

Building Regulations England Part L (BREL) Compliance Report

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

Date: Fri 26 Jan 2024 12:37:36

Project Information			
Assessed By	Thomas McMahon	Building Type	House, Detached
OCDEA Registration	EES/022313	Assessment Date	2024-01-26

Dwelling Details			
Assessment Type	As designed	Total Floor Area	115 m ²
Site Reference	68 Stirling	Plot Reference	DS 2024
Address	68 New build at Stirling Close, Stevenage, SG2 8TQ		

Client Details	
Name	Hertford Planning Service
Company	Hertford Planning Service
Address	Westgate House, 37-41 Castle Street, Hertford, SG14 1HH

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

1a Target emission rate and dwelling emission rate			
Fuel for main heating system	Electricity		
Target carbon dioxide emission rate	10.78 kgCO ₂ /m ²		
Dwelling carbon dioxide emission rate	4.42 kgCO ₂ /m ²	OK	
1b Target primary energy rate and dwelling primary energy			
Target primary energy	56.45 kWh _{PE} /m ²		
Dwelling primary energy	46.36 kWh _{PE} /m ²	OK	
1c Target fabric energy efficiency and dwelling fabric energy efficiency			
Target fabric energy efficiency	44.4 kWh/m ²		
Dwelling fabric energy efficiency	42.4 kWh/m ²	OK	

2a Fabric U-values				
Element	Maximum permitted average U-Value [W/m ² K]	Dwelling average U-Value [W/m ² K]	Element with highest individual U-Value	
External walls	0.26	0.17	Walls (1) (0.17)	OK
Party walls	0.2	N/A	N/A	N/A
Curtain walls	1.6	N/A	N/A	N/A
Floors	0.18	0.12	Ground Floor (0.12)	OK
Roofs	0.16	0.12	Roof (2) (0.16)	OK
Windows, doors, and roof windows	1.6	1.2	E G (1.2)	OK
Rooflights	2.2	N/A	N/A	N/A

2b Envelope elements (better than typically expected values are flagged with a subsequent (!))			
Name	Net area [m ²]	U-Value [W/m ² K]	
Exposed wall: Walls (1)	125.76	0.17	
Ground floor: Ground Floor, Ground Floor	66.62	0.12	
Exposed roof: Roof (1)	48.7	0.11	
Exposed roof: Roof (2)	19.7	0.16	

2c Openings (better than typically expected values are flagged with a subsequent (!))				
Name	Area [m ²]	Orientation	Frame factor	U-Value [W/m ² K]
E G, Glazing	9.79	East	0.7	1.2
N G, Glazing	9.54	North	0.7	1.2
W G, Glazing	6.21	West	0.7	1.2
W D, Door	1.96	West	N/A	1.2

2d Thermal bridging (better than typically expected values are flagged with a subsequent (!))				
Building part 1 - Main Dwelling: Thermal bridging calculated from linear thermal transmittances for each junction				
Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E2: Other lintels (including other steel lintels)	Calculated by person with suitable expertise	0.234	RCD - E2-04
External wall	E3: Sill	Calculated by person with suitable expertise	0.023 (!)	RCD

Main element	Junction detail	Source	Psi value [W/mK]	Drawing / reference
External wall	E4: Jamb	Calculated by person with suitable expertise	0.018 (!)	RCD
External wall	E5: Ground floor (normal)	Calculated by person with suitable expertise	0.053	RCD
External wall	E6: Intermediate floor within a dwelling	Calculated by person with suitable expertise	0.001 (!)	RCD
External wall	E10: Eaves (insulation at ceiling level)	Calculated by person with suitable expertise	0.055	RCD
External wall	E12: Gable (insulation at ceiling level)	Calculated by person with suitable expertise	0.037 (!)	RCD
External wall	E16: Corner (normal)	Calculated by person with suitable expertise	0.04	RCD
External wall	E24: Eaves (insulation at ceiling level - inverted)	SAP table default	0.15	
External wall	E11: Eaves (insulation at rafter level)	Calculated by person with suitable expertise	0.018 (!)	RCD
External wall	E13: Gable (insulation at rafter level)	Calculated by person with suitable expertise	0.039 (!)	RCD

3 Air permeability (better than typically expected values are flagged with a subsequent (!))		
Maximum permitted air permeability at 50Pa	8 m ³ /hm ²	
Dwelling air permeability at 50Pa	5 m ³ /hm ² , Design value	OK
Air permeability test certificate reference		

4 Space heating	
Main heating system 1: Heat pump with radiators or underfloor heating - Electricity	
Efficiency	310.9%
Emitter type	Both radiators and underfloor
Flow temperature	45°C
System type	Heat Pump
Manufacturer	Mitsubishi Electric Europe B.V.
Model	Ecodan 11.2kW
Commissioning	
Secondary heating system: N/A	
Fuel	N/A
Efficiency	N/A
Commissioning	

5 Hot water	
Cylinder/store - type: Cylinder	
Capacity	200 litres
Declared heat loss	1.9 kWh/day
Primary pipework insulated	Yes
Manufacturer	
Model	
Commissioning	
Waste water heat recovery system 1 - type: N/A	
Efficiency	
Manufacturer	
Model	

6 Controls	
Main heating 1 - type: Time and temperature zone control by arrangement of plumbing and electrical services	
Function	
Ecodesign class	
Manufacturer	
Model	
Water heating - type: Cylinder thermostat and HW separately timed	
Manufacturer	
Model	

7 Lighting		
Minimum permitted light source efficacy	75 lm/W	
Lowest light source efficacy	80 lm/W	OK
External lights control	N/A	
8 Mechanical ventilation		
System type: N/A		
Maximum permitted specific fan power	N/A	
Specific fan power	N/A	N/A
Minimum permitted heat recovery efficiency	N/A	
Heat recovery efficiency	N/A	N/A
Manufacturer/Model		
Commissioning		
9 Local generation		
N/A		
10 Heat networks		
N/A		
11 Supporting documentary evidence		
N/A		
12 Declarations		
a. Assessor Declaration		
This declaration by the assessor is confirmation that the contents of this BREL Compliance Report are a true and accurate reflection based upon the design information submitted for this dwelling for the purpose of carrying out the "As designed" assessment, and that the supporting documentary evidence (SAP Conventions, Appendix 1 (documentary evidence) schedules the minimum documentary evidence required) has been reviewed in the course of preparing this BREL Compliance Report.		
Signed:	Assessor ID:	
Name:	Date:	
b. Client Declaration		
N/A		

Full SAP Calculation Printout



Property Reference	68 Stirling		Issued on Date	26/01/2024	
Assessment Reference	DS 2024	Prop Type Ref	New build		
Property	New build at, 68, Stirling Close, Stevenage, SG2 8TQ				
SAP Rating	80 C	DER	4.42	TER	10.78
Environmental	96 A	% DER < TER			59.00
CO ₂ Emissions (t/year)	0.49	DFEE	42.37	TFEE	44.37
Compliance Check	See BREL	% DFEE < TFEE			4.50
% DPER < TPER	17.87	DPER	46.36	TPER	56.45
Assessor Details	Mr. Thomas McMahon			Assessor ID	R863-0001
Client	HPS, Hertford Planning Service				

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 ²)	Storey height (m)	Volume (m ³)
Ground floor	66.6200 (1b)	x 2.3500 (2b)	= 156.5570 (1b) - (3b)
First floor	48.7000 (1c)	x 2.6000 (2c)	= 126.6200 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	115.3200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	283.1770 (5)

2. Ventilation rate

	m3 per hour												
Number of open chimneys	0 * 80 =											0.0000 (6a)	
Number of open flues	0 * 20 =											0.0000 (6b)	
Number of chimneys / flues attached to closed fire	0 * 10 =											0.0000 (6c)	
Number of flues attached to solid fuel boiler	0 * 20 =											0.0000 (6d)	
Number of flues attached to other heater	0 * 35 =											0.0000 (6e)	
Number of blocked chimneys	0 * 20 =											0.0000 (6f)	
Number of intermittent extract fans	4 * 10 =											40.0000 (7a)	
Number of passive vents	0 * 10 =											0.0000 (7b)	
Number of flueless gas fires	0 * 40 =											0.0000 (7c)	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =											0.1413 (8)	
Pressure test	Yes												
Pressure Test Method	Blower Door												
Measured/design AP50	5.0000											(17)	
Infiltration rate	0.3913											(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) =											0.3619 (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	0.4614	0.4524	0.4433	0.3981	0.3891	0.3438	0.3438	0.3348	0.3619	0.3891	0.4071	0.4252	(22b)
Effective ac	0.6065	0.6023	0.5983	0.5792	0.5757	0.5591	0.5591	0.5560	0.5655	0.5757	0.5829	0.5904	(25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Glazing (Uw = 1.20)			25.5400	1.1450	29.2443		(27)
Door			1.9600	1.2000	2.3520		(26)
Ground Floor			66.6200	0.1200	7.9944	75.0000	4996.5000 (28a)
External Walls	153.2620	27.5000	125.7620	0.1700	21.3795	60.0000	7545.7196 (29a)
Joisted Roof	48.7000		48.7000	0.1100	5.3570	9.0000	438.3000 (30)
Rafter Roof	19.7000		19.7000	0.1600	3.1520	9.0000	177.3000 (30)
Total net area of external elements Aum(A, m ²)			288.2820				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	69.4792	(33)
Internal Walls			200.5400			9.0000	1804.8600 (32c)
Internal Floor 1			48.7000			18.0000	876.6000 (32d)
Internal Ceiling 1			48.7000			9.0000	438.3000 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	16277.5796 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							141.1514 (35)
List of Thermal Bridges							
K1 Element				Length	Psi-value	Total	
E2 Other lintels (including other steel lintels)				17.2700	0.2340	4.0412	
E3 Sill				9.6000	0.0230	0.2208	
E4 Jamb				33.8800	0.0180	0.6098	

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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	33.2204	33.3150	33.4082	33.8531	33.9376	34.3369	34.3369	34.4118	34.1820	33.9376	33.7670	33.5905
alpha	3.2147	3.2210	3.2272	3.2569	3.2625	3.2891	3.2891	3.2941	3.2788	3.2625	3.2511	3.2394
util living area	0.9781	0.9630	0.9322	0.8554	0.7276	0.5605	0.4263	0.4811	0.7111	0.9031	0.9647	0.9810 (86)
Living	19.3208	19.5370	19.8739	20.3141	20.6434	20.8266	20.8820	20.8702	20.7275	20.2783	19.7311	19.2929
Non living	17.9724	18.2474	18.6714	19.2169	19.5952	19.7904	19.8352	19.8303	19.7004	19.1892	18.5054	17.9446
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10
MIT	20.1410	19.5370	19.8739	20.3141	20.6434	20.8266	20.8820	20.8702	20.7275	20.2783	19.7311	19.5317 (87)
Th 2	19.9358	19.9385	19.9412	19.9536	19.9559	19.9668	19.9668	19.9688	19.9626	19.9559	19.9512	19.9463 (88)
util rest of house	0.9738	0.9559	0.9190	0.8276	0.6778	0.4858	0.3332	0.3841	0.6413	0.8780	0.9566	0.9772 (89)
MIT 2	19.1531	18.2474	18.6714	19.2169	19.5952	19.7904	19.8352	19.8303	19.7004	19.1892	18.5054	18.3053 (90)
Living area fraction									fLA = Living area / (4) =			0.2685 (91)
MIT	19.4183	18.5937	18.9942	19.5115	19.8766	20.0686	20.1162	20.1095	19.9762	19.4816	18.8345	18.6345 (92)
Temperature adjustment												0.0000
adjusted MIT	19.4183	18.5937	18.9942	19.5115	19.8766	20.0686	20.1162	20.1095	19.9762	19.4816	18.8345	18.6345 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9713	0.9442	0.9044	0.8141	0.6736	0.4936	0.3471	0.3979	0.6423	0.8640	0.9454	0.9712 (94)
Useful gains	765.5342	871.8013	956.9610	1007.4160	918.3297	676.1262	453.0167	471.7028	672.7030	760.1598	738.2034	730.3233 (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	2057.7154	1858.5199	1690.9976	1417.3096	1089.3824	720.1170	463.0196	487.4117	777.2905	1183.3012	1571.2996	1943.0068 (97)
Space heating kWh	961.3829	663.0749	546.1233	295.1234	127.2632	0.0000	0.0000	0.0000	0.0000	314.8172	599.8293	902.2365 (98a)
Space heating requirement - total per year (kWh/year)												4409.8505
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	961.3829	663.0749	546.1233	295.1234	127.2632	0.0000	0.0000	0.0000	0.0000	314.8172	599.8293	902.2365 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4409.8505
Space heating per m2										(98c) / (4) =		38.2401 (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 %)												310.8623 (206)
Efficiency of main space heating system 2 (in %)												0.0000 (207)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement	961.3829	663.0749	546.1233	295.1234	127.2632	0.0000	0.0000	0.0000	0.0000	314.8172	599.8293	902.2365 (98)
Space heating efficiency (main heating system 1)	310.8623	310.8623	310.8623	310.8623	310.8623	0.0000	0.0000	0.0000	0.0000	310.8623	310.8623	310.8623 (210)
Space heating fuel (main heating system)	309.2632	213.3018	175.6801	94.9370	40.9388	0.0000	0.0000	0.0000	0.0000	101.2722	192.9566	290.2367 (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	315.8370	279.3566	296.4358	259.3036	250.5665	224.8722	221.0501	230.1882	233.1563	261.1205	279.1093	312.1703 (64)
Efficiency of water heater (217)m	175.0368	175.0368	175.0368	175.0368	175.0368	175.0368	175.0368	175.0368	175.0368	175.0368	175.0368	175.0368 (216)
Fuel for water heating, kWh/month	180.4403	159.5988	169.3563	148.1423	143.1508	128.4714	126.2878	131.5085	133.2042	149.1804	159.4575	178.3455 (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	29.2428	23.4597	21.1228	15.4755	11.9537	9.7663	10.9046	14.1742	18.4109	24.1561	27.2842	30.0556 (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												1418.5864 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												175.0368
Water heating fuel used												1807.1439 (219)
Space cooling fuel												0.0000 (221)

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Electricity for pumps and fans:		
Total electricity for the above, kWh/year		0.0000 (231)
Electricity for lighting (calculated in Appendix L)		236.0064 (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		3461.7367 (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	1418.5864	0.1555	220.6152 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1807.1439	0.1410	254.7907 (264)
Space and water heating			475.4059 (265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (267)
Energy for lighting	236.0064	0.1443	34.0630 (268)
Total CO2, kg/year			509.4689 (272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			4.4200 (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	1418.5864	1.5757	2235.3049 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1807.1439	1.5213	2749.2758 (278)
Space and water heating			4984.5807 (279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (281)
Energy for lighting	236.0064	1.5338	361.9945 (282)
Total Primary energy kWh/year			5346.5752 (286)
Dwelling Primary energy Rate (DPER)			46.3600 (287)

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

1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	66.6200 (1b)	x 2.3500 (2b)	= 156.5570 (1b) - (3b)
First floor	48.7000 (1c)	x 2.6000 (2c)	= 126.6200 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	115.3200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	283.1770 (5)

2. Ventilation rate

		m3 per hour
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	4 * 10 =	40.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(7a)+(7b)+(7c) =	40.0000 / (5) = 0.1413 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3913 (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) =	0.3619 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.4614	0.4524	0.4433	0.3981	0.3891	0.3438	0.3438	0.3348	0.3619	0.3891	0.4071	0.4252 (22b)
Effective ac	0.6065	0.6023	0.5983	0.5792	0.5757	0.5591	0.5591	0.5560	0.5655	0.5757	0.5829	0.5904 (25)

3. Heat losses and heat loss parameter

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Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
TER Opaque door			1.9600	1.0000	1.9600		(26)
TER Opening Type (Uw = 1.20)			25.5400	1.1450	29.2443		(27)
Ground floor			66.6200	0.1300	8.6606		(28a)
External Walls	153.2620	27.5000	125.7620	0.1800	22.6372		(29a)
Joisted Roof	48.7000		48.7000	0.1100	5.3570		(30)
Rafter Roof	19.7000		19.7000	0.1100	2.1670		(30)
Total net area of external elements Aum(A, m2)			288.2820				(31)
Fabric heat loss, W/K = Sum (A x U)					70.0260		(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 141.1514 (35)

List of Thermal Bridges	Length	Psi-value	Total
K1 Element			
E2 Other lintels (including other steel lintels)	17.2700	0.0500	0.8635
E3 Sill	9.6000	0.0500	0.4800
E4 Jamb	33.8800	0.0500	1.6940
E5 Ground floor (normal)	34.0400	0.1600	5.4464
E6 Intermediate floor within a dwelling	22.0800	0.0000	0.0000
E10 Eaves (insulation at ceiling level)	8.4600	0.0600	0.5076
E12 Gable (insulation at ceiling level)	19.7000	0.0600	1.1820
E16 Corner (normal)	19.8000	0.0900	1.7820
E24 Eaves (insulation at ceiling level - inverted)	6.1000	0.2400	1.4640
E11 Eaves (insulation at rafter level)	6.1000	0.0400	0.2440
E13 Gable (insulation at rafter level)	6.3200	0.0800	0.5056
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			14.1691 (36)
Point Thermal bridges			0.0000 (36a) =
Total fabric heat loss			84.1951 (37) (33) + (36) + (36a) =

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	56.6729	56.2865	55.9079	54.1293	53.7965	52.2474	52.2474	51.9605	52.8441	53.7965	54.4697	55.1735 (38)
Average = Sum(39)m / 12 =	140.8680	140.4817	140.1030	138.3244	137.9916	136.4425	136.4425	136.1557	137.0392	137.9916	138.6648	139.3686 (39)
												138.3228
HLP	1.2215	1.2182	1.2149	1.1995	1.1966	1.1832	1.1832	1.1807	1.1883	1.1966	1.2024	1.2085 (40)
HLP (average)												1.1995
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy												
Hot water usage for mixer showers	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	71.8920	70.8116	69.2373	66.2250	64.0021	61.5231	60.1140	61.6764	63.3891	66.0508	69.1278	71.6166 (42a)
Hot water usage for baths	31.0391	30.5782	29.9290	28.7321	27.8359	26.8421	26.3053	26.9499	27.6518	28.7151	29.9367	30.9342 (42b)
Hot water usage for other uses	43.7479	42.1570	40.5662	38.9754	37.3845	35.7937	35.7937	37.3845	38.9754	40.5662	42.1570	43.7479 (42c)
Average daily hot water use (litres/day)												134.8310 (43)
Daily hot water use	146.6790	143.5468	139.7325	133.9325	129.2225	124.1588	122.2130	126.0109	130.0163	135.3322	141.2215	146.2986 (44)
Energy conte	232.3037	204.4087	214.7636	183.3469	173.9583	152.6678	147.8060	156.0278	160.3231	183.6445	201.1960	229.0683 (45)
Energy content (annual)												Total = Sum(45)m = 2239.5147
Distribution loss (46)m = 0.15 x (45)m	34.8456	30.6613	32.2145	27.5020	26.0937	22.9002	22.1709	23.4042	24.0485	27.5467	30.1794	34.3602 (46)
Water storage loss:												200.0000 (47)
Store volume												1.6525 (48)
a) If manufacturer declared loss factor is known (kWh/day):												0.5400 (49)
Temperature factor from Table 2b												0.8924 (55)
Enter (49) or (54) in (55)												
Total storage loss	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637 (56)
If cylinder contains dedicated solar storage												
Primary loss	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637 (57)
Combi 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)
Total heat required for water heating calculated for each month	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
WWHRS	283.2298	250.4065	265.6897	232.6302	224.8844	201.9511	198.7321	206.9538	209.6064	234.5706	250.4792	279.9944 (62)
PV diverter	-32.8660	-29.0670	-30.4373	-25.2033	-23.4885	-20.0993	-18.8399	-20.0343	-20.7955	-24.5156	-27.7732	-32.2574 (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	250.3638	221.3395	235.2524	207.4269	201.3958	181.8518	179.8922	186.9195	188.8108	210.0550	222.7060	247.7370 (64)
Total per year (kWh/year)												2533.7507 (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	117.9818	104.7641	112.1498	100.3895	98.5820	90.1887	89.8864	92.6201	92.7341	101.8027	106.3243	116.9061 (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	142.1632	142.1632	142.1632	142.1632	142.1632	142.1632	142.1632	142.1632	142.1632	142.1632	142.1632	142.1632 (66)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	140.7392	155.8184	140.7392	145.4305	140.7392	145.4305	140.7392	140.7392	145.4305	140.7392	145.4305	140.7392 (67)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	278.9888	281.8838	274.5884	259.0574	239.4523	221.0263	208.7166	205.8215	213.1169	228.6479	248.2530	266.6791 (68)
Pumps, fans	37.2163	37.2163	37.2163	37.2163	37.2163	37.2163	37.2163	37.2163	37.2163	37.2163	37.2163	37.2163 (69)
Losses e.g. evaporation (negative values) (Table 5)	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)
Water heating gains (Table 5)	-113.7306	-113.7306	-113.7306	-113.7306	-113.7306	-113.7306	-113.7306	-113.7306	-113.7306	-113.7306	-113.7306	-113.7306 (71)
Total internal gains	158.5777	155.8990	150.7389	139.4298	132.5027	125.2621	120.8150	124.4894	128.7973	136.8315	147.6726	157.1318 (72)
	646.9547	662.2502	634.7156	612.5668	581.3432	557.3678	535.9197	536.6991	552.9937	574.8676	610.0052	633.1991 (73)

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6. Solar gains

[Jan]			Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W				
North			9.5400	10.6334	0.6300	0.7000	0.7700	31.0022 (74)				
East			9.7900	19.6403	0.6300	0.7000	0.7700	58.7627 (76)				
West			6.2100	19.6403	0.6300	0.7000	0.7700	37.2744 (80)				
Solar gains	127.0393	247.1157	410.0681	612.9412	770.8389	799.2968	756.6692	635.6823	480.8810	293.4479	157.9922	104.8212 (83)
Total gains	773.9940	909.3659	1044.7837	1225.5080	1352.1821	1356.6647	1292.5890	1172.3813	1033.8747	868.3155	767.9973	738.0203 (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	32.0978	32.1860	32.2730	32.6880	32.7668	33.1389	33.1389	33.2087	32.9946	32.7668	32.6078	32.4431
alpha	3.1399	3.1457	3.1515	3.1792	3.1845	3.2093	3.2093	3.2139	3.1996	3.1845	3.1739	3.1629
util living area	0.9793	0.9652	0.9362	0.8635	0.7408	0.5775	0.4424	0.4985	0.7268	0.9092	0.9669	0.9821 (86)
MIT	18.7839	19.0746	19.5334	20.1394	20.6059	20.8740	20.9599	20.9411	20.7278	20.0965	19.3446	18.7452 (87)
Th 2	19.9028	19.9055	19.9081	19.9204	19.9227	19.9335	19.9335	19.9355	19.9293	19.9227	19.9181	19.9132 (88)
util rest of house	0.9752	0.9583	0.9234	0.8363	0.6906	0.5001	0.3438	0.3964	0.6563	0.8848	0.9592	0.9785 (89)
MIT 2	17.3291	17.6983	18.2756	19.0241	19.5621	19.8447	19.9147	19.9055	19.7128	18.9923	18.0522	17.2863 (90)
Living area fraction	17.7197	18.0678	18.6133	19.3235	19.8423	20.1210	20.1953	20.1835	19.9853	19.2887	18.3992	17.6780 (92)
MIT	17.7197	18.0678	18.6133	19.3235	19.8423	20.1210	20.1953	20.1835	19.9853	19.2887	18.3992	17.6780 (92)
Temperature adjustment												0.0000
adjusted MIT	17.7197	18.0678	18.6133	19.3235	19.8423	20.1210	20.1953	20.1835	19.9853	19.2887	18.3992	17.6780 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9633	0.9425	0.9038	0.8185	0.6865	0.5145	0.3688	0.4213	0.6604	0.8668	0.9441	0.9677 (94)
Useful gains	745.6002	857.0879	944.3186	1003.0957	928.2751	697.9373	476.7294	493.9389	682.7924	752.6251	725.0711	714.1933 (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	1890.4077	1849.8316	1697.1078	1441.8298	1123.5746	753.3008	490.5474	515.1509	806.5199	1198.9742	1566.8008	1878.4037 (97)
Space heating kWh	851.7368	667.1238	560.0752	315.8885	145.3028	0.0000	0.0000	0.0000	0.0000	332.0837	606.0454	866.1725 (98a)
Space heating requirement - total per year (kWh/year)												4344.4288
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	851.7368	667.1238	560.0752	315.8885	145.3028	0.0000	0.0000	0.0000	0.0000	332.0837	606.0454	866.1725 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4344.4288
Space heating per m2										(98c) / (4) =		37.6728 (99)

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

Fraction of space heat from secondary/supplementary system (Table 11) 0.0000 (201)

Fraction of space heat from main system(s) 1.0000 (202)

Efficiency of main space heating system 1 (in %) 92.3000 (206)

Efficiency of main space heating system 2 (in %) 0.0000 (207)

Efficiency of secondary/supplementary heating system, % 0.0000 (208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	851.7368	667.1238	560.0752	315.8885	145.3028	0.0000	0.0000	0.0000	0.0000	332.0837	606.0454	866.1725 (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)	922.7917	722.7777	606.7987	342.2411	157.4245	0.0000	0.0000	0.0000	0.0000	359.7874	656.6039	938.4318 (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	250.3638	221.3395	235.2524	207.4269	201.3958	181.8518	179.8922	186.9195	188.8108	210.0550	222.7060	247.7370 (64)
Efficiency of water heater (217)m	86.5817	86.3732	85.9333	85.0002	83.3400	79.8000	79.8000	79.8000	79.8000	85.0821	86.1879	79.8000 (216)
Fuel for water heating, kWh/month	289.1647	256.2595	273.7618	244.0311	241.6556	227.8844	225.4288	234.2350	236.6051	246.8851	258.3960	285.9808 (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	29.2428	23.4597	21.1228	15.4755	11.9537	9.7663	10.9046	14.1742	18.4109	24.1561	27.2842	30.0556 (232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-57.7908	-79.2620	-110.8617	-121.1524	-127.7209	-118.1108	-116.5454	-111.3564	-101.8996	-88.8459	-62.6982	-50.2181 (233a)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (235c)
Electricity generated by PVs (Appendix M) (negative quantity) (233b)m	-39.7540	-82.6942	-162.7060	-242.0618	-317.9233	-318.7387	-315.0781	-267.8301	-197.6629	-117.5879	-52.8446	-31.5166 (233b)
Electricity generated by wind turbines (Appendix M) (negative quantity)												

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(234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity)													
(235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation)													
(235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												4706.8567	(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												3020.2880	(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)												236.0064	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV generation												-3292.8604	(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												4756.2907	(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	4706.8567	0.2100	988.4399 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	3020.2880	0.2100	634.2605 (264)
Space and water heating			1622.7004 (265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293 (267)
Energy for lighting	236.0064	0.1443	34.0630 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1146.4621	0.1352	-154.9971
PV Unit electricity exported	-2146.3983	0.1262	-270.8161
Total			-425.8132 (269)
Total CO2, kg/year			1242.8795 (272)
EPC Target Carbon Dioxide Emission Rate (TER)			10.7800 (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	4706.8567	1.1300	5318.7481 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	3020.2880	1.1300	3412.9254 (278)
Space and water heating			8731.6735 (279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008 (281)
Energy for lighting	236.0064	1.5338	361.9945 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-1146.4621	1.4997	-1719.3440
PV Unit electricity exported	-2146.3983	0.4632	-994.1070
Total			-2713.4510 (283)
Total Primary energy kWh/year			6510.3178 (286)
Target Primary Energy Rate (TPER)			56.4500 (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	66.6200 (1b)	x 2.3500 (2b)	= 156.5570 (1b) - (3b)
First floor	48.7000 (1c)	x 2.6000 (2c)	= 126.6200 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	115.3200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	283.1770 (5)

 2. Ventilation rate

	m3 per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	4 * 10 = 40.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
	Air changes per hour

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Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1413 (8)
Pressure test			Yes
Pressure Test Method			Blower Door
Measured/design AP50			5.0000 (17)
Infiltration rate			0.3913 (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) =		0.3619 (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 infiltr rate	0.4614	0.4524	0.4433	0.3981	0.3891	0.3438	0.3438	0.3348	0.3619	0.3891	0.4071	0.4252 (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	0.6065	0.6023	0.5983	0.5792	0.5757	0.5591	0.5591	0.5560	0.5655	0.5757	0.5829	0.5904 (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
Glazing (Uw = 1.20)			25.5400	1.1450	29.2443		(27)
Door			1.9600	1.2000	2.3520		(26)
Ground Floor			66.6200	0.1200	7.9944	75.0000	4996.5000 (28a)
External Walls	153.2620	27.5000	125.7620	0.1700	21.3795	60.0000	7545.7196 (29a)
Joisted Roof	48.7000		48.7000	0.1100	5.3570	9.0000	438.3000 (30)
Rafter Roof	19.7000		19.7000	0.1600	3.1520	9.0000	177.3000 (30)
Total net area of external elements Aum (A, m2)			288.2820				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	69.4792	(33)
Internal Walls			200.5400			9.0000	1804.8600 (32c)
Internal Floor 1			48.7000			18.0000	876.6000 (32d)
Internal Ceiling 1			48.7000			9.0000	438.3000 (32e)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) =
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							16277.5796 (34)
List of Thermal Bridges							141.1514 (35)

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	17.2700	0.2340	4.0412
E3 Sill	9.6000	0.0230	0.2208
E4 Jamb	33.8800	0.0180	0.6098
E5 Ground floor (normal)	34.0400	0.0530	1.8041
E6 Intermediate floor within a dwelling	22.0800	0.0010	0.0221
E10 Eaves (insulation at ceiling level)	8.4600	0.0550	0.4653
E12 Gable (insulation at ceiling level)	19.7000	0.0370	0.7289
E16 Corner (normal)	19.8000	0.0400	0.7920
E24 Eaves (insulation at ceiling level - inverted)	6.1000	0.1500	0.9150
E11 Eaves (insulation at rafter level)	6.1000	0.0180	0.1098
E13 Gable (insulation at rafter level)	6.3200	0.0390	0.2465
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			9.9555 (36)
Point Thermal bridges			(36a) =
Total fabric heat loss			(33) + (36) + (36a) =
			79.4347 (37)

(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	56.6729	56.2865	55.9079	54.1293	53.7965	52.2474	52.2474	51.9605	52.8441	53.7965	54.4697	55.1735 (38)
Average = Sum(39)m / 12 =	136.1076	135.7213	135.3426	133.5640	133.2312	131.6821	131.6821	131.3953	132.2788	133.2312	133.9044	134.6082 (39)
												133.5624

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.1803	1.1769	1.1736	1.1582	1.1553	1.1419	1.1419	1.1394	1.1471	1.1553	1.1612	1.1673 (40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy													2.8433 (42)
Hot water usage for mixer showers													0.0000 (42a)
Hot water usage for baths													30.9342 (42b)
Hot water usage for other uses													43.7479 (42c)
Average daily hot water use (litres/day)													68.5490 (43)

Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	74.7870	72.7352	70.4952	67.7075	65.2204	62.6358	62.0990	64.3344	66.6271	69.2813	72.0937	74.6821 (44)
Energy content (annual)	118.4443	103.5740	108.3485	92.6881	87.7992	77.0180	75.1034	79.6595	82.1579	94.0141	102.7108	116.9341 (45)
Distribution loss (46)m = 0.15 x (45)m												
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage												
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Total heat required for water heating calculated for each month												
WWHRS	100.6777	88.0379	92.0962	78.7849	74.6293	65.4653	63.8379	67.7106	69.8342	79.9120	87.3041	99.3940 (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	100.6777	88.0379	92.0962	78.7849	74.6293	65.4653	63.8379	67.7106	69.8342	79.9120	87.3041	99.3940 (64)
12Total per year (kWh/year)												
Electric shower(s)	57.5735	51.2985	56.0160	53.4554	54.4584	51.9481	53.6797	54.4584	53.4554	56.0160	54.9627	57.5735 (64a)

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Heat gains from water heating, kWh/month
 39.5628 34.8341 37.0281 33.0601 32.2719 29.3533 29.3794 30.5422 30.8224 33.9820 35.5667 39.2419 (65)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 654.8954 (64a)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	142.1632	142.1632	142.1632	142.1632	142.1632	142.1632	142.1632	142.1632	142.1632	142.1632	142.1632	142.1632 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	140.7392	155.8184	140.7392	145.4305	140.7392	145.4305	140.7392	140.7392	145.4305	140.7392	145.4305	140.7392 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	278.9888	281.8838	274.5884	259.0574	239.4523	221.0263	208.7166	205.8215	213.1169	228.6479	248.2530	266.6791 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.2163	37.2163	37.2163	37.2163	37.2163	37.2163	37.2163	37.2163	37.2163	37.2163	37.2163	37.2163 (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)	-113.7306	-113.7306	-113.7306	-113.7306	-113.7306	-113.7306	-113.7306	-113.7306	-113.7306	-113.7306	-113.7306	-113.7306 (71)
Water heating gains (Table 5)	53.1758	51.8364	49.7689	45.9168	43.3763	40.7685	39.4884	41.0514	42.8089	45.6747	49.3982	52.7445 (72)
Total internal gains	538.5528	555.1877	530.7455	516.0537	489.2168	472.8743	454.5932	453.2611	467.0053	480.7108	508.7307	525.8117 (73)

6. Solar gains

[Jan]	Area m ²	Solar flux Table 6a W/m ²	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W						
North	9.5400	10.6334	0.6300	0.7000	0.7700	31.0022 (74)						
East	9.7900	19.6403	0.6300	0.7000	0.7700	58.7627 (76)						
West	6.2100	19.6403	0.6300	0.7000	0.7700	37.2744 (80)						
Solar gains	127.0393	247.1157	410.0681	612.9412	770.8389	799.2968	756.6692	635.6823	480.8810	293.4479	157.9922	104.8212 (83)
Total gains	665.5921	802.3034	940.8136	1128.9949	1260.0557	1272.1711	1211.2624	1088.9434	947.8862	774.1587	666.7229	630.6329 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation factor for gains for living area, nil,m (see Table 9a)												21.0000 (85)
tau	33.2204	33.3150	33.4082	33.8531	33.9376	34.3369	34.3369	34.4118	34.1820	33.9376	33.7670	33.5905
alpha	3.2147	3.2210	3.2272	3.2569	3.2625	3.2891	3.2891	3.2941	3.2788	3.2625	3.2511	3.2394
util living area	0.9863	0.9745	0.9492	0.8803	0.7589	0.5928	0.4553	0.5165	0.7516	0.9279	0.9769	0.9884 (86)
MIT	18.7278	19.0257	19.4940	20.1199	20.5998	20.8742	20.9603	20.9402	20.7159	20.0556	19.2903	18.6892 (87)
Th 2	19.9358	19.9385	19.9412	19.9536	19.9559	19.9668	19.9668	19.9688	19.9626	19.9559	19.9512	19.9463 (88)
util rest of house	0.9835	0.9694	0.9387	0.8557	0.7110	0.5167	0.3574	0.4149	0.6845	0.9078	0.9714	0.9861 (89)
MIT 2	17.8646	18.1612	18.6231	19.2320	19.6671	19.8966	19.9519	19.9445	19.7828	19.1863	18.4348	17.8335 (90)
Living area fraction	18.0963	18.3933	18.8569	19.4704	19.9175	20.1590	20.2227	20.2118	20.0333	19.4197	18.6644	18.0632 (92)
Temperature adjustment												0.0000
adjusted MIT	18.0963	18.3933	18.8569	19.4704	19.9175	20.1590	20.2227	20.2118	20.0333	19.4197	18.6644	18.0632 (93)

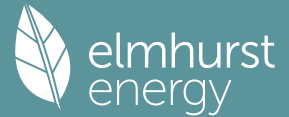
8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9767	0.9594	0.9251	0.8424	0.7091	0.5317	0.3825	0.4400	0.6896	0.8948	0.9622	0.9801 (94)
Useful gains	650.0811	769.7163	870.3295	951.1106	893.4641	676.3541	463.2949	479.1366	653.6351	692.7139	641.4987	618.0781 (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	1877.7821	1831.3258	1672.4161	1411.8229	1094.8301	732.0271	477.0399	500.8542	784.8540	1175.0614	1548.5287	1866.1017 (97)
Space heating kWh	913.4095	713.4016	596.7524	331.7129	149.8164	0.0000	0.0000	0.0000	0.0000	358.8666	653.0616	928.5296 (98a)
Space heating requirement - total per year (kWh/year)												4645.5506
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	913.4095	713.4016	596.7524	331.7129	149.8164	0.0000	0.0000	0.0000	0.0000	358.8666	653.0616	928.5296 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4645.5506
Space heating per m ²										(98c) / (4) =		40.2840 (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	1237.8119	974.4477	998.6039	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8186	0.8756	0.8374	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1013.3003	853.2269	836.2403	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1428.9838	1360.4982	1220.3165	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	299.2921	377.4099	285.7527	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	74.8230	94.3525	71.4382	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling requirement												240.6137 (107)
Energy for space heating												40.2840 (99)

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Energy for space cooling 2.0865 (108)
 Total 42.3705 (109)
 Fabric Energy Efficiency (DFEE) 42.4 (109)

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

1. Overall dwelling characteristics

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	66.6200 (1b)	x 2.3500 (2b)	= 156.5570 (1b) - (3b)
First floor	48.7000 (1c)	x 2.6000 (2c)	= 126.6200 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	115.3200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 283.1770 (5)

2. Ventilation rate

		m ³ per hour
Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	4 * 10 =	40.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c)	40.0000 / (5) =	0.1413 (8)
Pressure test	Yes	
Pressure Test Method	Blower Door	
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3913 (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) =	0.3619 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate	0.4614	0.4524	0.4433	0.3981	0.3891	0.3438	0.3438	0.3348	0.3619	0.3891	0.4071	0.4252 (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	0.6065	0.6023	0.5983	0.5792	0.5757	0.5591	0.5591	0.5560	0.5655	0.5757	0.5829	0.5904 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
TER Opaque door			1.9600	1.0000	1.9600		(26)
TER Opening Type (Uw = 1.20)			25.5400	1.1450	29.2443		(27)
Ground floor			66.6200	0.1300	8.6606		(28a)
External Walls	153.2620	27.5000	125.7620	0.1800	22.6372		(29a)
Joisted Roof	48.7000		48.7000	0.1100	5.3570		(30)
Rafter Roof	19.7000		19.7000	0.1100	2.1670		(30)
Total net area of external elements Aum(A, m ²)			288.2820				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	70.0260	(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K 141.1514 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	17.2700	0.0500	0.8635
E3 Sill	9.6000	0.0500	0.4800
E4 Jamb	33.8800	0.0500	1.6940
E5 Ground floor (normal)	34.0400	0.1600	5.4464
E6 Intermediate floor within a dwelling	22.0800	0.0000	0.0000
E10 Eaves (insulation at ceiling level)	8.4600	0.0600	0.5076
E12 Gable (insulation at ceiling level)	19.7000	0.0600	1.1820
E16 Corner (normal)	19.8000	0.0900	1.7820
E24 Eaves (insulation at ceiling level - inverted)	6.1000	0.2400	1.4640
E11 Eaves (insulation at rafter level)	6.1000	0.0400	0.2440
E13 Gable (insulation at rafter level)	6.3200	0.0800	0.5056
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			14.1691 (36)
Point Thermal bridges			(36a) = 0.0000
Total fabric heat loss			(33) + (36) + (36a) = 84.1951 (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	56.6729	56.2865	55.9079	54.1293	53.7965	52.2474	52.2474	51.9605	52.8441	53.7965	54.4697	55.1735 (38)
Heat transfer coeff	140.8680	140.4817	140.1030	138.3244	137.9916	136.4425	136.4425	136.1557	137.0392	137.9916	138.6648	139.3686 (39)
Average = Sum(39)m / 12 =												138.3228
HLP	1.2215	1.2182	1.2149	1.1995	1.1966	1.1832	1.1832	1.1807	1.1883	1.1966	1.2024	1.2085 (40)
HLP (average)												1.1995

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Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)												

Assumed occupancy												2.8433 (42)
Hot water usage for mixer showers												0.0000 (42a)
Hot water usage for baths	31.0391	30.5782	29.9290	28.7321	27.8359	26.8421	26.3053	26.9499	27.6518	28.7151	29.9367	30.9342 (42b)
Hot water usage for other uses	43.7479	42.1570	40.5662	38.9754	37.3845	35.7937	35.7937	37.3845	38.9754	40.5662	42.1570	43.7479 (42c)
Average daily hot water use (litres/day)												68.5490 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	74.7870	72.7352	70.4952	67.7075	65.2204	62.6358	62.0990	64.3344	66.6271	69.2813	72.0937	74.6821 (44)
Energy conte	118.4443	103.5740	108.3485	92.6881	87.7992	77.0180	75.1034	79.6595	82.1579	94.0141	102.7108	116.9341 (45)
Energy content (annual)												Total = Sum(45)m = 1138.4519
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 (59)
Combi loss												0.0000 (61)
Total heat required for water heating calculated for each month	100.6777	88.0379	92.0962	78.7849	74.6293	65.4653	63.8379	67.7106	69.8342	79.9120	87.3041	99.3940 (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	100.6777	88.0379	92.0962	78.7849	74.6293	65.4653	63.8379	67.7106	69.8342	79.9120	87.3041	99.3940 (64)
											Total per year (kWh/year) = Sum(64)m = 967.6841 (64)	
											968 (64)	
12Total per year (kWh/year)												968 (64)
Electric shower(s)												57.5735 (64a)
											Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 654.8954 (64a)	
Heat gains from water heating, kWh/month	39.5628	34.8341	37.0281	33.0601	32.2719	29.3533	29.3794	30.5422	30.8224	33.9820	35.5667	39.2419 (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	142.1632	142.1632	142.1632	142.1632	142.1632	142.1632	142.1632	142.1632	142.1632	142.1632	142.1632	142.1632 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	140.7392	155.8184	140.7392	145.4305	140.7392	145.4305	140.7392	140.7392	145.4305	140.7392	145.4305	140.7392 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	278.9888	281.8838	274.5884	259.0574	239.4523	221.0263	208.7166	205.8215	213.1169	228.6479	248.2530	266.6791 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.2163	37.2163	37.2163	37.2163	37.2163	37.2163	37.2163	37.2163	37.2163	37.2163	37.2163	37.2163 (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)	-113.7306	-113.7306	-113.7306	-113.7306	-113.7306	-113.7306	-113.7306	-113.7306	-113.7306	-113.7306	-113.7306	-113.7306 (71)
Water heating gains (Table 5)	53.1758	51.8364	49.7689	45.9168	43.3763	40.7685	39.4884	41.0514	42.8089	45.6747	49.3982	52.7445 (72)
Total internal gains	538.5528	555.1877	530.7455	516.0537	489.2168	472.8743	454.5932	453.2611	467.0053	480.7108	508.7307	525.8117 (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	9.5400		10.6334		0.6300		0.7000		0.7700		31.0022 (74)	
East	9.7900		19.6403		0.6300		0.7000		0.7700		58.7627 (76)	
West	6.2100		19.6403		0.6300		0.7000		0.7700		37.2744 (80)	

Solar gains	127.0393	247.1157	410.0681	612.9412	770.8389	799.2968	756.6692	635.6823	480.8810	293.4479	157.9922	104.8212 (83)
Total gains	665.5921	802.3034	940.8136	1128.9949	1260.0557	1272.1711	1211.2624	1088.9434	947.8862	774.1587	666.7229	630.6329 (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	32.0978	32.1860	32.2730	32.6880	32.7668	33.1389	33.1389	33.2087	32.9946	32.7668	32.6078	32.4431
alpha	3.1399	3.1457	3.1515	3.1792	3.1845	3.2093	3.2093	3.2139	3.1996	3.1845	3.1739	3.1629
util living area	0.9863	0.9749	0.9505	0.8847	0.7679	0.6055	0.4679	0.5294	0.7610	0.9302	0.9772	0.9884 (86)
MIT	18.6428	18.9417	19.4166	20.0563	20.5583	20.8554	20.9528	20.9300	20.6855	19.9995	19.2174	18.6037 (87)
Th 2	19.9028	19.9055	19.9081	19.9204	19.9227	19.9335	19.9335	19.9355	19.9293	19.9227	19.9181	19.9132 (88)
util rest of house	0.9835	0.9698	0.9401	0.8603	0.7197	0.5270	0.3652	0.4236	0.6932	0.9103	0.9717	0.9860 (89)
MIT 2	17.7579	18.0554	18.5241	19.1471	19.6040	19.8530	19.9160	19.9072	19.7305	19.1086	18.3400	17.7261 (90)
Living area fraction												fLA = Living area / (4) = 0.2685 (91)
MIT	17.9954	18.2934	18.7637	19.3912	19.8602	20.1221	20.1944	20.1818	19.9869	19.3478	18.5755	17.9617 (92)
Temperature adjustment												0.0000
adjusted MIT	17.9954	18.2934	18.7637	19.3912	19.8602	20.1221	20.1944	20.1818	19.9869	19.3478	18.5755	17.9617 (93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9765	0.9595	0.9261	0.8462	0.7166	0.5417	0.3913	0.4494	0.6973	0.8967	0.9623	0.9799	(94)
Useful gains	649.9748	769.8433	871.3253	955.3416	902.9978	689.1642	474.0264	489.3745	660.9541	694.2187	641.5620	617.9557	(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	1929.2502	1881.5228	1718.1803	1451.1845	1126.0396	753.4477	490.4237	514.9113	806.7317	1207.1242	1591.2543	1917.9463	(97)
Space heating kWh	951.7809	747.0486	630.0602	357.0069	165.9430	0.0000	0.0000	0.0000	0.0000	381.6016	683.7784	967.1930	(98a)
Space heating requirement - total per year (kWh/year)												4884.4127	
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	951.7809	747.0486	630.0602	357.0069	165.9430	0.0000	0.0000	0.0000	0.0000	381.6016	683.7784	967.1930	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4884.4127	
Space heating per m2										(98c) / (4) =		42.3553	(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	1282.5599	1009.6748	1034.7831	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8019	0.8615	0.8213	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1028.4589	869.8419	849.9175	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1428.9838	1360.4982	1220.3165	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	288.3779	365.0483	275.5769	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	72.0945	91.2621	68.8942	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												232.2508	(107)
Energy for space heating												42.3553	(99)
Energy for space cooling												2.0140	(108)
Total												44.3693	(109)
Fabric Energy Efficiency (TFEE)												44.4	(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	66.6200 (1b)	x 2.3500 (2b)	= 156.5570 (1b) - (3b)	
First floor	48.7000 (1c)	x 2.6000 (2c)	= 126.6200 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	115.3200		(4)	
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	283.1770 (5)	

2. Ventilation rate

Number of open chimneys	0 * 80 =	0.0000 (6a)
Number of open flues	0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000 (6d)
Number of flues attached to other heater	0 * 35 =	0.0000 (6e)
Number of blocked chimneys	0 * 20 =	0.0000 (6f)
Number of intermittent extract fans	4 * 10 =	40.0000 (7a)
Number of passive vents	0 * 10 =	0.0000 (7b)
Number of flueless gas fires	0 * 40 =	0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1413 (8)
Pressure test		Yes
Pressure Test Method		Blower Door
Measured/design AP50		5.0000 (17)
Infiltration rate		0.3913 (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) =	0.3619 (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	Jan 1.2750 Feb 1.2500 Mar 1.2250 Apr 1.1000 May 1.0750 Jun 0.9500 Jul 0.9500 Aug 0.9250 Sep 1.0000 Oct 1.0750 Nov 1.1250 Dec 1.1750 (22a)	
Adj infilt rate	Jan 0.4614 Feb 0.4524 Mar 0.4433 Apr 0.3981 May 0.3891 Jun 0.3438 Jul 0.3438 Aug 0.3348 Sep 0.3619 Oct 0.3891 Nov 0.4071 Dec 0.4252 (22b)	
Effective ac	Jan 0.6065 Feb 0.6023 Mar 0.5983 Apr 0.5792 May 0.5757 Jun 0.5591 Jul 0.5591 Aug 0.5560 Sep 0.5655 Oct 0.5757 Nov 0.5829 Dec 0.5904 (25)	

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3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Glazing (Uw = 1.20)			25.5400	1.1450	29.2443		(27)
Door			1.9600	1.2000	2.3520		(26)
Ground Floor			66.6200	0.1200	7.9944	75.0000	4996.5000 (28a)
External Walls	153.2620	27.5000	125.7620	0.1700	21.3795	60.0000	7545.7196 (29a)
Joisted Roof	48.7000		48.7000	0.1100	5.3570	9.0000	438.3000 (30)
Rafter Roof	19.7000		19.7000	0.1600	3.1520	9.0000	177.3000 (30)
Total net area of external elements Aum(A, m ²)			288.2820				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) = 69.4792		(33)
Internal Walls			200.5400			9.0000	1804.8600 (32c)
Internal Floor 1			48.7000			18.0000	876.6000 (32d)
Internal Ceiling 1			48.7000			9.0000	438.3000 (32e)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) = 16277.5796 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m ² K							141.1514 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	17.2700	0.2340	4.0412
E3 Sill	9.6000	0.0230	0.2208
E4 Jamb	33.8800	0.0180	0.6098
E5 Ground floor (normal)	34.0400	0.0530	1.8041
E6 Intermediate floor within a dwelling	22.0800	0.0010	0.0221
E10 Eaves (insulation at ceiling level)	8.4600	0.0550	0.4653
E12 Gable (insulation at ceiling level)	19.7000	0.0370	0.7289
E16 Corner (normal)	19.8000	0.0400	0.7920
E24 Eaves (insulation at ceiling level - inverted)	6.1000	0.1500	0.9150
E11 Eaves (insulation at rafter level)	6.1000	0.0180	0.1098
E13 Gable (insulation at rafter level)	6.3200	0.0390	0.2465
Thermal bridges (Sum(L x Psi) calculated using Appendix K)			9.9555 (36)
Point Thermal bridges			(36a) = 0.0000
Total fabric heat loss			(33) + (36) + (36a) = 79.4347 (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	56.6729	56.2865	55.9079	54.1293	53.7965	52.2474	52.2474	51.9605	52.8441	53.7965	54.4697	55.1735 (38)
Average = Sum(39)m / 12 =	136.1076	135.7213	135.3426	133.5640	133.2312	131.6821	131.6821	131.3953	132.2788	133.2312	133.9044	134.6082 (39)
												133.5624

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.1803	1.1769	1.1736	1.1582	1.1553	1.1419	1.1419	1.1394	1.1471	1.1553	1.1612	1.1673 (40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31

4. Water heating energy requirements (kWh/year)

Assumed occupancy													2.8433 (42)
Hot water usage for mixer showers	89.8650	88.5145	86.5466	82.7813	80.0026	76.9038	75.1425	77.0955	79.2364	82.5636	86.4097	89.5207	89.5207 (42a)
Hot water usage for baths	31.0391	30.5782	29.9290	28.7321	27.8359	26.8421	26.3053	26.9499	27.6518	28.7151	29.9367	30.9342	30.9342 (42b)
Hot water usage for other uses	43.7479	42.1570	40.5662	38.9754	37.3845	35.7937	35.7937	37.3845	38.9754	40.5662	42.1570	43.7479	43.7479 (42c)
Average daily hot water use (litres/day)													151.4015 (43)
Daily hot water use	164.6520	161.2497	157.0418	150.4888	145.2230	139.5396	137.2415	141.4300	145.8636	151.8449	158.5035	164.2028	164.2028 (44)
Energy conte	260.7686	229.6174	241.3674	206.0116	195.4981	171.5802	165.9817	175.1198	179.8643	206.0521	225.8173	257.1019	257.1019 (45)
Energy content (annual)													Total = Sum(45)m = 2514.7804
Distribution loss (46)m = 0.15 x (45)m	39.1153	34.4426	36.2051	30.9017	29.3247	25.7370	24.8973	26.2680	26.9797	30.9078	33.8726	38.5653	38.5653 (46)
Water storage loss:													200.0000 (47)
Store volume													1.9000 (48)
a) If manufacturer declared loss factor is known (kWh/day):													0.5400 (49)
Temperature factor from Table 2b													1.0260 (55)
Enter (49) or (54) in (55)													
Total storage loss	31.8060	28.7280	31.8060	30.7800	31.8060	30.7800	31.8060	31.8060	30.7800	31.8060	30.7800	31.8060	31.8060 (56)
If cylinder contains dedicated solar storage	31.8060	28.7280	31.8060	30.7800	31.8060	30.7800	31.8060	31.8060	30.7800	31.8060	30.7800	31.8060	31.8060 (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	23.2624 (59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
Total heat required for water heating calculated for each month	315.8370	279.3566	296.4358	259.3036	250.5665	224.8722	221.0501	230.1882	233.1563	261.1205	279.1093	312.1703	312.1703 (62)
WWHS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63c)
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	0.0000 (63d)
Output from w/h	315.8370	279.3566	296.4358	259.3036	250.5665	224.8722	221.0501	230.1882	233.1563	261.1205	279.1093	312.1703	312.1703 (64)
													Total per year (kWh/year) = Sum(64)m = 3163.1664 (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	130.7603	116.1392	124.3094	111.1325	109.0578	99.6840	99.2436	102.2821	102.4385	112.5670	117.7178	129.5411	129.5411 (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	170.5959	170.5959	170.5959	170.5959	170.5959	170.5959	170.5959	170.5959	170.5959	170.5959	170.5959	170.5959	170.5959 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	33.4091	29.6737	24.1323	18.2697	13.6568	11.5297	12.4582	16.1936	21.7351	27.5977	32.2105	34.3377	34.3377 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	416.4012	420.7221	409.8335	386.6529	357.3915	329.8900	311.5172	307.1963	318.0849	341.2655	370.5269	398.0285	398.0285 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.9028	54.9028	54.9028	54.9028	54.9028	54.9028	54.9028	54.9028	54.9028	54.9028	54.9028	54.9028	54.9028 (69)
Pumps, fans	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)	-113.7306	-113.7306	-113.7306	-113.7306	-113.7306	-113.7306	-113.7306	-113.7306	-113.7306	-113.7306	-113.7306	-113.7306	-113.7306 (71)

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Water heating gains (Table 5)	175.7530	172.8261	167.0825	154.3506	146.5831	138.4500	133.3920	137.4759	142.2757	151.2998	163.4970	174.1144 (72)
Total internal gains	737.3315	734.9901	712.8164	671.0413	629.3996	591.6378	569.1355	572.6340	593.8638	631.9311	678.0026	718.2486 (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	9.5400	10.6334	0.6300	0.7000	0.7700	31.0022 (74)
East	9.7900	19.6403	0.6300	0.7000	0.7700	58.7627 (76)
West	6.2100	19.6403	0.6300	0.7000	0.7700	37.2744 (80)

Solar gains	127.0393	247.1157	410.0681	612.9412	770.8389	799.2968	756.6692	635.6823	480.8810	293.4479	157.9922	104.8212 (83)
Total gains	864.3708	982.1058	1122.8845	1283.9826	1400.2385	1390.9346	1325.8048	1208.3162	1074.7448	925.3790	835.9947	823.0698 (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	33.2204	33.3150	33.4082	33.8531	33.9376	34.3369	34.3369	34.4118	34.1820	33.9376	33.7670	33.5905
alpha	3.2147	3.2210	3.2272	3.2569	3.2625	3.2891	3.2891	3.2941	3.2788	3.2625	3.2511	3.2394
util living area	0.9718	0.9566	0.9220	0.8444	0.7166	0.5539	0.4204	0.4733	0.7003	0.8916	0.9578	0.9756 (86)
Living	19.3937	19.5902	19.9255	20.3414	20.6556	20.8294	20.8830	20.8720	20.7359	20.3107	19.7814	19.3620
Non living	18.0643	18.3137	18.7341	19.2480	19.6074	19.7925	19.8357	19.8313	19.7078	19.2267	18.5679	18.0318
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10
MIT	20.1783	19.5902	19.9255	20.3414	20.6556	20.8294	20.8830	20.8720	20.7359	20.3107	19.7814	19.5911 (87)
Th 2	19.9358	19.9385	19.9412	19.9536	19.9559	19.9668	19.9668	19.9688	19.9626	19.9559	19.9512	19.9463 (88)
util rest of house	0.9665	0.9485	0.9073	0.8154	0.6663	0.4796	0.3283	0.3774	0.6300	0.8644	0.9484	0.9709 (89)
MIT 2	19.1897	18.3137	18.7341	19.2480	19.6074	19.7925	19.8357	19.8313	19.7078	19.2267	18.5679	18.3768 (90)
Living area fraction												FLA = Living area / (4) = 0.2685 (91)
MIT	19.4551	18.6564	19.0540	19.5416	19.8888	20.0709	20.1168	20.1107	19.9838	19.5177	18.8937	18.7028 (92)
Temperature adjustment												0.0000
adjusted MIT	19.4551	18.6564	19.0540	19.5416	19.8888	20.0709	20.1168	20.1107	19.9838	19.5177	18.8937	18.7028 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9636	0.9359	0.8922	0.8024	0.6627	0.4874	0.3421	0.3911	0.6316	0.8507	0.9362	0.9638 (94)
Useful gains	832.9095	919.1365	1001.8242	1030.2348	927.9968	677.9997	453.5228	472.6297	678.7709	787.2184	782.6762	793.2902 (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	2062.7236	1867.0330	1699.0903	1421.3295	1091.0096	720.4179	463.1031	487.5633	778.3038	1188.1160	1579.2231	1952.1951 (97)
Space heating kWh	914.9817	636.9864	518.7660	281.5882	121.2815	0.0000	0.0000	0.0000	0.0000	298.2678	573.5138	862.2252 (98a)
Space heating requirement - total per year (kWh/year)												4207.6107
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	914.9817	636.9864	518.7660	281.5882	121.2815	0.0000	0.0000	0.0000	0.0000	298.2678	573.5138	862.2252 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4207.6107
Space heating per m2												(98c) / (4) = 36.4864 (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 %)												310.8623 (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	914.9817	636.9864	518.7660	281.5882	121.2815	0.0000	0.0000	0.0000	0.0000	298.2678	573.5138	862.2252 (98)
Space heating efficiency (main heating system 1)	310.8623	310.8623	310.8623	310.8623	310.8623	0.0000	0.0000	0.0000	0.0000	310.8623	310.8623	310.8623 (210)
Space heating fuel (main heating system)	294.3367	204.9095	166.8797	90.5829	39.0145	0.0000	0.0000	0.0000	0.0000	95.9485	184.4913	277.3656 (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	315.8370	279.3566	296.4358	259.3036	250.5665	224.8722	221.0501	230.1882	233.1563	261.1205	279.1093	312.1703 (64)
Efficiency of water heater (217)m	175.0368	175.0368	175.0368	175.0368	175.0368	175.0368	175.0368	175.0368	175.0368	175.0368	175.0368	175.0368 (216)
Fuel for water heating, kWh/month	180.4403	159.5988	169.3563	148.1423	143.1508	128.4714	126.2878	131.5085	133.2042	149.1804	159.4575	178.3455 (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	29.2428	23.4597	21.1228	15.4755	11.9537	9.7663	10.9046	14.1742	18.4109	24.1561	27.2842	30.0556 (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)

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Electricity generated by wind turbines (Appendix M) (negative quantity) (234a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234a)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235a)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235a)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235c)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235c)
Electricity generated by PVs (Appendix M) (negative quantity) (233b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(233b)
Electricity generated by wind turbines (Appendix M) (negative quantity) (234b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(234b)
Electricity generated by hydro-electric generators (Appendix M) (negative quantity) (235b)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235b)
Electricity used or net electricity generated by micro-CHP (Appendix N) (negative if net generation) (235d)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(235d)
Annual totals kWh/year													
Space heating fuel - main system 1												1353.5288	(211)
Space heating fuel - main system 2												0.0000	(213)
Space heating fuel - secondary												0.0000	(215)
Efficiency of water heater												175.0368	
Water heating fuel used												1807.1439	(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)												236.0064	(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												3396.6790	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1353.5288	16.4900	223.1969	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1807.1439	16.4900	297.9980	(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	236.0064	16.4900	38.9175	(250)
Additional standing charges			0.0000	(251)
Total energy cost			560.1124	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600	(256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	1.2577	(257)
SAP value		79.6121	
SAP rating (Section 12)		80	(258)
SAP band		C	

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	1353.5288	0.1555	210.5160	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1807.1439	0.1410	254.7907	(264)
Space and water heating			465.3067	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	236.0064	0.1443	34.0630	(268)
Total CO2, kg/year			499.3697	(272)
CO2 emissions per m2			4.3300	(273)
EI value			95.8261	
EI rating			96	(274)
EI band			A	

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

1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)	
Ground floor	66.6200 (1b)	x 2.3500 (2b)	= 156.5570 (1b) - (3b)	
First floor	48.7000 (1c)	x 2.6000 (2c)	= 126.6200 (1c) - (3c)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	115.3200		(4)	
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	283.1770 (5)	

2. Ventilation rate

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												m3 per hour	
Number of open chimneys												0 * 80 =	0.0000 (6a)
Number of open flues												0 * 20 =	0.0000 (6b)
Number of chimneys / flues attached to closed fire												0 * 10 =	0.0000 (6c)
Number of flues attached to solid fuel boiler												0 * 20 =	0.0000 (6d)
Number of flues attached to other heater												0 * 35 =	0.0000 (6e)
Number of blocked chimneys												0 * 20 =	0.0000 (6f)
Number of intermittent extract fans												4 * 10 =	40.0000 (7a)
Number of passive vents												0 * 10 =	0.0000 (7b)
Number of flueless gas fires												0 * 40 =	0.0000 (7c)
												Air changes per hour	
Infiltration due to chimneys, flues and fans	= (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =											40.0000 / (5) =	0.1413 (8)
Pressure test												Yes	
Pressure Test Method												Blower Door	
Measured/design AP50												5.0000 (17)	
Infiltration rate												0.3913 (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) =	0.3619 (21)

Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	4.8000	4.6000	4.6000	4.1000	4.0000	3.6000	3.6000	3.7000	3.8000	4.1000	4.1000	4.3000	(22)
Wind factor	1.2000	1.1500	1.1500	1.0250	1.0000	0.9000	0.9000	0.9250	0.9500	1.0250	1.0250	1.0750	(22a)
Adj infilt rate													
	0.4343	0.4162	0.4162	0.3710	0.3619	0.3257	0.3257	0.3348	0.3438	0.3710	0.3710	0.3891	(22b)
Effective ac	0.5943	0.5866	0.5866	0.5688	0.5655	0.5530	0.5530	0.5560	0.5591	0.5688	0.5688	0.5757	(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						
Glazing (Uw = 1.20)			25.5400	1.1450	29.2443			(27)					
Door			1.9600	1.2000	2.3520			(26)					
Ground Floor			66.6200	0.1200	7.9944	75.0000	4996.5000	(28a)					
External Walls	153.2620	27.5000	125.7620	0.1700	21.3795	60.0000	7545.7196	(29a)					
Joisted Roof	48.7000		48.7000	0.1100	5.3570	9.0000	438.3000	(30)					
Rafter Roof	19.7000		19.7000	0.1600	3.1520	9.0000	177.3000	(30)					
Total net area of external elements Aum(A, m2)			288.2820					(31)					
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	69.4792		(33)					
Internal Walls			200.5400			9.0000	1804.8600	(32c)					
Internal Floor 1			48.7000			18.0000	876.6000	(32d)					
Internal Ceiling 1			48.7000			9.0000	438.3000	(32e)					
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) =	16277.5796 (34)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K								141.1514 (35)					
List of Thermal Bridges													
K1 Element					Length	Psi-value	Total						
E2 Other lintels (including other steel lintels)					17.2700	0.2340	4.0412						
E3 Sill					9.6000	0.0230	0.2208						
E4 Jamb					33.8800	0.0180	0.6098						
E5 Ground floor (normal)					34.0400	0.0530	1.8041						
E6 Intermediate floor within a dwelling					22.0800	0.0010	0.0221						
E10 Eaves (insulation at ceiling level)					8.4600	0.0550	0.4653						
E12 Gable (insulation at ceiling level)					19.7000	0.0370	0.7289						
E16 Corner (normal)					19.8000	0.0400	0.7920						
E24 Eaves (insulation at ceiling level - inverted)					6.1000	0.1500	0.9150						
E11 Eaves (insulation at rafter level)					6.1000	0.0180	0.1098						
E13 Gable (insulation at rafter level)					6.3200	0.0390	0.2465						
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.9555	(36)					
Point Thermal bridges							(36a) =	0.0000					
Total fabric heat loss							(33) + (36) + (36a) =	79.4347 (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	
	55.5369	54.8178	54.8178	53.1539	52.8441	51.6813	51.6813	51.9605	52.2474	53.1539	53.1539	53.7965	(38)
Heat transfer coeff													
	134.9716	134.2525	134.2525	132.5886	132.2788	131.1160	131.1160	131.3953	131.6821	132.5886	132.5886	133.2312	(39)
Average = Sum(39)m / 12 =													132.6718
HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	1.1704	1.1642	1.1642	1.1497	1.1471	1.1370	1.1370	1.1394	1.1419	1.1497	1.1497	1.1553	(40)
HLP (average)													1.1505
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy													2.8433 (42)
Hot water usage for mixer showers													89.5207 (42a)
Hot water usage for baths													30.9342 (42b)
Hot water usage for other uses													43.7479 (42c)
Average daily hot water use (litres/day)													151.4015 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	164.6520	161.2497	157.0418	150.4888	145.2230	139.5396	137.2415	141.4300	145.8636	151.8449	158.5035	164.2028	(44)
Energy conte	260.7686	229.6174	241.3674	206.0116	195.4981	171.5802	165.9817	175.1198	179.8643	206.0521	225.8173	257.1019	(45)
Energy content (annual)													Total = Sum(45)m = 2514.7804
Distribution loss (46)m = 0.15 x (45)m													39.1153 (46)
Water storage loss:													200.0000 (47)
Store volume													1.9000 (48)
a) If manufacturer declared loss factor is known (kWh/day):													0.5400 (49)
Temperature factor from Table 2b													1.0260 (55)
Enter (49) or (54) in (55)													
Total storage loss	31.8060	28.7280	31.8060	30.7800	31.8060	30.7800	31.8060	31.8060	30.7800	31.8060	30.7800	31.8060	(56)

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If cylinder contains dedicated solar storage												
Primary loss	31.8060	28.7280	31.8060	30.7800	31.8060	30.7800	31.8060	31.8060	30.7800	31.8060	30.7800	31.8060 (57)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (61)
Total heat required for water heating calculated for each month												
WWHRS	315.8370	279.3566	296.4358	259.3036	250.5665	224.8722	221.0501	230.1882	233.1563	261.1205	279.1093	312.1703 (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	315.8370	279.3566	296.4358	259.3036	250.5665	224.8722	221.0501	230.1882	233.1563	261.1205	279.1093	312.1703 (64)
Total per year (kWh/year) = Sum(64)m =											3163.1664 (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												
	130.7603	116.1392	124.3094	111.1325	109.0578	99.6840	99.2436	102.2821	102.4385	112.5670	117.7178	129.5411 (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	170.5959	170.5959	170.5959	170.5959	170.5959	170.5959	170.5959	170.5959	170.5959	170.5959	170.5959	170.5959 (66)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	33.4091	29.6737	24.1323	18.2697	13.6568	11.5297	12.4582	16.1936	21.7351	27.5977	32.2105	34.3377 (67)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	416.4012	420.7221	409.8335	386.6529	357.3915	329.8900	311.5172	307.1963	318.0849	341.2655	370.5269	398.0285 (68)
Pumps, fans	54.9028	54.9028	54.9028	54.9028	54.9028	54.9028	54.9028	54.9028	54.9028	54.9028	54.9028	54.9028 (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)	-113.7306	-113.7306	-113.7306	-113.7306	-113.7306	-113.7306	-113.7306	-113.7306	-113.7306	-113.7306	-113.7306	-113.7306 (71)
Total internal gains	737.3315	734.9901	712.8164	671.0413	629.3996	591.6378	569.1355	572.6340	593.8638	631.9311	678.0026	718.2486 (73)

6. Solar gains

[Jan]	Area m ²	Solar flux Table 6a W/m ²	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W						
North	9.5400	12.0246	0.6300	0.7000	0.7700	35.0584 (74)						
East	9.7900	22.3829	0.6300	0.7000	0.7700	66.9687 (76)						
West	6.2100	22.3829	0.6300	0.7000	0.7700	42.4796 (80)						
Solar gains	144.5067	257.8132	423.8432	643.0050	789.3760	870.1825	811.4922	690.2532	523.6311	321.2646	179.4801	118.0191 (83)
Total gains	881.8382	992.8033	1136.6596	1314.0464	1418.7756	1461.8203	1380.6277	1262.8872	1117.4950	953.1957	857.4826	836.2678 (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)											21.0000 (85)	
tau	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
alpha	33.5000	33.6795	33.6795	34.1021	34.1820	34.4851	34.4851	34.4118	34.3369	34.1021	34.1021	33.9376
util living area	3.2333	3.2453	3.2453	3.2735	3.2788	3.2990	3.2990	3.2941	3.2891	3.2735	3.2735	3.2625
util living area	0.9697	0.9558	0.9165	0.8306	0.6905	0.4966	0.3528	0.3932	0.6565	0.8764	0.9537	0.9740 (86)
Living	19.4404	19.6070	19.9755	20.3890	20.6959	20.8558	20.8948	20.8896	20.7761	20.3704	19.8302	19.4085
Non living	18.1289	18.3420	18.8015	19.3091	19.6559	19.8181	19.8466	19.8422	19.7496	19.3008	18.6355	18.0975
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10
MIT	20.2021	19.6070	19.9755	20.3890	20.6959	20.8558	20.8948	20.8896	20.7761	20.3704	19.8302	19.6311 (87)
Th 2	19.9437	19.9488	19.9488	19.9604	19.9626	19.9708	19.9708	19.9688	19.9668	19.9604	19.9604	19.9559 (88)
util rest of house	0.9639	0.9476	0.9008	0.7998	0.6369	0.4204	0.2608	0.2946	0.5806	0.8458	0.9436	0.9690 (89)
MIT 2	19.2202	18.3420	18.8015	19.3091	19.6559	19.8181	19.8466	19.8422	19.7496	19.3008	18.6355	18.4324 (90)
Living area fraction										FLA = Living area / (4) =		
MIT	19.4839	18.6816	19.1167	19.5990	19.9351	20.0967	20.1280	20.1234	20.0252	19.5879	18.9563	18.7542 (92)
Temperature adjustment												0.0000
adjusted MIT	19.4839	18.6816	19.1167	19.5990	19.9351	20.0967	20.1280	20.1234	20.0252	19.5879	18.9563	18.7542 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	0.9610	0.9350	0.8857	0.7876	0.6354	0.4301	0.2751	0.3098	0.5852	0.8327	0.9310	0.9617 (94)
Ext temp.	847.4239	928.2515	1006.7260	1034.9196	901.4542	628.7065	379.8274	391.1829	654.0025	793.7342	798.3453	804.2277 (95)
Heat loss rate W	4.4000	4.8000	6.7000	9.1000	12.1000	15.1000	17.2000	17.1000	14.5000	10.9000	7.2000	4.3000 (96)
Space heating kWh	2035.8912	1863.6400	1666.9732	1392.0489	1036.4222	655.1465	383.9082	397.2567	727.5668	1151.9227	1558.7471	1925.7541 (97)
Space heating requirement - total per year (kWh/year)	884.2197	628.5811	491.2239	257.1331	100.4162	0.0000	0.0000	0.0000	0.0000	266.4923	547.4893	834.4156 (98a)
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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Space heating kWh	884.2197	628.5811	491.2239	257.1331	100.4162	0.0000	0.0000	0.0000	0.0000	266.4923	547.4893	834.4156 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)												4009.9712
Space heating per m ²										(98c) / (4) =		34.7726 (99)

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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 %)													310.6235	(206)
Efficiency of main space heating system 2 (in %)													0.0000	(207)
Efficiency of secondary/supplementary heating system, %													0.0000	(208)
Space heating requirement	884.2197	628.5811	491.2239	257.1331	100.4162	0.0000	0.0000	0.0000	0.0000	266.4923	547.4893	834.4156	(98)	
Space heating efficiency (main heating system 1)	310.6235	310.6235	310.6235	310.6235	310.6235	0.0000	0.0000	0.0000	0.0000	310.6235	310.6235	310.6235	(210)	
Space heating fuel (main heating system)	284.6597	202.3611	158.1413	82.7797	32.3273	0.0000	0.0000	0.0000	0.0000	85.7927	176.2550	268.6261	(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	319.8370	279.3566	296.4358	259.3036	250.5665	224.8722	221.0501	230.1882	233.1563	261.1205	279.1093	312.1703	(64)	
Efficiency of water heater (217)m	175.0201	175.0201	175.0201	175.0201	175.0201	175.0201	175.0201	175.0201	175.0201	175.0201	175.0201	175.0201	(216)	
Fuel for water heating, kWh/month	180.4575	159.6140	169.3724	148.1564	143.1644	128.4836	126.2998	131.5210	133.2169	149.1945	159.4726	178.3625	(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	29.2428	23.4597	21.1228	15.4755	11.9537	9.7663	10.9046	14.1742	18.4109	24.1561	27.2842	30.0556	(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													1290.9427	(211)
Space heating fuel - main system 2													0.0000	(213)
Space heating fuel - secondary													0.0000	(215)
Efficiency of water heater													175.0201	(216)
Water heating fuel used													1807.3155	(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)													236.0064	(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													3334.2647	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1290.9427	25.1600	324.8012	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1807.3155	25.1600	454.7206	(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	236.0064	25.1600	59.3792	(250)
Additional standing charges			0.0000	(251)
Total energy cost			838.9010	(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	1290.9427	0.1558	201.1460	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1807.3155	0.1410	254.8149	(264)
Space and water heating			455.9608	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	236.0064	0.1443	34.0630	(268)
Total CO2, kg/year			490.0239	(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	1290.9427	1.5768	2035.5888	(275)

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Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1807.3155	1.5213	2749.5369 (278)
Space and water heating			4785.1257 (279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000 (281)
Energy for lighting	236.0064	1.5338	361.9945 (282)
Total Primary energy kWh/year			5147.1202 (286)

SAP 10 EPC IMPROVEMENTS

DS 2024

Current energy efficiency rating: C 80
Current environmental impact rating: A 96

N Solar water heating			Recommended
U Solar photovoltaic panels			Recommended
V2 Wind turbine			Not applicable
Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.9	-£ 89	-44 kg (9.0%)
U Solar photovoltaic panels	+ 5.5	-£ 238	-127 kg (28.5%)

	Typical annual savings	Energy efficiency	Environmental impact
Recommended measures			
Solar water heating	£89	0.38 kg/m ²	B 82 A 96
Solar photovoltaic panels	£238	1.10 kg/m ²	B 87 A 97
Total Savings	£327	1.49 kg/m ²	

Potential energy efficiency rating: B 87
Potential environmental impact rating: A 97

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

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

	Current	Potential	Saving
Electricity	£839	£750	£89
Space heating	£325	£345	-£21
Water heating	£455	£345	£110
Lighting	£59	£59	£0
Generated (PV)	-£10	-£238	£238
Total cost of fuels	£839	£512	£327
Total cost of uses	£839	£511	£327
Delivered energy	29 kWh/m ²	18 kWh/m ²	11 kWh/m ²
Carbon dioxide emissions	0.5 tonnes	0.3 tonnes	0.2 tonnes
CO2 emissions per m ²	4 kg/m ²	3 kg/m ²	1 kg/m ²
Primary energy	45 kWh/m ²	28 kWh/m ²	17 kWh/m ²

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 ²)	Storey height (m)	Volume (m ³)
Ground floor	66.6200 (1b)	x 2.3500 (2b)	= 156.5570 (1b) - (3b)
First floor	48.7000 (1c)	x 2.6000 (2c)	= 126.6200 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	115.3200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 283.1770 (5)

2. Ventilation rate

	m3 per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	4 * 10 = 40.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) = 0.1413 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3913 (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) = 0.3619 (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													
Effective ac	0.4614	0.4524	0.4433	0.3981	0.3891	0.3438	0.3438	0.3348	0.3619	0.3891	0.4071	0.4252	(22b)
	0.6065	0.6023	0.5983	0.5792	0.5757	0.5591	0.5591	0.5560	0.5655	0.5757	0.5829	0.5904	(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	
Glazing (Uw = 1.20)			25.5400	1.1450	29.2443			(27)
Door			1.9600	1.2000	2.3520			(26)
Ground Floor			66.6200	0.1200	7.9944	75.0000	4996.5000	(28a)
External Walls	153.2620	27.5000	125.7620	0.1700	21.3795	60.0000	7545.7196	(29a)
Joisted Roof	48.7000		48.7000	0.1100	5.3570	9.0000	438.3000	(30)
Rafter Roof	19.7000		19.7000	0.1600	3.1520	9.0000	177.3000	(30)
Total net area of external elements Aum(A, m2)			288.2820					(31)
Fabric heat loss, W/K = Sum (A x U)			(26) ... (30) + (32) =		69.4792			(33)
Internal Walls			200.5400			9.0000	1804.8600	(32c)
Internal Floor 1			48.7000			18.0000	876.6000	(32d)
Internal Ceiling 1			48.7000			9.0000	438.3000	(32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 16277.5796 (34)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 141.1514 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E2 Other lintels (including other steel lintels)	17.2700	0.2340	4.0412
E3 Sill	9.6000	0.0230	0.2208
E4 Jamb	33.8800	0.0180	0.6098
E5 Ground floor (normal)	34.0400	0.0530	1.8041
E6 Intermediate floor within a dwelling	22.0800	0.0010	0.0221
E10 Eaves (insulation at ceiling level)	8.4600	0.0550	0.4653
E12 Gable (insulation at ceiling level)	19.7000	0.0370	0.7289
E16 Corner (normal)	19.8000	0.0400	0.7920
E24 Eaves (insulation at ceiling level - inverted)	6.1000	0.1500	0.9150
E11 Eaves (insulation at rafter level)	6.1000	0.0180	0.1098
E13 Gable (insulation at rafter level)	6.3200	0.0390	0.2465

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 9.9555 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 79.4347 (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	56.6729	56.2865	55.9079	54.1293	53.7965	52.2474	52.2474	51.9605	52.8441	53.7965	54.4697	55.1735	(38)
Average = Sum(39)m / 12 =	136.1076	135.7213	135.3426	133.5640	133.2312	131.6821	131.6821	131.3953	132.2788	133.2312	133.9044	134.6082	(39)
													133.5624

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1803	1.1769	1.1736	1.1582	1.1553	1.1419	1.1419	1.1394	1.1471	1.1553	1.1612	1.1673	(40)
HLP (average)													1.1582
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Assumed occupancy													2.8433 (42)
Hot water usage for mixer showers													
Hot water usage for baths	89.8650	88.5145	86.5466	82.7813	80.0026	76.9038	75.1425	77.0955	79.2364	82.5636	86.4097	89.5207	(42a)
Hot water usage for other uses	31.0391	30.5782	29.9290	28.7321	27.8359	26.8421	26.3053	26.9499	27.6518	28.7151	29.9367	30.9342	(42b)
Average daily hot water use (litres/day)	43.7479	42.1570	40.5662	38.9754	37.3845	35.7937	35.7937	37.3845	38.9754	40.5662	42.1570	43.7479	(42c)
													151.4015 (43)
Daily hot water use	164.6520	161.2497	157.0418	150.4888	145.2230	139.5396	137.2415	141.4300	145.8636	151.8449	158.5035	164.2028	(44)
Energy content (annual)	260.7686	229.6174	241.3674	206.0116	195.4981	171.5802	165.9817	175.1198	179.8643	206.0521	225.8173	257.1019	(45)
Distribution loss (46)m = 0.15 x (45)m													2514.7804
Water storage loss:	39.1153	34.4426	36.2051	30.9017	29.3247	25.7370	24.8973	26.2680	26.9797	30.9078	33.8726	38.5653	(46)
Store volume													200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													1.9000 (48)
Temperature factor from Table 2b													0.5400 (49)
Enter (49) or (54) in (55)													1.0260 (55)
Total storage loss	31.8060	28.7280	31.8060	30.7800	31.8060	30.7800	31.8060	31.8060	30.7800	31.8060	30.7800	31.8060	(56)
If cylinder contains dedicated solar storage	31.8060	28.7280	31.8060	30.7800	31.8060	30.7800	31.8060	31.8060	30.7800	31.8060	30.7800	31.8060	(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	315.8370	279.3566	295.0400	252.5500	237.7721	212.2655	208.0231	218.0918	227.7535	259.7248	279.1093	312.1703	(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													642.4570 (H24)
Heat delivered to space heating													0.0000 (H29)

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Efficiency of secondary/supplementary heating system, %												0.0000 (208)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	914.9817	636.9864	519.3864	283.7274	123.4695	0.0000	0.0000	0.0000	0.0000	298.7994	573.5138	862.2252 (98)
Space heating efficiency (main heating system 1)	310.8623	310.8623	310.8623	310.8623	310.8623	0.0000	0.0000	0.0000	0.0000	310.8623	310.8623	310.8623 (210)
Space heating fuel (main heating system)	294.3367	204.9095	167.0792	91.2711	39.7184	0.0000	0.0000	0.0000	0.0000	96.1195	184.4913	277.3656 (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	315.8370	263.1782	235.6629	170.0467	128.7734	111.6018	108.0074	131.3139	168.6355	230.9006	279.1093	312.1703 (64)
Efficiency of water heater (217)m	175.0368	175.0368	175.0368	175.0368	175.0368	175.0368	175.0368	175.0368	175.0368	175.0368	175.0368	175.0368 (216)
Fuel for water heating, kWh/month	180.4403	150.3560	134.6362	97.1492	73.5694	63.7590	61.7056	75.0207	96.3429	131.9155	159.4575	178.3455 (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	29.2428	23.4597	21.1228	15.4755	11.9537	9.7663	10.9046	14.1742	18.4109	24.1561	27.2842	30.0556 (232)
Electricity generated by PVs (Appendix M) (negative quantity) (233a)m	-39.2697	-58.8517	-88.8242	-102.2652	-109.3489	-99.0212	-97.5304	-91.6471	-80.6027	-67.9545	-44.0316	-33.4162 (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												1355.2913 (211)
Space heating fuel - main system 2												0.0000 (213)
Space heating fuel - secondary												0.0000 (215)
Efficiency of water heater												175.0368
Water heating fuel used												1402.6978 (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)												236.0064 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV generation												-912.7634 (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												2161.2321 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	1355.2913	16.4900	223.4875 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1402.6978	16.4900	231.3049 (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	236.0064	16.4900	38.9175 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-912.7634	16.4900	-150.5147
PV Unit electricity exported	0.0000	5.5900	0.0000
Total			-150.5147 (252)
Total energy cost			356.3872 (255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600 (256)
Energy cost factor (ECF)		0.8003 (257)
SAP value	$[(255) \times (256)] / [(4) + 45.0] =$	87.0276
SAP rating (Section 12)		87 (258)
SAP band		B

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year
Space heating - main system 1	1355.2913	0.1555	210.7612 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1402.6978	0.1450	203.4170 (264)
Space and water heating			414.1782 (265)
Pumps, fans and electric keep-hot	80.0000	0.1387	11.0970 (267)

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Energy for lighting	236.0064	0.1443	34.0630 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-912.7634	0.1343	-122.6092
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-122.6092 (269)
Total CO2, kg/year			336.7290 (272)
CO2 emissions per m2			2.9200 (273)
EI value			97.1855
EI rating			97 (274)
EI band			A

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

1. Overall dwelling characteristics

	Area (m2)	Storey height (m)	Volume (m3)
Ground floor	66.6200 (1b)	x 2.3500 (2b)	= 156.5570 (1b) - (3b)
First floor	48.7000 (1c)	x 2.6000 (2c)	= 126.6200 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	115.3200		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 283.1770 (5)

2. Ventilation rate

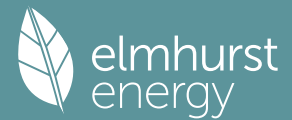
	m3 per hour
Number of open chimneys	0 * 80 = 0.0000 (6a)
Number of open flues	0 * 20 = 0.0000 (6b)
Number of chimneys / flues attached to closed fire	0 * 10 = 0.0000 (6c)
Number of flues attached to solid fuel boiler	0 * 20 = 0.0000 (6d)
Number of flues attached to other heater	0 * 35 = 0.0000 (6e)
Number of blocked chimneys	0 * 20 = 0.0000 (6f)
Number of intermittent extract fans	4 * 10 = 40.0000 (7a)
Number of passive vents	0 * 10 = 0.0000 (7b)
Number of flueless gas fires	0 * 40 = 0.0000 (7c)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	40.0000 / (5) = 0.1413 (8)
Pressure test	Yes
Pressure Test Method	Blower Door
Measured/design AP50	5.0000 (17)
Infiltration rate	0.3913 (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) = 0.3619 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.8000	4.6000	4.6000	4.1000	4.0000	3.6000	3.6000	3.7000	3.8000	4.1000	4.1000	4.3000 (22)
Wind factor	1.2000	1.1500	1.1500	1.0250	1.0000	0.9000	0.9000	0.9250	0.9500	1.0250	1.0250	1.0750 (22a)
Adj infilt rate												
Effective ac	0.4343	0.4162	0.4162	0.3710	0.3619	0.3257	0.3257	0.3348	0.3438	0.3710	0.3710	0.3891 (22b)
	0.5943	0.5866	0.5866	0.5688	0.5655	0.5530	0.5530	0.5560	0.5591	0.5688	0.5688	0.5757 (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
Glazing (Uw = 1.20)			25.5400	1.1450	29.2443		(27)
Door			1.9600	1.2000	2.3520		(26)
Ground Floor			66.6200	0.1200	7.9944	75.0000	4996.5000 (28a)
External Walls	153.2620	27.5000	125.7620	0.1700	21.3795	60.0000	7545.7196 (29a)
Joisted Roof	48.7000		48.7000	0.1100	5.3570	9.0000	438.3000 (30)
Rafter Roof	19.7000		19.7000	0.1600	3.1520	9.0000	177.3000 (30)
Total net area of external elements Aum(A, m2)			288.2820				(31)
Fabric heat loss, W/K = Sum (A x U)					(26)...(30) + (32) =	69.4792	(33)
Internal Walls			200.5400			9.0000	1804.8600 (32c)
Internal Floor 1			48.7000			18.0000	876.6000 (32d)
Internal Ceiling 1			48.7000			9.0000	438.3000 (32e)
Heat capacity Cm = Sum(A x k)							(28)...(30) + (32) + (32a)...(32e) =
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							16277.5796 (34)
List of Thermal Bridges							141.1514 (35)
K1 Element				Length	Psi-value		Total
E2 Other lintels (including other steel lintels)				17.2700	0.2340		4.0412
E3 Sill				9.6000	0.0230		0.2208
E4 Jamb				33.8800	0.0180		0.6098
E5 Ground floor (normal)				34.0400	0.0530		1.8041
E6 Intermediate floor within a dwelling				22.0800	0.0010		0.0221
E10 Eaves (insulation at ceiling level)				8.4600	0.0550		0.4653
E12 Gable (insulation at ceiling level)				19.7000	0.0370		0.7289
E16 Corner (normal)				19.8000	0.0400		0.7920
E24 Eaves (insulation at ceiling level - inverted)				6.1000	0.1500		0.9150
E11 Eaves (insulation at rafter level)				6.1000	0.0180		0.1098
E13 Gable (insulation at rafter level)				6.3200	0.0390		0.2465
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.9555 (36)
Point Thermal bridges							(36a) = 0.0000
Total fabric heat loss							(33) + (36) + (36a) = 79.4347 (37)

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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	55.5369	54.8178	54.8178	53.1539	52.8441	51.6813	51.6813	51.9605	52.2474	53.1539	53.1539	53.7965 (38)
Average = Sum(39)m / 12 =	134.9716	134.2525	134.2525	132.5886	132.2788	131.1160	131.1160	131.3953	131.6821	132.5886	132.5886	133.2312 (39)

HLP	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP (average)	1.1704	1.1642	1.1642	1.1497	1.1471	1.1370	1.1370	1.1394	1.1419	1.1497	1.1497	1.1553 (40)
Days in mont	31	28	31	30	31	30	31	31	30	31	30	1.1505 (40)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												
Hot water usage for mixer showers												2.8433 (42)
Hot water usage for baths	89.8650	88.5145	86.5466	82.7813	80.0026	76.9038	75.1425	77.0955	79.2364	82.5636	86.4097	89.5207 (42a)
Hot water usage for other uses	31.0391	30.5782	29.9290	28.7321	27.8359	26.8421	26.3053	26.9499	27.6518	28.7151	29.9367	30.9342 (42b)
Average daily hot water use (litres/day)	43.7479	42.1570	40.5662	38.9754	37.3845	35.7937	35.7937	37.3845	38.9754	40.5662	42.1570	43.7479 (42c)
Daily hot water use												
Energy conte	164.6520	161.2497	157.0418	150.4888	145.2230	139.5396	137.2415	141.4300	145.8636	151.8449	158.5035	164.2028 (44)
Energy content (annual)	260.7686	229.6174	241.3674	206.0116	195.4981	171.5802	165.9817	175.1198	179.8643	206.0521	225.8173	257.1019 (45)
Distribution loss (46)m = 0.15 x (45)m	39.1153	34.4426	36.2051	30.9017	29.3247	25.7370	24.8973	26.2680	26.9797	30.9078	33.8726	38.5653 (46)
Water storage loss:												
Store volume												200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.9000 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												1.0260 (55)
Total storage loss	31.8060	28.7280	31.8060	30.7800	31.8060	30.7800	31.8060	31.8060	30.7800	31.8060	30.7800	31.8060 (56)
If cylinder contains dedicated solar storage	31.8060	28.7280	31.8060	30.7800	31.8060	30.7800	31.8060	31.8060	30.7800	31.8060	30.7800	31.8060 (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	315.8370	279.3566	295.0400	252.5500	237.7721	212.2655	208.0231	218.0918	227.7535	259.7248	279.1093	312.1703 (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												697.6878 (H24)
Heat delivered to space heating												0.0000 (H29)
Solar input												697.6878
Solar input	-0.0000	-17.8498	-61.8071	-87.1354	-111.5509	-110.7119	-108.2790	-96.0986	-66.9171	-35.3743	-1.9637	-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	315.8370	261.5068	233.2330	165.4146	126.2213	101.5537	99.7441	121.9932	160.8364	224.3505	277.1455	312.1703 (64)
Total per year (kWh/year) = Sum(64)m =												2400.0062 (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	130.7603	116.1392	123.1928	105.7296	98.8224	89.5987	88.8221	92.6049	98.1162	111.4504	117.7178	129.5411 (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	170.5959	170.5959	170.5959	170.5959	170.5959	170.5959	170.5959	170.5959	170.5959	170.5959	170.5959	170.5959 (66)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	33.4091	29.6737	24.1323	18.2697	13.6568	11.5297	12.4582	16.1936	21.7351	27.5977	32.2105	34.3377 (67)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	416.4012	420.7221	409.8335	386.6529	357.3915	329.8900	311.5172	307.1963	318.0849	341.2655	370.5269	398.0285 (68)
Pumps, fans	54.9028	54.9028	54.9028	54.9028	54.9028	54.9028	54.9028	54.9028	54.9028	54.9028	54.9028	54.9028 (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)	-113.7306	-113.7306	-113.7306	-113.7306	-113.7306	-113.7306	-113.7306	-113.7306	-113.7306	-113.7306	-113.7306	-113.7306 (71)
Total internal gains	175.7530	172.8261	165.5817	146.8466	132.8258	124.4426	119.3845	124.4690	136.2725	149.7990	163.4970	174.1144 (72)
Total internal gains	737.3315	734.9901	711.3156	663.5373	615.6422	577.6303	555.1281	559.6270	587.8606	630.4303	678.0026	718.2486 (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	9.5400	12.0246	0.6300	0.7000	0.7700	35.0584 (74)
East	9.7900	22.3829	0.6300	0.7000	0.7700	66.9687 (76)
West	6.2100	22.3829	0.6300	0.7000	0.7700	42.4796 (80)

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Solar gains	144.5067	257.8132	423.8432	643.0050	789.3760	870.1825	811.4922	690.2532	523.6311	321.2646	179.4801	118.0191 (83)
Total gains	881.8382	992.8033	1135.1588	1306.5424	1405.0183	1447.8128	1366.6202	1249.8802	1111.4918	951.6949	857.4826	836.2678 (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	33.5000	33.6795	33.6795	34.1021	34.1820	34.4851	34.4851	34.4118	34.3369	34.1021	34.1021	33.9376	
alpha	3.2333	3.2453	3.2453	3.2735	3.2788	3.2990	3.2990	3.2941	3.2891	3.2735	3.2735	3.2625	
util living area	0.9697	0.9558	0.9168	0.8325	0.6946	0.5006	0.3562	0.3969	0.6588	0.8768	0.9537	0.9740 (86)	
Living	19.4404	19.6070	19.9743	20.3849	20.6920	20.8546	20.8945	20.8891	20.7747	20.3694	19.8302	19.4085	
Non living	18.1289	18.3420	18.8001	19.3045	19.6521	19.8172	19.8464	19.8420	19.7484	19.2997	18.6355	18.0975	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	3	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	28	0	0	0	0	0	0	0	0	0	0	10	
MIT	20.2021	19.6070	19.9743	20.3849	20.6920	20.8546	20.8945	20.8891	20.7747	20.3694	19.8302	19.6311 (87)	
Th 2	19.9437	19.9488	19.9488	19.9604	19.9626	19.9708	19.9708	19.9688	19.9668	19.9604	19.9604	19.9559 (88)	
util rest of house	0.9639	0.9476	0.9011	0.8018	0.6412	0.4240	0.2634	0.2975	0.5829	0.8462	0.9436	0.9690 (89)	
MIT 2	19.2202	18.3420	18.8001	19.3045	19.6521	19.8172	19.8464	19.8420	19.7484	19.2997	18.6355	18.4324 (90)	
Living area fraction	FLA = Living area / (4) =												
MIT	19.4839	18.6816	19.1154	19.5946	19.9313	20.0957	20.1278	20.1231	20.0239	19.5869	18.9563	18.7542 (92)	
Temperature adjustment	0.0000												
adjusted MIT	19.4839	18.6816	19.1154	19.5946	19.9313	20.0957	20.1278	20.1231	20.0239	19.5869	18.9563	18.7542 (93)	

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9610	0.9350	0.8860	0.7895	0.6394	0.4337	0.2778	0.3128	0.5875	0.8332	0.9310	0.9617 (94)
Useful gains	847.4239	928.2515	1005.7340	1031.5346	898.4013	627.9240	379.6794	390.9657	653.0039	792.9246	798.3453	804.2277 (95)
Ext temp.	4.4000	4.8000	6.7000	9.1000	12.1000	15.1000	17.2000	17.1000	14.5000	10.9000	7.2000	4.3000 (96)
Heat loss rate W	2035.8912	1863.6400	1666.7954	1391.4591	1035.9159	655.0218	383.8829	397.2200	727.4027	1151.7798	1558.7471	1925.7541 (97)
Space heating kWh	884.2197	628.5811	491.8296	259.1457	102.3109	0.0000	0.0000	0.0000	0.0000	266.9883	547.4893	834.4156 (98a)
Space heating requirement - total per year (kWh/year)	4014.9802											
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	884.2197	628.5811	491.8296	259.1457	102.3109	0.0000	0.0000	0.0000	0.0000	266.9883	547.4893	834.4156 (98c)
Space heating requirement after solar contribution - total per year (kWh/year)	4014.9802											
Space heating per m2	(98c) / (4) = 34.8160 (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 %)													310.6235 (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	884.2197	628.5811	491.8296	259.1457	102.3109	0.0000	0.0000	0.0000	0.0000	266.9883	547.4893	834.4156 (98)	
Space heating efficiency (main heating system 1)	310.6235	310.6235	310.6235	310.6235	310.6235	0.0000	0.0000	0.0000	0.0000	310.6235	310.6235	310.6235 (210)	
Space heating fuel (main heating system)	284.6597	202.3611	158.3363	83.4276	32.9373	0.0000	0.0000	0.0000	0.0000	85.9524	176.2550	268.6261 (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	315.8370	261.5068	233.2330	165.4146	126.2213	101.5537	99.7441	121.9932	160.8364	224.3505	277.1455	312.1703 (64)	
Efficiency of water heater (217)m	175.0201	175.0201	175.0201	175.0201	175.0201	175.0201	175.0201	175.0201	175.0201	175.0201	175.0201	175.0201 (216)	
Fuel for water heating, kWh/month	180.4575	149.4153	133.2606	94.5117	72.1181	58.0240	56.9901	69.7024	91.8959	128.1855	158.3506	178.3625 (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	29.2428	23.4597	21.1228	15.4755	11.9537	9.7663	10.9046	14.1742	18.4109	24.1561	27.2842	30.0556 (232)	
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-43.4865	-60.3343	-89.9770	-104.2355	-109.5313	-102.6121	-100.3390	-95.1132	-84.2708	-71.7473	-48.4856	-36.7294 (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													1292.5553 (211)
Space heating fuel - main system 2													0.0000 (213)
Space heating fuel - secondary													0.0000 (215)
Efficiency of water heater													175.0201

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Water heating fuel used	1371.2742	(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)	236.0064	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-946.8619	(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	2032.9740	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	1292.5553	25.1600	325.2069 (240)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1371.2742	25.1600	345.0126 (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	236.0064	25.1600	59.3792 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-946.8619	25.1600	-238.2305
PV Unit electricity exported	0.0000	5.8100	0.0000
Total			-238.2305 (252)
Total energy cost			511.4963 (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	1292.5553	0.1558	201.3707 (261)
Total CO2 associated with community systems			0.0000 (373)
Water heating (other fuel)	1371.2742	0.1455	199.4687 (264)
Space and water heating			400.8393 (265)
Pumps, fans and electric keep-hot	80.0000	0.1387	11.0970 (267)
Energy for lighting	236.0064	0.1443	34.0630 (268)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-946.8619	0.1345	-127.3227
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-127.3227 (269)
Total CO2, kg/year			318.6766 (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	1292.5553	1.5767	2038.0330 (275)
Total CO2 associated with community systems			0.0000 (473)
Water heating (other fuel)	1371.2742	1.5381	2109.1166 (278)
Space and water heating			4147.1496 (279)
Pumps, fans and electric keep-hot	80.0000	1.5128	121.0240 (281)
Energy for lighting	236.0064	1.5338	361.9945 (282)
Energy saving/generation technologies			
PV Unit electricity used in dwelling	-946.8619	1.4970	-1417.4229
PV Unit electricity exported	0.0000	0.0000	0.0000
Total			-1417.4229 (283)
Total Primary energy kWh/year			3212.7452 (286)