352	29.5299	28.3246	27.1193	27.1193	28.3246	29.5299	30.7352	31.9405	33.1458	42c) 33.1458
Average daily hot water use (litres/day)													114.8377 (43)
Daily hot water use	Jan 124.8875	Feb 122.3077	Mar 119.1166	Apr 114.1460	May 110.1523	Jun 105.8416	Jul 104.0978	Aug 107.2742	Sep 110.6366	Oct 115.1733	Nov 120.2239	Dec 124.5467	44) 124.5467
Energy content (annual)	197.7913	174.1645	183.0778	156.2602	148.2861	130.1446	125.8973	132.8279	136.4259	156.2891	171.2810	195.0100	45) 195.0100
Distribution loss (46)m = 0.15 x (45)m	29.6687	26.1247	27.4617	23.4390	22.2429	19.5217	18.8846	19.9242	20.4639	23.4434	25.6922	29.2515	46) 29.2515
Water storage loss:													210.0000 (47)
Store volume													2.0000 (48)
a) If manufacturer declared loss factor is known (kWh/day):													0.5400 (49)
Temperature factor from Table 2b													1.0800 (55)
Enter (49) or (54) in (55)													
Total storage loss	33.4800	30.2400	33.4800	32.4000	33.4800	32.4000	33.4800	33.4800	32.4000	33.4800	32.4000	33.4800	56) 33.4800
If cylinder contains dedicated solar storage	33.4800	30.2400	33.4800	32.4000	33.4800	32.4000	33.4800	33.4800	32.4000	33.4800	32.4000	33.4800	57) 33.4800
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) 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	61) 0.0000
Total heat required for water heating calculated for each month	254.5337	225.4157	239.8202	211.1722	205.0285	185.0566	182.6397	189.5703	191.3379	213.0315	226.1930	251.7524	62) 251.7524
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) 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	63b) -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	63c) 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	63d) 0.0000
Output from w/h	254.5337	225.4157	239.8202	211.1722	205.0285	185.0566	182.6397	189.5703	191.3379	213.0315	226.1930	251.7524	64) 251.7524
Total per year (kWh/year) = Sum(64)m =													2575.5518 (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
Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =													0.0000 (64a)
Heat gains from water heating, kWh/month	111.1595	98.9107	106.2673	95.8861	94.6991	87.2027	87.2548	89.5592	89.2912	97.3600	100.8805	110.2347	65) 110.2347

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

Metabolic gains (Table 5), Watts													
(66)m	Jan 108.4802	Feb 108.4802	Mar 108.4802	Apr 108.4802	May 108.4802	Jun 108.4802	Jul 108.4802	Aug 108.4802	Sep 108.4802	Oct 108.4802	Nov 108.4802	Dec 108.4802	66) 108.4802
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	19.3076	17.1488	13.9464	10.5583	7.8924	6.6631	7.1998	9.3585	12.5610	15.9490	18.6149	19.8442	67) 19.8442
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	235.2311	237.6721	231.5209	218.4259	201.8957	186.3597	175.9807	173.5397	179.6908	192.7859	209.3161	224.8521	68) 224.8521
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560	69) 47.6560
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) 0.0000
Losses e.g. evaporation (negative values) (Table 5)	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	71) -72.3201
Water heating gains (Table 5)	149.4080	147.1885	142.8324	133.1752	127.2837	121.1148	117.2779	120.3753	124.0156	130.8603	140.1119	148.1650	72) 148.1650
Total internal gains	487.7628	485.8255	472.1157	445.9754	420.8879	397.9537	384.2744	387.0895	400.0835	423.4113	451.8589	476.6774	73) 476.6774

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## 6. Solar gains

[Jan]		Area m <sup>2</sup>	Solar flux Table 6a W/m <sup>2</sup>	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W					
North		5.7000	12.7350	0.6300	0.7000	0.7700	22.1843 (74)					
East		1.6000	23.7652	0.6300	0.7000	0.7700	11.6207 (76)					
South		5.4000	53.8987	0.6300	0.7000	0.7700	88.9496 (78)					
West		0.8000	23.7652	0.6300	0.7000	0.7700	5.8104 (80)					
North		0.9000	20.0333	0.6300	0.8000	1.0000	8.1784 (82)					
East		3.5000	32.0000	0.6300	0.8000	1.0000	50.8032 (82)					
South		0.9000	50.0836	0.6300	0.8000	1.0000	20.4461 (82)					
Solar gains	207.9927	339.0362	526.6271	773.9077	891.7373	1005.7867	917.2940	799.7287	633.9352	407.4715	250.3801	168.9394 (83)
Total gains	695.7555	824.8617	998.7428	1219.8831	1312.6252	1403.7404	1301.5684	1186.8183	1034.0187	830.8828	702.2390	645.6168 (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	8.8905	9.0563	9.0007	9.1658	9.1658	9.3251	9.3251	9.4276	9.4276	9.2727	9.2727	9.1114
alpha	1.5927	1.6038	1.6000	1.6111	1.6111	1.6217	1.6217	1.6285	1.6285	1.6182	1.6182	1.6074
util living area	0.9124	0.8850	0.8346	0.7463	0.6487	0.5005	0.4211	0.4463	0.6243	0.7972	0.8815	0.9192 (86)
MIT	17.4331	17.7625	18.3574	19.1484	19.8125	20.3771	20.5775	20.5577	20.1332	19.2441	18.3032	17.4397 (87)
Th 2	18.6891	18.7168	18.7075	18.7348	18.7348	18.7606	18.7606	18.7770	18.7770	18.7522	18.7522	18.7259 (88)
util rest of house	0.8928	0.8599	0.7973	0.6874	0.5576	0.3606	0.2334	0.2525	0.4947	0.7338	0.8502	0.9009 (89)
MIT 2	15.7338	16.0684	16.6305	17.3803	17.9650	18.4137	18.5335	18.5447	18.2831	17.5177	16.6284	15.7659 (90)
Living area fraction									fLA = Living area / (4) =			
MIT	16.1744	16.5076	17.0782	17.8387	18.4440	18.9227	19.0634	19.0666	18.7628	17.9653	17.0626	16.1998 (92)
Temperature adjustment												0.0000
adjusted MIT	16.1744	16.5076	17.0782	17.8387	18.4440	18.9227	19.0634	19.0666	18.7628	17.9653	17.0626	16.1998 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.8620	0.8261	0.7619	0.6582	0.5435	0.3724	0.2628	0.2822	0.4937	0.7041	0.8170	0.8714 (94)
Useful gains	599.7565	681.3956	760.9567	802.9741	713.3796	522.7053	342.0802	334.8608	510.4924	585.0047	573.7345	562.5714 (95)
Ext temp.	4.9000	5.4000	7.0000	9.3000	12.1000	15.0000	16.7000	16.7000	14.4000	11.1000	7.9000	5.0000 (96)
Heat loss rate W	1902.2060	1839.7595	1679.5722	1397.3708	1038.2013	630.9955	380.1670	376.5394	694.1507	1110.5688	1482.1813	1843.8220 (97)
Space heating kWh	969.0224	778.4206	683.4500	427.9657	241.6673	0.0000	0.0000	0.0000	0.0000	391.0198	654.0817	953.2505 (98a)
Space heating requirement - total per year (kWh/year)												5098.8778
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	969.0224	778.4206	683.4500	427.9657	241.6673	0.0000	0.0000	0.0000	0.0000	391.0198	654.0817	953.2505 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												5098.8778
Space heating per m <sup>2</sup>												94.4237 (99)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												219.3000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement	969.0224	778.4206	683.4500	427.9657	241.6673	0.0000	0.0000	0.0000	0.0000	391.0198	654.0817	953.2505 (98)
Space heating efficiency (main heating system 1)	219.3000	219.3000	219.3000	219.3000	219.3000	0.0000	0.0000	0.0000	0.0000	219.3000	219.3000	219.3000 (210)
Space heating fuel (main heating system)	441.8707	354.9569	311.6507	195.1508	110.1994	0.0000	0.0000	0.0000	0.0000	178.3036	298.2589	434.6787 (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	254.5337	225.4157	239.8202	211.1722	205.0285	185.0566	182.6397	189.5703	191.3379	213.0315	226.1930	251.7524 (64)
Efficiency of water heater (217)m	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000 (216)
Fuel for water heating, kWh/month	133.6837	118.3906	125.9560	110.9098	107.6830	97.1936	95.9242	99.5642	100.4926	111.8863	118.7989	132.2229 (219)
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (221)
Pumps and Fa	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (231)
Lighting	16.8998	13.5577	12.2072	8.9435	6.9082	5.6441	6.3019	8.1914	10.6399	13.9601	15.7679	17.3695 (232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-14.8179	-23.2276	-41.7965	-57.1517	-63.5152	-59.2075	-56.5781	-51.0887	-40.5443	-29.9315	-17.2481	-11.7622 (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)												

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(235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233b)m	-2.3238	-5.3190	-14.4499	-30.4579	-44.6921	-60.0245	-55.3791	-44.2624	-27.8845	-10.2445	-3.4879	-1.6298	(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												2325.0697	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												190.4000	
Water heating fuel used												1352.7058	(219)
Space cooling fuel												0.0000	(221)
Electricity for pumps and fans:													
Total electricity for the above, kWh/year												0.0000	(231)
Electricity for lighting (calculated in Appendix L)												136.3911	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-767.0246	(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												3047.1419	(238)

## 10a. Fuel costs - using BEDF prices (538)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2325.0697	25.1600	584.9875	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1352.7058	25.1600	340.3408	(247)
Energy for instantaneous electric shower(s)	0.0000	25.1600	0.0000	(247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(249)
Energy for lighting	136.3911	25.1600	34.3160	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-466.8692	25.1600	-117.4643	
PV Unit electricity exported	-300.1554	5.8100	-17.4390	
Total			-134.9033	(252)
Total energy cost			824.7410	(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	2325.0697	0.1544	359.0925	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1352.7058	0.1408	190.5081	(264)
Space and water heating			549.6005	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	136.3911	0.1443	19.6855	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-466.8692	0.1322	-61.7291	
PV Unit electricity exported	-300.1554	0.1179	-35.3856	
Total			-97.1147	(269)
Total CO2, kg/year			472.1713	(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	2325.0697	1.5718	3654.5193	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1352.7058	1.5208	2057.1314	(278)
Space and water heating			5711.6507	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	136.3911	1.5338	209.2012	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-466.8692	1.4885	-694.9521	
PV Unit electricity exported	-300.1554	0.4321	-129.7101	
Total			-824.6622	(283)
Total Primary energy kWh/year			5096.1898	(286)

## SAP 10 EPC IMPROVEMENTS

CB5602

Current energy efficiency rating: D 65  
 Current environmental impact rating: A 93

N Solar water heating Recommended  
 U Solar photovoltaic panels Already installed  
 V2 Wind turbine Recommended

Recommended measures: SAP change Cost change CO2 change



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N Solar water heating	+ 2.6	-£ 77	-40 kg (8.4%)
V2 Wind turbine	+ 27.7	-£ 685	-496 kg (114.7%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£77	0.74 kg/m <sup>2</sup>	D 68	A 93
Wind turbine	£685	9.18 kg/m <sup>2</sup>	A 96	A 100
<b>Total Savings</b>	<b>£762</b>	<b>9.92 kg/m<sup>2</sup></b>		

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

Fuel prices for cost data on this page from database revision number 538 TEST (29 Feb 2024)  
 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	£960	£879	£81
Space heating	£585	£606	-£21
Water heating	£340	£239	£101
Lighting	£34	£34	£0
Generated (PV)	-£135	-£131	-£4
Generated (wind)	-£0	-£685	£685
<b>Total cost of fuels</b>	<b>£825</b>	<b>£63</b>	<b>£762</b>
Total cost of uses	£824	£63	£761
Delivered energy	56 kWh/m <sup>2</sup>	-16 kWh/m <sup>2</sup>	72 kWh/m <sup>2</sup>
Carbon dioxide emissions	0.5 tonnes	-0.1 tonnes	0.5 tonnes
CO2 emissions per m <sup>2</sup>	9 kg/m <sup>2</sup>	-1 kg/m <sup>2</sup>	10 kg/m <sup>2</sup>
Primary energy	94 kWh/m <sup>2</sup>	6 kWh/m <sup>2</sup>	88 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	54.0000 (1b)	x 2.6000 (2b)	= 140.4000 (1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	54.0000		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	140.4000 (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	3 * 10 = 30.0000 (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) =	30.0000 / (5) =	0.2137 (8)
Pressure test	No	
Pressure Test Method	Blower Door	
Measured/design APF50		15.0000 (17)
Infiltration rate		0.9637 (18)
Number of sides sheltered		1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.8914 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate												
Effective ac	1.1365	1.1142	1.0920	0.9805	0.9583	0.8468	0.8468	0.8245	0.8914	0.9583	1.0028	1.0474 (22b)
	1.1365	1.1142	1.0920	0.9807	0.9591	0.8586	0.8586	0.8399	0.8973	0.9591	1.0028	1.0474 (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
Doors			2.0000	1.4000	2.8000		(26)
Windows (Uw = 1.40)			13.5000	1.3258	17.8977		(27)
Rooflights (N)			0.9000	1.3258	1.1932		(27a)
Rooflights (S)			0.9000	1.3258	1.1932		(27a)
Roof Glazing			3.5000	1.3258	4.6402		(27a)
Floor			54.0000	0.2500	13.5000		(28a)
Wall (uninsulated)	3.5000		3.5000	2.5000	8.7500		(29a)
Wall (upgrade)	48.0000	3.6500	44.3500	0.3000	13.3050		(29a)
Wall (new)	43.0000	11.8500	31.1500	0.1800	5.6070		(29a)

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Roof		58.0000	1.8000	56.2000	0.1500	8.4300							(30)
Roof (flat)		6.0000	3.5000	2.5000	0.1500	0.3750							(30)
Total net area of external elements Aum(A, m <sup>2</sup> )				212.5000									(31)
Fabric heat loss, W/K = Sum (A x U)				(26) ... (30) + (32) =		77.6912							(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K													100.0000 (35)
Thermal bridges (Default value 0.200 * total exposed area)													42.5000 (36)
Point Thermal bridges													0.0000 (36a) =
Total fabric heat loss													(33) + (36) + (36a) = 120.1912 (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	52.6579	51.6254	50.5929	45.4391	44.4382	39.7788	39.7788	38.9160	41.5735	44.4382	46.4629	48.5279	(38)
Average = Sum(39)m / 12 =	172.8492	171.8166	170.7841	165.6304	164.6295	159.9701	159.9701	159.1072	161.7648	164.6295	166.6541	168.7191	(39)
													165.5437

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP (average)	3.2009	3.1818	3.1627	3.0672	3.0487	2.9624	2.9624	2.9464	2.9956	3.0487	3.0862	3.1244	(40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	3.0656

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

Assumed occupancy													1.8080 (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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy conte	124.8875	122.3077	119.1166	114.1460	110.1523	105.8416	104.0978	107.2742	110.6366	115.1733	120.2239	124.5467	(44)
Energy content (annual)	197.7913	174.1645	183.0778	156.2602	148.2861	130.1446	125.8973	132.8279	136.4259	156.2891	171.2810	195.0100	(45)
Distribution loss (46)m = 0.15 x (45)m													Total = Sum(45)m = 1907.4558
Water storage loss:													
Store volume													210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													2.0000 (48)
Temperature factor from Table 2b													0.5400 (49)
Enter (49) or (54) in (55)													1.0800 (55)
Total storage loss													
If cylinder contains dedicated solar storage													
Primary loss	33.4800	30.2400	33.4800	32.4000	33.4800	32.4000	33.4800	33.4800	32.4000	33.4800	32.4000	33.4800	(56)
Combi loss	33.4800	30.2400	33.4800	32.4000	33.4800	32.4000	33.4800	33.4800	32.4000	33.4800	32.4000	33.4800	(57)
Total heat required for water heating calculated for each month	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)
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													614.0409 (H24)
Heat delivered to space heating													0.0000 (H29)
Solar input													614.0409
Solar input	-0.0000	-16.2232	-57.9097	-79.2573	-103.0121	-94.9271	-94.2167	-82.6036	-57.2757	-28.6155	-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	254.5337	209.1925	180.5147	125.1613	89.2221	77.5228	75.3961	94.8702	128.6594	183.0202	226.1930	251.7524	(64)
Electric shower(s)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(64a)
Heat gains from water heating, kWh/month	111.1595	98.9107	105.1507	90.4832	84.4636	77.1173	76.8332	79.8820	84.9689	96.2434	100.8805	110.2347	(65)

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

Metabolic gains (Table 5), Watts													
(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	108.4802	108.4802	108.4802	108.4802	108.4802	108.4802	108.4802	108.4802	108.4802	108.4802	108.4802	108.4802	(66)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	19.3076	17.1488	13.9464	10.5583	7.8924	6.6631	7.1998	9.3585	12.5610	15.9490	18.6149	19.8442	(67)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	235.2311	237.6721	231.5209	218.4259	201.8957	186.3597	175.9807	173.5397	179.6908	192.7859	209.3161	224.8521	(68)
Pumps, fans	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560	(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)	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	(71)
Total internal gains	149.4080	147.1885	141.3316	125.6712	113.5263	107.1074	103.2705	107.3683	118.0124	129.3595	140.1119	148.1650	(72)
	487.7628	485.8255	470.6149	438.4714	407.1306	383.9463	370.2669	374.0826	394.0803	421.9105	451.8589	476.6774	(73)

#### 6. Solar gains

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[Jan]		Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W
North		5.7000	10.6334	0.6300	0.7000	0.7700	18.5233 (74)
East		1.6000	19.6403	0.6300	0.7000	0.7700	9.6037 (76)
South		5.4000	46.7521	0.6300	0.7000	0.7700	77.1554 (78)
West		0.8000	19.6403	0.6300	0.7000	0.7700	4.8019 (80)
North		0.9000	16.7973	0.6300	0.8000	1.0000	6.8573 (82)
East		3.5000	26.0000	0.6300	0.8000	1.0000	41.2776 (82)
South		0.9000	42.0754	0.6300	0.8000	1.0000	17.1768 (82)

Solar gains	175.3961	320.5434	492.8998	696.0049	853.2468	878.3639	833.8983	712.5429	562.9860	369.2554	214.1358	147.4344 (83)
Total gains	663.1588	806.3689	963.5147	1134.4763	1260.3774	1262.3101	1204.1653	1086.6255	957.0663	791.1659	665.9947	624.1117 (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	8.6781	8.7302	8.7830	9.0563	9.1114	9.3768	9.3768	9.4276	9.2727	9.1114	9.0007	8.8905
alpha	1.5785	1.5820	1.5855	1.6038	1.6074	1.6251	1.6251	1.6285	1.6182	1.6074	1.6000	1.5927
util living area	0.9227	0.8949	0.8502	0.7745	0.6750	0.5532	0.4503	0.4947	0.6647	0.8205	0.8991	0.9286 (86)
MIT	17.1845	17.5372	18.1468	18.9630	19.6919	20.2693	20.5463	20.4901	20.0140	19.0584	17.9995	17.1512 (87)
Th 2	18.6529	18.6619	18.6709	18.7168	18.7259	18.7689	18.7689	18.7770	18.7522	18.7259	18.7075	18.6891 (88)
util rest of house	0.9056	0.8719	0.8163	0.7210	0.5898	0.4196	0.2599	0.3047	0.5425	0.7645	0.8730	0.9128 (89)
MIT 2	15.4670	15.8137	16.4059	17.2030	17.8599	18.3565	18.5311	18.5169	18.1800	17.3307	16.3053	15.4582 (90)
Living area fraction									fLA = Living area / (4) =			
MIT	15.9123	16.2605	16.8573	17.6593	18.3349	18.8524	19.0536	19.0285	18.6555	17.7786	16.7445	15.8971 (92)
Temperature adjustment												0.0000
adjusted MIT	15.9123	16.2605	16.8573	17.6593	18.3349	18.8524	19.0536	19.0285	18.6555	17.7786	16.7445	15.8971 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.8763	0.8386	0.7806	0.6892	0.5718	0.4255	0.2884	0.3304	0.5359	0.7327	0.8409	0.8849 (94)
Useful gains	581.1351	676.2206	752.1438	781.9086	720.7400	537.1756	347.3250	359.0736	512.8578	579.6900	560.0159	552.2706 (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	2007.1681	1951.9248	1768.8586	1450.8046	1092.2927	680.2641	392.4959	418.2111	736.9148	1181.8096	1607.3001	1973.5222 (97)
Space heating kWh	1060.9686	857.2733	756.4358	481.6051	276.4352	0.0000	0.0000	0.0000	0.0000	447.9770	754.0447	1057.4112 (98a)
Space heating requirement - total per year (kWh/year)												5692.1509
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	1060.9686	857.2733	756.4358	481.6051	276.4352	0.0000	0.0000	0.0000	0.0000	447.9770	754.0447	1057.4112 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												5692.1509
Space heating per m2										(98c) / (4) =		105.4102 (99)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												219.3000 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement	1060.9686	857.2733	756.4358	481.6051	276.4352	0.0000	0.0000	0.0000	0.0000	447.9770	754.0447	1057.4112 (98)
Space heating efficiency (main heating system 1)	219.3000	219.3000	219.3000	219.3000	219.3000	0.0000	0.0000	0.0000	0.0000	219.3000	219.3000	219.3000 (210)
Space heating fuel (main heating system)	483.7978	390.9135	344.9320	219.6102	126.0534	0.0000	0.0000	0.0000	0.0000	204.2759	343.8416	482.1756 (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	254.5337	209.1925	180.5147	125.1613	89.2221	77.5228	75.3961	94.8702	128.6594	183.0202	226.1930	251.7524 (64)
Efficiency of water heater												190.4000 (216)
(217)m	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000 (217)
Fuel for water heating, kWh/month	133.6837	109.8700	94.8082	65.7360	46.8603	40.7157	39.5988	49.8268	67.5732	96.1241	118.7989	132.2229 (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)
(221)m	6.7945	6.1370	6.7945	6.5753	6.7945	6.5753	6.7945	6.7945	6.5753	6.7945	6.5753	6.7945 (231)
Pumps and Fa	16.8998	13.5577	12.2072	8.9435	6.9082	5.6441	6.3019	8.1914	10.6399	13.9601	15.7679	17.3695 (232)
Lighting												
Electricity generated by PVs (Appendix M) (negative quantity)												
(233a)m	-12.2661	-21.5599	-38.8030	-51.7081	-59.5117	-49.9951	-48.9839	-44.1862	-35.5983	-26.9699	-14.5785	-10.0309 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234a)m	-212.5732	-192.0016	-212.5732	-205.7160	-212.5732	-202.6175	-199.6450	-209.9464	-205.7160	-212.5732	-205.7160	-212.5732 (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	-1.6616	-4.5675	-12.6223	-26.0519	-43.3388	-53.6849	-52.2596	-39.9156	-24.0177	-8.3850	-2.5287	-1.2184 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												
(234b)m	-91.1028	-82.2864	-91.1028	-88.1640	-91.1028	-91.2626	-104.0311	-93.7296	-88.1640	-91.1028	-88.1640	-91.1028 (234b)

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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	(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	(235d)
Annual totals kWh/year												
Space heating fuel - main system 1											2595.6000	(211)
Space heating fuel - main system 2											0.0000	(213)
Space heating fuel - secondary											0.0000	(215)
Efficiency of water heater											190.4000	
Water heating fuel used											995.8185	(219)
Space cooling fuel											0.0000	(221)
Electricity for pumps and fans:												
pump for solar water heating											80.0000	(230g)
Total electricity for the above, kWh/year											80.0000	(231)
Electricity for lighting (calculated in Appendix L)											136.3911	(232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation											-684.4435	(233)
Wind generation											-3575.5408	(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											-452.1746	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2595.6000	16.4900	428.0144	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	995.8185	16.4900	164.2105	(247)
Energy for instantaneous electric shower(s)	0.0000	16.4900	0.0000	(247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(249)
Pump for solar water heating	80.0000	16.4900	13.1920	(249)
Energy for lighting	136.3911	16.4900	22.4909	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-414.1916	16.4900	-68.3002	
PV Unit electricity exported	-270.2520	5.5900	-15.1071	
Total			-83.4073	(252)
Wind Turbine electricity used in dwelling	-2484.2248	16.4900	-409.6487	
Wind Turbine electricity exported	-1091.3159	5.5900	-61.0046	
Total			-470.6532	(252)
Total energy cost			73.8473	(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] =	0.2685	(257)
SAP value		95.6470	
SAP rating (Section 12)		96	(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	2595.6000	0.1543	400.5193	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	995.8185	0.1457	145.1308	(264)
Space and water heating			545.6502	(265)
Pumps, fans and electric keep-hot	80.0000	0.1387	11.0970	(267)
Energy for lighting	136.3911	0.1443	19.6855	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-414.1916	0.1325	-54.8684	
PV Unit electricity exported	-270.2520	0.1171	-31.6561	
Total			-86.5245	(269)
Wind Turbine electricity used in dwelling	-2484.2248	0.1389	-345.0790	
Wind Turbine electricity exported	-1091.3159	0.1383	-150.8925	
Total			-495.9716	(269)
Total CO2, kg/year			-6.0635	(272)
CO2 emissions per m2			-0.1100	(273)
EI value			100.0821	
EI rating			100	(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	54.0000 (1b)	x 2.6000 (2b)	= 140.4000 (1b) - (3b)	(4)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	54.0000			

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Dwelling volume

(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 140.4000 (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	3 * 10 =	30.0000 (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) =	30.0000 / (5) = 0.2137 (8)
Pressure test		No
Pressure Test Method		Blower Door
Measured/design AP50		15.0000 (17)
Infiltration rate		0.9637 (18)
Number of sides sheltered		1 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.8914 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.7000	4.4000	4.5000	4.2000	4.2000	3.9000	3.9000	3.7000	3.7000	4.0000	4.0000	4.3000 (22)
Wind factor	1.1750	1.1000	1.1250	1.0500	1.0500	0.9750	0.9750	0.9250	0.9250	1.0000	1.0000	1.0750 (22a)
Adj infilt rate												
Effective ac	1.0474	0.9805	1.0028	0.9360	0.9360	0.8691	0.8691	0.8245	0.8245	0.8914	0.8914	0.9583 (22b)
	1.0474	0.9807	1.0028	0.9380	0.9380	0.8777	0.8777	0.8399	0.8399	0.8973	0.8973	0.9591 (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					
Doors			2.0000	1.4000	2.8000		(26)					
Windows (Uw = 1.40)			13.5000	1.3258	17.8977		(27)					
Rooflights (N)			0.9000	1.3258	1.1932		(27a)					
Rooflights (S)			0.9000	1.3258	1.1932		(27a)					
Roof Glazing			3.5000	1.3258	4.6402		(27a)					
Floor			54.0000	0.2500	13.5000		(28a)					
Wall (uninsulated)	3.5000		3.5000	2.5000	8.7500		(29a)					
Wall (upgrade)	48.0000	3.6500	44.3500	0.3000	13.3050		(29a)					
Wall (new)	43.0000	11.8500	31.1500	0.1800	5.6070		(29a)					
Roof	58.0000	1.8000	56.2000	0.1500	8.4300		(30)					
Roof (flat)	6.0000	3.5000	2.5000	0.1500	0.3750		(30)					
Total net area of external elements Aum(A, m2)			212.5000				(31)					
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 77.6912		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000 (35)					
Thermal bridges (Default value 0.200 * total exposed area)							42.5000 (36)					
Point Thermal bridges						(36a) =	0.0000					
Total fabric heat loss						(33) + (36) + (36a) =	120.1912 (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	48.5279	45.4391	46.4629	43.4603	43.4603	40.6647	40.6647	38.9160	38.9160	41.5735	41.5735	44.4382 (38)
Average = Sum(39)m / 12 =	168.7191	165.6304	166.6541	163.6516	163.6516	160.8559	160.8559	159.1072	159.1072	161.7648	161.7648	164.6295 (39)
												163.0327
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	3.1244	3.0672	3.0862	3.0306	3.0306	2.9788	2.9788	2.9464	2.9464	2.9956	2.9956	3.0487 (40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

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

Assumed occupancy													1.8080 (42)
Hot water usage for mixer showers	68.1672	67.1428	65.6500	62.7939	60.6861	58.3355	56.9994	58.4809	60.1049	62.6287	65.5462	67.9061 (42a)	
Hot water usage for baths	23.5745	23.2244	22.7314	21.8223	21.1416	20.3868	19.9791	20.4687	21.0018	21.8094	22.7372	23.4948 (42b)	
Hot water usage for other uses	33.1458	31.9405	30.7352	29.5299	28.3246	27.1193	27.1193	28.3246	29.5299	30.7352	31.9405	33.1458 (42c)	
Average daily hot water use (litres/day)													114.8377 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy conte	124.8875	122.3077	119.1166	114.1460	110.1523	105.8416	104.0978	107.2742	110.6366	115.1733	120.2239	124.5467 (44)	
Energy content (annual)	197.7913	174.1645	183.0778	156.2602	148.2861	130.1446	125.8973	132.8279	136.4259	156.2891	171.2810	195.0100 (45)	
Distribution loss (46)m = 0.15 x (45)m													Total = Sum(45)m = 1907.4558
Water storage loss:	29.6687	26.1247	27.4617	23.4390	22.2429	19.5217	18.8846	19.9242	20.4639	23.4434	25.6922	29.2515 (46)	
Store volume													210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													2.0000 (48)
Temperature factor from Table 2b													0.5400 (49)
Enter (49) or (54) in (55)													1.0800 (55)
Total storage loss	33.4800	30.2400	33.4800	32.4000	33.4800	32.4000	33.4800	33.4800	32.4000	33.4800	32.4000	33.4800 (56)	
If cylinder contains dedicated solar storage	33.4800	30.2400	33.4800	32.4000	33.4800	32.4000	33.4800	33.4800	32.4000	33.4800	32.4000	33.4800 (57)	
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624 (59)	
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)	
Total heat required for water heating calculated for each month													

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WWHRS	254.5337	225.4157	238.4244	204.4186	192.2342	172.4499	169.6128	177.4738	185.9351	211.6358	226.1930	251.7524 (62)
PV diverter	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000 (63b)
Aperture area of solar collector												3.0000 (H1)
Zero-loss collector efficiency												0.8000 (H2)
Collector linear heat loss coefficient												1.8000 (H3)
Collector 2nd order heat loss coefficient												0.0000 (H4)
Collector loop efficiency												0.9000 (H5)
Incidence angle modifier												1.0000 (H6)
Overshading factor												0.8000 (H8)
Overall heat loss coefficient of system												6.5000 (H10)
Heat loss coefficient of collector loop												3.9667 (H11)
Dedicated solar storage volume												75.0000 (H12)
Effective solar volume												75.0000 (H14)
Reference volume												225.0000 (H15)
Storage tank correction coefficient												1.3161 (H16)
Heat delivered to hot water												701.5191 (H24)
Heat delivered to space heating												0.0000 (H29)
Solar input												701.5191
Solar input	-0.6496	-20.0464	-64.6169	-90.5908	-107.8285	-109.2906	-103.7937	-94.4146	-68.2859	-36.6270	-5.3752	-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	253.8841	205.3693	173.8075	113.8278	84.4057	63.1592	65.8190	83.0592	117.6492	175.0088	220.8179	251.7524 (64)
												Total per year (kWh/year) = Sum(64) m = 1808.5602 (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	111.1595	98.9107	105.1507	90.4832	84.4636	77.1173	76.8332	79.8820	84.9689	96.2434	100.8805	110.2347 (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	108.4802	108.4802	108.4802	108.4802	108.4802	108.4802	108.4802	108.4802	108.4802	108.4802	108.4802	108.4802 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	19.3076	17.1488	13.9464	10.5583	7.8924	6.6631	7.1998	9.3585	12.5610	15.9490	18.6149	19.8442 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	235.2311	237.6721	231.5209	218.4259	201.8957	186.3597	175.9807	173.5397	179.6908	192.7859	209.3161	224.8521 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560	47.6560 (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)	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201	-72.3201 (71)
Water heating gains (Table 5)	149.4080	147.1885	141.3316	125.6712	113.5263	107.1074	103.2705	107.3683	118.0124	129.3595	140.1119	148.1650 (72)
Total internal gains	487.7628	485.8255	470.6149	438.4714	407.1306	383.9463	370.2669	374.0826	394.0803	421.9105	451.8589	476.6774 (73)

## 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b g	Specific data or Table 6c FF	Access factor Table 6d	Gains W						
North	5.7000	12.7350	0.6300	0.7000	0.7700	22.1843 (74)						
East	1.6000	23.7652	0.6300	0.7000	0.7700	11.6207 (76)						
South	5.4000	53.8987	0.6300	0.7000	0.7700	88.9496 (78)						
West	0.8000	23.7652	0.6300	0.7000	0.7700	5.8104 (80)						
North	0.9000	20.0333	0.6300	0.8000	1.0000	8.1784 (82)						
East	3.5000	32.0000	0.6300	0.8000	1.0000	50.8032 (82)						
South	0.9000	50.0836	0.6300	0.8000	1.0000	20.4461 (82)						
Solar gains	207.9927	339.0362	526.6271	773.9077	891.7373	1005.7867	917.2940	799.7287	633.9352	407.4715	250.3801	168.9394 (83)
Total gains	695.7555	824.8617	997.2420	1212.3791	1298.8679	1389.7330	1287.5610	1173.8113	1028.0155	829.3820	702.2390	645.6168 (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)	8.8905	9.0563	9.0007	9.1658	9.1658	9.3251	9.3251	9.4276	9.4276	9.2727	9.2727	9.1114
alpha	1.5927	1.6038	1.6000	1.6111	1.6111	1.6217	1.6217	1.6285	1.6285	1.6182	1.6182	1.6074
util living area	0.9124	0.8850	0.8349	0.7479	0.6519	0.5036	0.4243	0.4497	0.6261	0.7976	0.8815	0.9192 (86)
MIT	17.4331	17.7625	18.3558	19.1423	19.8045	20.3727	20.5746	20.5546	20.1300	19.2427	18.3032	17.4397 (87)
Th 2	18.6891	18.7168	18.7075	18.7348	18.7348	18.7606	18.7606	18.7770	18.7770	18.7522	18.7522	18.7259 (88)
util rest of house	0.8928	0.8599	0.7976	0.6892	0.5610	0.3634	0.2356	0.2549	0.4966	0.7343	0.8502	0.9009 (89)
MIT 2	15.7338	16.0684	16.6291	17.3753	17.9594	18.4117	18.5328	18.5439	18.2813	17.5166	16.6284	15.7659 (90)
Living area fraction									fLA = Living area / (4) =			0.2593 (91)
MIT	16.1744	16.5076	17.0767	17.8334	18.4378	18.9201	19.0621	19.0652	18.7606	17.9641	17.0626	16.1998 (92)
Temperature adjustment												0.0000
adjusted MIT	16.1744	16.5076	17.0767	17.8334	18.4378	18.9201	19.0621	19.0652	18.7606	17.9641	17.0626	16.1998 (93)

## 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.8620	0.8261	0.7623	0.6599	0.5465	0.3750	0.2651	0.2846	0.4954	0.7045	0.8170	0.8714 (94)
Useful gains	599.7565	681.3956	760.1491	800.0364	709.8280	521.1640	341.3788	334.0974	509.2510	584.3267	573.7345	562.5714 (95)
Ext temp.	4.9000	5.4000	7.0000	9.3000	12.1000	15.0000	16.7000	16.7000	14.4000	11.1000	7.9000	5.0000 (96)
Heat loss rate W	1902.2060	1839.7595	1679.3296	1396.5046	1037.1860	630.5744	379.9640	376.3194	693.8008	1110.3673	1482.1813	1843.8220 (97)
Space heating kWh	969.0224	778.4206	683.8703	429.4570	243.5543	0.0000	0.0000	0.0000	0.0000	391.3742	654.0817	953.2505 (98a)
Space heating requirement - total per year (kWh/year)												5103.0310

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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	969.0224	778.4206	683.8703	429.4570	243.5543	0.0000	0.0000	0.0000	0.0000	391.3742	654.0817	953.2505	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												5103.0310	(207)
Space heating per m2										(98c) / (4) =		94.5006	(99)

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

Fraction of space heat from secondary/supplementary system (Table 11)													0.0000	(201)
Fraction of space heat from main system(s)													1.0000	(202)
Efficiency of main space heating system 1 (in %)													219.3000	(206)
Efficiency of main space heating system 2 (in %)													0.0000	(207)
Efficiency of secondary/supplementary heating system, %													0.0000	(208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	969.0224	778.4206	683.8703	429.4570	243.5543	0.0000	0.0000	0.0000	0.0000	391.3742	654.0817	953.2505	(98)	
Space heating efficiency (main heating system 1)	219.3000	219.3000	219.3000	219.3000	219.3000	0.0000	0.0000	0.0000	0.0000	219.3000	219.3000	219.3000	(210)	
Space heating fuel (main heating system)	441.8707	354.9569	311.8424	195.8308	111.0599	0.0000	0.0000	0.0000	0.0000	178.4652	298.2589	434.6787	(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	253.8841	205.3693	173.8075	113.8278	84.4057	63.1592	65.8190	83.0592	117.6492	175.0088	220.8179	251.7524	(64)	
Efficiency of water heater (217)m	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	190.4000	(216)	
Fuel for water heating, kWh/month	133.3425	107.8620	91.2855	59.7835	44.3307	33.1719	34.5688	43.6235	61.7905	91.9164	115.9758	132.2229	(219)	
Space cooling fuel requirement (221)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(221)	
Pumps and Fa	6.7945	6.1370	6.7945	6.5753	6.7945	6.5753	6.7945	6.7945	6.5753	6.7945	6.5753	6.7945	(231)	
Lighting	16.8998	13.5577	12.2072	8.9435	6.9082	5.6441	6.3019	8.1914	10.6399	13.9601	15.7679	17.3695	(232)	
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-14.8270	-23.2112	-41.5129	-55.9597	-60.8103	-53.6431	-51.6119	-47.4991	-39.0668	-29.8027	-17.2582	-11.7690	(233a)	
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	-212.5732	-192.0016	-212.5732	-205.7160	-212.5732	-195.0736	-194.6150	-203.7432	-205.7160	-212.5732	-205.7160	-212.5732	(234a)	
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)	
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)	
Electricity generated by PVs (Appendix M) (negative quantity) (233b)m	-2.3148	-5.3353	-14.7335	-31.6499	-47.3971	-65.5889	-60.3452	-47.8520	-29.3620	-10.3733	-3.4778	-1.6230	(233b)	
Electricity generated by wind turbines (Appendix M) (negative quantity) (234b)m	-91.1028	-82.2864	-91.1028	-88.1640	-91.1028	-98.8065	-109.0611	-99.9329	-88.1640	-91.1028	-88.1640	-91.1028	(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													2326.9635	(211)
Space heating fuel - main system 2													0.0000	(213)
Space heating fuel - secondary													0.0000	(215)
Efficiency of water heater													190.4000	(217)
Water heating fuel used													949.8741	(219)
Space cooling fuel													0.0000	(221)
Electricity for pumps and fans:														
pump for solar water heating													80.0000	(230g)
Total electricity for the above, kWh/year													80.0000	(231)
Electricity for lighting (calculated in Appendix L)													136.3911	(232)
Energy saving/generation technologies (Appendices M ,N and Q)														
PV generation													-767.0246	(233)
Wind generation													-3575.5408	(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													-849.3367	(238)

## 10a. Fuel costs - using BEDF prices (538)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2326.9635	25.1600	585.4640	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	949.8741	25.1600	238.9883	(247)
Energy for instantaneous electric shower(s)	0.0000	25.1600	0.0000	(247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(249)
Pump for solar water heating	80.0000	25.1600	20.1280	(249)
Energy for lighting	136.3911	25.1600	34.3160	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-446.9720	25.1600	-112.4582	
PV Unit electricity exported	-320.0526	5.8100	-18.5951	
Total			-131.0532	(252)
Wind Turbine electricity used in dwelling	-2465.4477	25.1600	-620.3066	
Wind Turbine electricity exported	-1110.0930	5.8100	-64.4964	
Total			-684.8031	(252)
Total energy cost			63.0401	(255)

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## 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	2326.9635	0.1544	359.3546 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	949.8741	0.1465	139.1675 (264)
Space and water heating			498.5221 (265)
Pumps, fans and electric keep-hot	80.0000	0.1387	11.0970 (267)
Energy for lighting	136.3911	0.1443	19.6855 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-446.9720	0.1328	-59.3409
PV Unit electricity exported	-320.0526	0.1172	-37.5256
Total			-96.8666 (269)
Wind Turbine electricity used in dwelling	-2465.4477	0.1391	-342.9207
Wind Turbine electricity exported	-1110.0930	0.1379	-153.0509
Total			-495.9716 (269)
Total CO2, kg/year			-63.5336 (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	2326.9635	1.5717	3657.3830 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	949.8741	1.5420	1464.6984 (278)
Space and water heating			5122.0814 (279)
Pumps, fans and electric keep-hot	80.0000	1.5128	121.0240 (281)
Energy for lighting	136.3911	1.5338	209.2012 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-446.9720	1.4906	-666.2495
PV Unit electricity exported	-320.0526	0.4297	-137.5295
Total			-803.7790 (283)
Wind Turbine electricity used in dwelling	-2465.4477	1.5142	-3733.2208
Wind Turbine electricity exported	-1110.0930	0.5097	-565.7642
Total			-4298.9850 (283)
Total Primary energy kWh/year			349.5427 (286)