Full SAP Calculation Printout

elmhurst energy

Property Reference	P22691(4) Mount P	Issued on Date	24/02/2023
Assessment Reference	P22691(4)	Prop Type Ref	
Property	New House 4, 40-48, Mount Pleasant, Reading, RG1 2TF		

SAP Rating	84 B	DER	3.92	TER	11.95
Environmental	97 A	% DER < TER			67.20
CO_2 Emissions (t/year)	0.28	DFEE	34.83	TFEE	35.61
Compliance Check	See BREL	% DFEE < TFEE			2.20
% DPER < TPER	33.92	DPER	41.34	TPER	62.56

Assessor Details	Mr. Malcolm Lisle	Assessor ID	P736-0001
Client	Mount P, Jay Zaman		

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	29.5600 (1b)	x	2.5000 (2b)	=	73.9000 (1b)	-
First floor	31.0800 (1c)	x	2.8000 (2c)	=	87.0240 (1c)	-
Second floor	17.7600 (1d)	x	2.9000 (2d)	=	51.5040 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 78.4000						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	212.4280	(5)

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2. Ventilation rate
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		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	3 * 10 =	30.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1412	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		4.0000	(17)
Infiltration rate		0.3412	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2900	(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	0.3698	0.3626	0.3553	0.3190	0.3118	0.2755	0.2755	0.2683	0.2900	0.3118	0.3263	0.3408	(22b)
Effective ac	0.5684	0.5657	0.5631	0.5509	0.5486	0.5380	0.5380	0.5360	0.5421	0.5486	0.5532	0.5581	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows/Doors (Uw = 1.20)			20.3700	1.1450	23.3244			(27)
Rooflights			4.0600	1.5918	6.4625			(27a)
Ground Floor			29.5600	0.1000	2.9560	110.0000	3251.6000	(28a)
External Wall	62.6800	20.3700	42.3100	0.1500	6.3465	9.0000	380.7900	(29a)
External Roof - Sloping	23.1800	4.0600	19.1200	0.1500	2.8680	9.0000	172.0800	(30)
External Roof - Flat Roof	13.3200		13.3200	0.1500	1.9980	9.0000	119.8800	(30)

Total net area of external elements Aum(A, m2)	128.7400					(31)
Fabric heat loss, W/K = Sum (A x U)	(26)...(30) + (32) =	43.9555				(33)
Party Wall 1	108.2400	0.0000	0.0000	70.0000	7576.8000	(32)
Internal Walls - Timber	105.3000			9.0000	947.7000	(32c)
Internal Floor - 1st Floor	29.5600			18.0000	532.0800	(32d)
Internal Floor - 2nd Floor	17.7600			18.0000	319.6800	(32d)
Internal Ceiling - G Floor	29.5600			9.0000	266.0400	(32e)
Internal Ceiling - 1st Floor	17.7600			9.0000	159.8400	(32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 13726.4900 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 175.0828 (35)
List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	10.4000	0.0580	0.6032
E3 Sill	5.9000	0.0450	0.2655
E4 Jamb	37.6000	0.0500	1.8800
E5 Ground floor (normal)	8.2000	0.0550	0.4510
E6 Intermediate floor within a dwelling	14.8000	0.0000	0.0000
E13 Gable (insulation at rafter level)	9.6000	0.0690	0.6624
E15 Flat roof with parapet	3.7000	0.3000	1.1100
E16 Corner (normal)	2.5000	0.0440	0.1100
E18 Party wall between dwellings	2.5000	0.0370	0.0925
E25 Staggered party wall between dwellings	29.2000	0.0370	1.0804
P1 Party wall - Ground floor	15.2000	0.0490	0.7448
P2 Party wall - Intermediate floor within a dwelling	26.4000	0.0000	0.0000
P4 Party wall - Roof (insulation at ceiling level)	6.6000	0.0770	0.5082
P5 Party wall - Roof (insulation at rafter level)	9.6000	0.0710	0.6816
R1 Head of roof window	3.1000	0.2400	0.7440
R2 Sill of roof window	3.1000	0.2400	0.7440
R3 Jamb of roof window	4.8000	0.2400	1.1520
R4 Ridge (vaulted ceiling)	4.8000	0.1200	0.5760
E17 Corner (inverted – internal area greater than external area)	2.5000	-0.0530	-0.1325

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 11.2731 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 55.2286 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.8439	39.6578	39.4753	38.6184	38.4581	37.7117	37.7117	37.5735	37.9992	38.4581	38.7824	39.1215	(38)
Heat transfer coeff	95.0725	94.8864	94.7039	93.8470	93.6867	92.9403	92.9403	92.8021	93.2278	93.6867	94.0110	94.3501	(39)

Average = Sum(39)m / 12 = 93.8462

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2127	1.2103	1.2080	1.1970	1.1950	1.1855	1.1855	1.1837	1.1891	1.1950	1.1991	1.2034	(40)
HLP (average)												1.1970	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.4318 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usage for baths	78.8836	77.7121	76.0623	73.0204	70.7427	68.2171	66.8529	68.4911	70.2748	72.9773	76.0818	78.6169	(42b)
Hot water usage for other uses	41.6148	40.1016	38.5883	37.0750	35.5618	34.0485	34.0485	35.5618	37.0750	38.5883	40.1016	41.6148	(42c)

Average daily hot water use (litres/day) 110.9692 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	120.4984	117.8136	114.6506	110.0955	106.3045	102.2656	100.9014	104.0529	107.3499	111.5656	116.1834	120.2317	(44)
Energy conte	190.8400	167.7650	176.2137	150.7152	143.1063	125.7475	122.0315	128.8392	132.3731	151.3935	165.5245	188.2538	(45)

Energy content (annual) Total = Sum(45)m = 1842.8033

Distribution loss (46)m = 0.15 x (45)m	28.6260	25.1648	26.4321	22.6073	21.4659	18.8621	18.3047	19.3259	19.8560	22.7090	24.8287	28.2381	(46)

Water storage loss:
Store volume 150.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.8600 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 1.0044 (55)

Total storage loss	31.1364	28.1232	31.1364	30.1320	31.1364	30.1320	31.1364	31.1364	30.1320	31.1364	30.1320	31.1364	(56)
If cylinder contains dedicated solar storage	31.1364	28.1232	31.1364	30.1320	31.1364	30.1320	31.1364	31.1364	30.1320	31.1364	30.1320	31.1364	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	245.2388	216.8994	230.6125	203.3592	197.5051	178.3915	176.4303	183.2380	185.0171	205.7923	218.1685	242.6526	(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	245.2388	216.8994	230.6125	203.3592	197.5051	178.3915	176.4303	183.2380	185.0171	205.7923	218.1685	242.6526	(64)

Total per year (kWh/year) = Sum(64)m = 2483.3053 (64)
12Total per year (kWh/year) 2483 (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

	106.9734	95.0894	102.1101	92.2280	91.1019	83.9262	84.0945	86.3581	86.1293	93.8574	97.1521	106.1134	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	121.5901	121.5901	121.5901	121.5901	121.5901	121.5901	121.5901	121.5901	121.5901	121.5901	121.5901	121.5901	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	108.9795	120.6559	108.9795	112.6122	108.9795	112.6122	108.9795	108.9795	112.6122	108.9795	112.6122	108.9795	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	216.0641	218.3061	212.6562	200.6281	185.4449	171.1748	161.6414	159.3994	165.0493	177.0774	192.2606	206.5308	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.1590	35.1590	35.1590	35.1590	35.1590	35.1590	35.1590	35.1590	35.1590	35.1590	35.1590	35.1590	(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)													
	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	(71)
Water heating gains (Table 5)													
	143.7814	141.5021	137.2447	128.0944	122.4488	116.5642	113.0302	116.0727	119.6240	126.1524	134.9335	142.6256	(72)
Total internal gains													
	528.3020	539.9411	518.3575	500.8118	476.3502	459.8281	443.1282	443.9286	456.7625	471.6863	499.2833	517.6129	(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	7.4800	10.6334	0.6300	0.7000	0.7700	24.3078	(74)
South	12.8900	46.7521	0.6300	0.7000	0.7700	184.1728	(78)
East	4.0600	26.2379	0.6300	0.7000	1.0000	42.2802	(82)

Solar gains	250.7608	432.9496	608.4127	781.7002	901.6928	906.8515	869.4273	777.9973	668.0582	482.7666	301.3974	213.9314	(83)
Total gains	779.0628	972.8907	1126.7702	1282.5120	1378.0430	1366.6796	1312.5555	1221.9259	1124.8206	954.4528	800.6807	731.5443	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	40.1053	40.1840	40.2614	40.6291	40.6986	41.0254	41.0254	41.0865	40.8989	40.6986	40.5582	40.4124	
alpha	3.6737	3.6789	3.6841	3.7086	3.7132	3.7350	3.7350	3.7391	3.7266	3.7132	3.7039	3.6942	
util living area													
	0.9614	0.9214	0.8566	0.7373	0.5844	0.4240	0.3088	0.3449	0.5390	0.7959	0.9299	0.9682	(86)
Living	19.8056	20.0800	20.3755	20.6644	20.8292	20.8970	20.9126	20.9102	20.8681	20.6315	20.1700	19.7531	
Non living	18.5424	18.8817	19.2381	19.5742	19.7459	19.8134	19.8239	19.8242	19.7896	19.5511	19.0063	18.4827	
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	20.3890	20.0800	20.3755	20.6644	20.8292	20.8970	20.9126	20.9102	20.8681	20.6315	20.1700	19.9275	(87)
Th 2	19.9099	19.9118	19.9136	19.9224	19.9240	19.9316	19.9316	19.9331	19.9287	19.9240	19.9207	19.9172	(88)
util rest of house													
	0.9532	0.9063	0.8310	0.6961	0.5287	0.3573	0.2351	0.2669	0.4660	0.7516	0.9136	0.9614	(89)
MIT 2	19.3647	18.8817	19.2381	19.5742	19.7459	19.8134	19.8239	19.8242	19.7896	19.5511	19.0063	18.7412	(90)
Living area fraction									fLA = Living area / (4) =			0.3515	(91)
MIT	19.7248	19.3029	19.6380	19.9574	20.1267	20.1943	20.2066	20.2060	20.1687	19.9309	19.4154	19.1582	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.7248	19.3029	19.6380	19.9574	20.1267	20.1943	20.2066	20.2060	20.1687	19.9309	19.4154	19.1582	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9516	0.8963	0.8237	0.6976	0.5396	0.3740	0.2542	0.2871	0.4829	0.7519	0.9045	0.9555	(94)
Useful gains	741.3451	872.0372	928.0819	894.6298	743.5333	511.1292	333.6706	350.7731	543.1742	717.6891	724.1764	698.9554	(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													
	1466.4722	1366.6424	1244.2158	1037.7076	789.4726	519.9372	335.1972	353.2032	565.7708	874.1777	1157.7831	1411.3083	(97)
Space heating kWh													
	539.4946	332.3747	235.2036	103.0160	34.1789	0.0000	0.0000	0.0000	0.0000	116.4275	312.1968	529.9906	(98a)
Space heating requirement - total per year (kWh/year)												2202.8827	
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													
	539.4946	332.3747	235.2036	103.0160	34.1789	0.0000	0.0000	0.0000	0.0000	116.4275	312.1968	529.9906	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2202.8827	
Space heating per m2											(98c) / (4) =	28.0980	(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 %)	353.6553 (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													
	539.4946	332.3747	235.2036	103.0160	34.1789	0.0000	0.0000	0.0000	0.0000	116.4275	312.1968	529.9906	(98)
Space heating efficiency (main heating system 1)													
	353.6553	353.6553	353.6553	353.6553	353.6553	0.0000	0.0000	0.0000	0.0000	353.6553	353.6553	353.6553	(210)
Space heating fuel (main heating system)													
	152.5481	93.9827	66.5065	29.1289	9.6645	0.0000	0.0000	0.0000	0.0000	32.9212	88.2772	149.8608	(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													
	245.2388	216.8994	230.6125	203.3592	197.5051	178.3915	176.4303	183.2380	185.0171	205.7923	218.1685	242.6526	(64)
Efficiency of water heater												189.9190	(216)
(217)m	189.9190	189.9190	189.9190	189.9190	189.9190	189.9190	189.9190	189.9190	189.9190	189.9190	189.9190	189.9190	(217)
Fuel for water heating, kWh/month													
	129.1281	114.2063	121.4268	107.0768	103.9944	93.9303	92.8976	96.4822	97.4190	108.3579	114.8745	127.7664	(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	21.6424	17.3623	15.6329	11.4533	8.8469	7.2280	8.0704	10.4902	13.6258	17.8777	20.1928	22.2439	(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	622.8898 (211)
Space heating fuel - main system 2	0.0000 (213)
Space heating fuel - secondary	0.0000 (215)
Efficiency of water heater	189.9190
Water heating fuel used	1307.5603 (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)	174.6666 (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	2105.1167 (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	622.8898	0.1569	97.7537	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1307.5603	0.1408	184.1215	(264)
Space and water heating			281.8751	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	174.6666	0.1443	25.2098	(268)
Total CO2, kg/year			307.0849	(272)
EPC Dwelling Carbon Dioxide Emission Rate (DER)			3.9200	(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	622.8898	1.5809	984.7430	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1307.5603	1.5207	1988.3690	(278)
Space and water heating			2973.1120	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	174.6666	1.5338	267.9094	(282)
Total Primary energy kWh/year			3241.0214	(286)
Dwelling Primary energy Rate (DPER)			41.3400	(287)

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

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1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	29.5600 (1b)	x	2.5000 (2b)	=	73.9000 (1b)	-
First floor	31.0800 (1c)	x	2.8000 (2c)	=	87.0240 (1c)	-
Second floor	17.7600 (1d)	x	2.9000 (2d)	=	51.5040 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 78.4000						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		212.4280	(5)

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2. Ventilation rate

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			m3 per hour	
Number of open chimneys	0 * 80 =		0.0000	(6a)
Number of open flues	0 * 20 =		0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =		0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =		0.0000	(6d)
Number of flues attached to other heater	0 * 35 =		0.0000	(6e)
Number of blocked chimneys	0 * 20 =		0.0000	(6f)
Number of intermittent extract fans	3 * 10 =		30.0000	(7a)
Number of passive vents	0 * 10 =		0.0000	(7b)
Number of flueless gas fires	0 * 40 =		0.0000	(7c)
			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =		0.1412	(8)
Pressure test			Yes	
Pressure Test Method			Blower Door	
Measured/design AP50			5.0000	(17)
Infiltration rate			0.3912	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3325	(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	0.4240	0.4157	0.4074	0.3658	0.3575	0.3159	0.3159	0.3076	0.3325	0.3575	0.3741	0.3907	(22b)
Effective ac	0.5899	0.5864	0.5830	0.5669	0.5639	0.5499	0.5499	0.5473	0.5553	0.5639	0.5700	0.5763	(25)

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3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opening Type (Uw = 1.20)			16.3500	1.1450	18.7214			(27)
Rooflights			3.2600	1.5038	4.9023			(27a)
Ground Floor			29.5600	0.1300	3.8428			(28a)
External Wall	62.6800	16.3500	46.3300	0.1800	8.3394			(29a)
External Roof - Sloping	23.1800	3.2600	19.9200	0.1100	2.1912			(30)
External Roof - Flat Roof	13.3200		13.3200	0.1100	1.4652			(30)
Total net area of external elements Aum(A, m2)			128.7400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	39.4622			(33)
Party Wall 1			108.2400	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 175.0828 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	10.4000	0.0500	0.5200
E3 Sill	5.9000	0.0500	0.2950
E4 Jamb	37.6000	0.0500	1.8800

E5 Ground floor (normal)	8.2000	0.1600	1.3120
E6 Intermediate floor within a dwelling	14.8000	0.0000	0.0000
E13 Gable (insulation at rafter level)	9.6000	0.0800	0.7680
E15 Flat roof with parapet	3.7000	0.5600	2.0720
E16 Corner (normal)	2.5000	0.0900	0.2250
E18 Party wall between dwellings	2.5000	0.0600	0.1500
E25 Staggered party wall between dwellings	29.2000	0.0600	1.7520
P1 Party wall - Ground floor	15.2000	0.0800	1.2160
P2 Party wall - Intermediate floor within a dwelling	26.4000	0.0000	0.0000
P4 Party wall - Roof (insulation at ceiling level)	6.6000	0.1200	0.7920
P5 Party wall - Roof (insulation at rafter level)	9.6000	0.0800	0.7680
R1 Head of roof window	3.1000	0.0800	0.2480
R2 Sill of roof window	3.1000	0.0600	0.1860
R3 Jamb of roof window	4.8000	0.0800	0.3840
R4 Ridge (vaulted ceiling)	4.8000	0.0800	0.3840
E17 Corner (inverted – internal area greater than external area)	2.5000	-0.0900	-0.2250

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 12.7270 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 52.1892 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.3516	41.1069	40.8671	39.7406	39.5298	38.5487	38.5487	38.3670	38.9266	39.5298	39.9562	40.4019	(38)
Heat transfer coeff													
	93.5408	93.2961	93.0563	91.9298	91.7191	90.7380	90.7380	90.5563	91.1159	91.7191	92.1454	92.5912	(39)
Average = Sum(39)m / 12 =												91.9288	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1931	1.1900	1.1869	1.1726	1.1699	1.1574	1.1574	1.1551	1.1622	1.1699	1.1753	1.1810	(40)
HLP (average)												1.1726	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.4318 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usage for baths													
	74.9394	73.8265	72.2592	69.3694	67.2056	64.8062	63.5102	65.0666	66.7611	69.3285	72.2778	74.6861	(42b)
Hot water usage for other uses													
	39.5341	38.0965	36.6589	35.2213	33.7837	32.3461	32.3461	33.7837	35.2213	36.6589	38.0965	39.5341	(42c)
Average daily hot water use (litres/day)												105.4207	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	114.4735	111.9229	108.9181	104.5907	100.9893	97.1523	95.8563	98.8502	101.9824	105.9873	110.3742	114.2202	(44)
Energy conte	181.2980	159.3768	167.4030	143.1794	135.9509	119.4601	115.9299	122.3972	125.7544	143.8238	157.2483	178.8412	(45)
Energy content (annual)										Total = Sum(45)m =		1750.6631	
Distribution loss (46)m = 0.15 x (45)m													
	27.1947	23.9065	25.1105	21.4769	20.3926	17.9190	17.3895	18.3596	18.8632	21.5736	23.5872	26.8262	(46)
Water storage loss:													
Store volume												150.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.3938	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.7527	(55)
Total storage loss													
	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(56)
If cylinder contains dedicated solar storage													
	23.3325	21.0745	23.3325	22.5798	23.3325	22.5798	23.3325	23.3325	22.5798	23.3325	22.5798	23.3325	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month													
	227.8929	201.4625	213.9979	188.2713	182.5458	164.5519	162.5248	168.9921	170.8463	190.4187	202.3402	225.4361	(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													
	227.8929	201.4625	213.9979	188.2713	182.5458	164.5519	162.5248	168.9921	170.8463	190.4187	202.3402	225.4361	(64)
								Total per year (kWh/year) = Sum(64)m =				2299.2805	(64)
12Total per year (kWh/year)												2299	(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													
	97.5575	86.6614	92.9374	83.6806	82.4796	75.7940	75.8226	77.9730	77.8868	85.0973	88.3585	96.7406	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	121.5901	121.5901	121.5901	121.5901	121.5901	121.5901	121.5901	121.5901	121.5901	121.5901	121.5901	121.5901	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	108.9795	120.6559	108.9795	112.6122	108.9795	112.6122	108.9795	108.9795	112.6122	108.9795	112.6122	108.9795	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	216.0641	218.3061	212.6562	200.6281	185.4449	171.1748	161.6414	159.3994	165.0493	177.0774	192.2606	206.5308	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.1590	35.1590	35.1590	35.1590	35.1590	35.1590	35.1590	35.1590	35.1590	35.1590	35.1590	35.1590	(69)

Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	0.0000	0.0000	0.0000	0.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	(71)
Water heating gains (Table 5)	131.1257	128.9603	124.9159	116.2231	110.8597	105.2694	101.9121	104.8024	108.1761	114.3781	122.7202	130.0277	(72)
Total internal gains	518.6463	530.3994	509.0286	491.9404	467.7611	448.5333	432.0101	432.6583	445.3146	462.9120	490.0700	508.0150	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	6.0100	10.6334	0.6300	0.7000	0.7700	19.5307	(74)
South	10.3400	46.7521	0.6300	0.7000	0.7700	147.7383	(78)
East	3.2600	26.2379	0.6300	0.7000	1.0000	33.9491	(82)

Solar gains	201.2182	347.4272	488.2685	627.3964	723.7537	727.9155	697.8671	624.4441	536.1560	387.4140	241.8534	171.6633	(83)
Total gains	719.8645	877.8265	997.2971	1119.3368	1191.5148	1176.4488	1129.8771	1057.1024	981.4707	850.3261	731.9234	679.6783	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	40.7620	40.8689	40.9743	41.4764	41.5717	42.0212	42.0212	42.1055	41.8469	41.5717	41.3793	41.1801	
alpha	3.7175	3.7246	3.7316	3.7651	3.7714	3.8014	3.8014	3.8070	3.7898	3.7714	3.7586	3.7453	
util living area	0.9689	0.9390	0.8890	0.7877	0.6435	0.4760	0.3489	0.3871	0.5923	0.8333	0.9438	0.9742	(86)
MIT	19.4666	19.7970	20.1782	20.5889	20.8463	20.9628	20.9911	20.9868	20.9153	20.5625	19.9491	19.4109	(87)
Th 2	19.9255	19.9280	19.9305	19.9420	19.9442	19.9543	19.9543	19.9561	19.9504	19.9442	19.9398	19.9352	(88)
util rest of house	0.9622	0.9266	0.8674	0.7499	0.5875	0.4044	0.2680	0.3023	0.5172	0.7935	0.9302	0.9685	(89)
MIT 2	18.1755	18.5874	19.0536	19.5402	19.8157	19.9312	19.9508	19.9505	19.8920	19.5270	18.7918	18.1124	(90)
Living area fraction										fLA = Living area / (4) =		0.3515	(91)
MIT	18.6293	19.0126	19.4489	19.9088	20.1780	20.2939	20.3165	20.3148	20.2517	19.8910	19.1986	18.5689	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6293	19.0126	19.4489	19.9088	20.1780	20.2939	20.3165	20.3148	20.2517	19.8910	19.1986	18.5689	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9515	0.9137	0.8561	0.7486	0.6005	0.4282	0.2963	0.3319	0.5396	0.7913	0.9183	0.9588	(94)
Useful gains	684.9573	802.0265	853.8221	837.9560	715.4670	503.7097	334.8307	350.8122	529.6393	672.8393	672.1542	651.6519	(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	1340.3777	1316.6497	1204.9776	1012.0411	777.5938	516.6497	337.2247	354.5114	560.5199	852.1637	1114.8343	1330.4291	(97)
Space heating kWh	487.6328	345.8268	261.2596	125.3413	46.2224	0.0000	0.0000	0.0000	0.0000	133.4173	318.7297	505.0102	(98a)
Space heating requirement - total per year (kWh/year)												2223.4401	
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	487.6328	345.8268	261.2596	125.3413	46.2224	0.0000	0.0000	0.0000	0.0000	133.4173	318.7297	505.0102	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2223.4401	
Space heating per m2											(98c) / (4) =	28.3602	(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	487.6328	345.8268	261.2596	125.3413	46.2224	0.0000	0.0000	0.0000	0.0000	133.4173	318.7297	505.0102	(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)	528.3129	374.6770	283.0549	135.7977	50.0784	0.0000	0.0000	0.0000	0.0000	144.5475	345.3193	547.1400	(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													
	227.8929	201.4625	213.9979	188.2713	182.5458	164.5519	162.5248	168.9921	170.8463	190.4187	202.3402	225.4361	(64)
Efficiency of water heater												79.8000	(216)
(217)m	85.7208	85.2603	84.5084	83.1689	81.4683	79.8000	79.8000	79.8000	79.8000	83.2773	85.0742	85.8130	(217)
Fuel for water heating, kWh/month													
	265.8548	236.2910	253.2268	226.3721	224.0698	206.2054	203.6652	211.7696	214.0931	228.6562	237.8397	262.7060	(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	22.6438	18.1657	16.3562	11.9832	9.2562	7.5624	8.4438	10.9756	14.2562	18.7049	21.1272	23.2731	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-29.2919	-42.1745	-61.9000	-71.1161	-77.9866	-73.2590	-72.3497	-67.6551	-59.5939	-48.8966	-32.5103	-25.2222	(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	-13.9897	-29.6872	-59.4849	-90.0459	-119.7504	-120.5758	-119.1663	-100.5940	-73.3252	-42.7003	-18.7572	-11.0443	(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	2408.9276	(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	2770.7497	(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)	182.7484	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-1461.0771	(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	3987.3486	(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	2408.9276	0.2100	505.8748	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	2770.7497	0.2100	581.8574	(264)
Space and water heating			1087.7322	(265)
Pumps, fans and electric keep-hot	86.0000	0.1387	11.9293	(267)
Energy for lighting	182.7484	0.1443	26.3762	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-661.9558	0.1341	-88.7970	
PV Unit electricity exported	-799.1212	0.1257	-100.4209	
Total			-189.2179	(269)
Total CO2, kg/year			936.8198	(272)
EPC Target Carbon Dioxide Emission Rate (TER)			11.9500	(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	2408.9276	1.1300	2722.0881	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	2770.7497	1.1300	3130.9472	(278)
Space and water heating			5853.0353	(279)
Pumps, fans and electric keep-hot	86.0000	1.5128	130.1008	(281)
Energy for lighting	182.7484	1.5338	280.3055	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-661.9558	1.4957	-990.1179	
PV Unit electricity exported	-799.1212	0.4613	-368.6051	
Total			-1358.7230	(283)
Total Primary energy kWh/year			4904.7186	(286)
Target Primary Energy Rate (TPER)			62.5600	(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	29.5600 (1b)	x	2.5000 (2b)	=	73.9000 (1b)	-
First floor	31.0800 (1c)	x	2.8000 (2c)	=	87.0240 (1c)	-
Second floor	17.7600 (1d)	x	2.9000 (2d)	=	51.5040 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	78.4000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		212.4280	(5)

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	3 * 10 =	30.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1412	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		4.0000	(17)
Infiltration rate		0.3412	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2900	(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	0.3698	0.3626	0.3553	0.3190	0.3118	0.2755	0.2755	0.2683	0.2900	0.3118	0.3263	0.3408	(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	0.5684	0.5657	0.5631	0.5509	0.5486	0.5380	0.5380	0.5360	0.5421	0.5486	0.5532	0.5581	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows/Doors (Uw = 1.20)			20.3700	1.1450	23.3244			(27)
Rooflights			4.0600	1.5918	6.4625			(27a)
Ground Floor			29.5600	0.1000	2.9560	110.0000	3251.6000	(28a)
External Wall	62.6800	20.3700	42.3100	0.1500	6.3465	9.0000	380.7900	(29a)
External Roof - Sloping	23.1800	4.0600	19.1200	0.1500	2.8680	9.0000	172.0800	(30)
External Roof - Flat Roof	13.3200		13.3200	0.1500	1.9980	9.0000	119.8800	(30)
Total net area of external elements Aum(A, m2)			128.7400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	43.9555			(33)
Party Wall 1			108.2400	0.0000	0.0000	70.0000	7576.8000	(32)
Internal Walls - Timber			105.3000			9.0000	947.7000	(32c)
Internal Floor - 1st Floor			29.5600			18.0000	532.0800	(32d)
Internal Floor - 2nd Floor			17.7600			18.0000	319.6800	(32d)
Internal Ceiling - G Floor			29.5600			9.0000	266.0400	(32e)
Internal Ceiling - 1st Floor			17.7600			9.0000	159.8400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 13726.4900	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	175.0828	(35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	10.4000	0.0580	0.6032
E3 Sill	5.9000	0.0450	0.2655
E4 Jamb	37.6000	0.0500	1.8800
E5 Ground floor (normal)	8.2000	0.0550	0.4510
E6 Intermediate floor within a dwelling	14.8000	0.0000	0.0000
E13 Gable (insulation at rafter level)	9.6000	0.0690	0.6624

E15 Flat roof with parapet	3.7000	0.3000	1.1100
E16 Corner (normal)	2.5000	0.0440	0.1100
E18 Party wall between dwellings	2.5000	0.0370	0.0925
E25 Staggered party wall between dwellings	29.2000	0.0370	1.0804
P1 Party wall - Ground floor	15.2000	0.0490	0.7448
P2 Party wall - Intermediate floor within a dwelling	26.4000	0.0000	0.0000
P4 Party wall - Roof (insulation at ceiling level)	6.6000	0.0770	0.5082
P5 Party wall - Roof (insulation at rafter level)	9.6000	0.0710	0.6816
R1 Head of roof window	3.1000	0.2400	0.7440
R2 Sill of roof window	3.1000	0.2400	0.7440
R3 Jamb of roof window	4.8000	0.2400	1.1520
R4 Ridge (vaulted ceiling)	4.8000	0.1200	0.5760
E17 Corner (inverted – internal area greater than external area)	2.5000	-0.0530	-0.1325

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 11.2731 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 55.2286 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.8439	39.6578	39.4753	38.6184	38.4581	37.7117	37.7117	37.5735	37.9992	38.4581	38.7824	39.1215	(38)
Heat transfer coeff	95.0725	94.8864	94.7039	93.8470	93.6867	92.9403	92.9403	92.8021	93.2278	93.6867	94.0110	94.3501	(39)

Average = Sum(39)m / 12 = 93.8462

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2127	1.2103	1.2080	1.1970	1.1950	1.1855	1.1855	1.1837	1.1891	1.1950	1.1991	1.2034	(40)
HLP (average)												1.1970	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.4318 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usage for baths	28.0723	27.6554	27.0683	25.9858	25.1752	24.2765	23.7910	24.3740	25.0087	25.9705	27.0753	27.9774	(42b)
Hot water usage for other uses	39.5341	38.0965	36.6589	35.2213	33.7837	32.3461	32.3461	33.7837	35.2213	36.6589	38.0965	39.5341	(42c)

Average daily hot water use (litres/day) 61.9676 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	67.6064	65.7519	63.7272	61.2071	58.9589	56.6225	56.1370	58.1576	60.2300	62.6294	65.1718	67.5115	(44)
Energy conte	107.0720	93.6298	97.9463	83.7894	79.3700	69.6240	67.8929	72.0113	74.2696	84.9874	92.8491	105.7067	(45)

Energy content (annual) Total = Sum(45)m = 1029.1487

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(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	91.0112	79.5854	83.2544	71.2210	67.4645	59.1804	57.7089	61.2096	63.1292	72.2393	78.9217	89.8507	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	91.0112	79.5854	83.2544	71.2210	67.4645	59.1804	57.7089	61.2096	63.1292	72.2393	78.9217	89.8507	(64)

Total per year (kWh/year) = Sum(64)m = 874.7764 (64)

12Total per year (kWh/year) 875 (64)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Electric shower(s)	52.0486	46.3757	50.6405	48.3256	49.2324	46.9629	48.5284	49.2324	48.3256	50.6405	49.6883	52.0486	(64a)

Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m = 592.0494 (64a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat gains from water heating, kWh/month	35.7650	31.4903	33.4737	29.8867	29.1742	26.5358	26.5593	27.6105	27.8637	30.7200	32.1525	35.4748	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	121.5901	121.5901	121.5901	121.5901	121.5901	121.5901	121.5901	121.5901	121.5901	121.5901	121.5901	121.5901	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	108.9795	120.6559	108.9795	112.6122	108.9795	112.6122	108.9795	108.9795	112.6122	108.9795	112.6122	108.9795	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	216.0641	218.3061	212.6562	200.6281	185.4449	171.1748	161.6414	159.3994	165.0493	177.0774	192.2606	206.5308	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.1590	35.1590	35.1590	35.1590	35.1590	35.1590	35.1590	35.1590	35.1590	35.1590	35.1590	35.1590	(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)	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	(71)
Water heating gains (Table 5)	48.0712	46.8605	44.9916	41.5092	39.2127	36.8553	35.6980	37.1109	38.6996	41.2903	44.6563	47.6812	(72)
Total internal gains	432.5918	445.2996	426.1043	414.2266	393.1141	380.1193	365.7960	364.9668	375.8381	386.8242	409.0061	422.6685	(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	7.4800	10.6334	0.6300	0.7000	0.7700	24.3078 (74)
South	12.8900	46.7521	0.6300	0.7000	0.7700	184.1728 (78)
East	4.0600	26.2379	0.6300	0.7000	1.0000	42.2802 (82)

Solar gains	250.7608	432.9496	608.4127	781.7002	901.6928	906.8515	869.4273	777.9973	668.0582	482.7666	301.3974	213.9314 (83)
Total gains	683.3526	878.2491	1034.5170	1195.9268	1294.8069	1286.9707	1235.2233	1142.9641	1043.8962	869.5907	710.4035	636.5999 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	40.1053	40.1840	40.2614	40.6291	40.6986	41.0254	41.0254	41.0865	40.8989	40.6986	40.5582	40.4124	
alpha	3.6737	3.6789	3.6841	3.7086	3.7132	3.7350	3.7350	3.7391	3.7266	3.7132	3.7039	3.6942	
util living area													
	0.9738	0.9400	0.8817	0.7668	0.6131	0.4479	0.3275	0.3676	0.5729	0.8302	0.9494	0.9791	(86)
MIT	19.3718	19.7599	20.1852	20.6127	20.8627	20.9673	20.9921	20.9879	20.9197	20.5525	19.8802	19.2984	(87)
Th 2	19.9099	19.9118	19.9136	19.9224	19.9240	19.9316	19.9316	19.9331	19.9287	19.9240	19.9207	19.9172	(88)
util rest of house													
	0.9679	0.9278	0.8590	0.7272	0.5567	0.3783	0.2496	0.2849	0.4976	0.7896	0.9368	0.9744	(89)
MIT 2	18.4576	18.8350	19.2391	19.6304	19.8359	19.9162	19.9293	19.9292	19.8862	19.5927	18.9647	18.3911	(90)
Living area fraction										fLA = Living area / (4) =		0.3515	(91)
MIT	18.7790	19.1601	19.5717	19.9757	20.1969	20.2857	20.3029	20.3013	20.2495	19.9301	19.2865	18.7101	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7790	19.1601	19.5717	19.9757	20.1969	20.2857	20.3029	20.3013	20.2495	19.9301	19.2865	18.7101	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9601	0.9175	0.8508	0.7293	0.5715	0.4018	0.2769	0.3138	0.5210	0.7899	0.9277	0.9675	(94)
Useful gains	656.0539	805.8179	880.2165	872.1431	740.0201	517.0530	342.0462	358.6766	543.8738	686.8607	659.0089	615.9059	(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													
	1376.5515	1353.0899	1237.9375	1039.4222	796.0433	528.4284	344.1500	362.0528	573.3035	874.1053	1145.6681	1369.0249	(97)
Space heating kWh													
	536.0502	367.7667	266.1444	120.4409	41.6813	0.0000	0.0000	0.0000	0.0000	139.3100	350.3946	560.3206	(98a)
Space heating requirement - total per year (kWh/year)												2382.1087	
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													
	536.0502	367.7667	266.1444	120.4409	41.6813	0.0000	0.0000	0.0000	0.0000	139.3100	350.3946	560.3206	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2382.1087	
Space heating per m2											(98c) / (4) =	30.3840	(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	873.6387	687.7582	705.2958	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9295	0.9595	0.9462	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	812.0431	659.9044	667.3821	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1413.7791	1358.0013	1259.6985	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	433.2499	519.3841	440.6834	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	108.3125	129.8460	110.1709	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												348.3294	(107)
Energy for space heating												30.3840	(99)
Energy for space cooling												4.4430	(108)
Total												34.8270	(109)
Fabric Energy Efficiency (DFEE)												34.8	(109)

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	29.5600 (1b)	x	2.5000 (2b)	=	73.9000 (1b)	-
First floor	31.0800 (1c)	x	2.8000 (2c)	=	87.0240 (1c)	-
Second floor	17.7600 (1d)	x	2.9000 (2d)	=	51.5040 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 78.4000						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		212.4280	(5)

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	3 * 10 =	30.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1412	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		5.0000	(17)
Infiltration rate		0.3912	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3325	(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	0.4240	0.4157	0.4074	0.3658	0.3575	0.3159	0.3159	0.3076	0.3325	0.3575	0.3741	0.3907	(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	0.5899	0.5864	0.5830	0.5669	0.5639	0.5499	0.5499	0.5473	0.5553	0.5639	0.5700	0.5763	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opening Type (Uw = 1.20)			16.3500	1.1450	18.7214			(27)
Rooflights			3.2600	1.5038	4.9023			(27a)
Ground Floor			29.5600	0.1300	3.8428			(28a)
External Wall	62.6800	16.3500	46.3300	0.1800	8.3394			(29a)
External Roof - Sloping	23.1800	3.2600	19.9200	0.1100	2.1912			(30)
External Roof - Flat Roof	13.3200		13.3200	0.1100	1.4652			(30)
Total net area of external elements Aum(A, m2)			128.7400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	39.4622			(33)
Party Wall 1			108.2400	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 175.0828 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	10.4000	0.0500	0.5200
E3 Sill	5.9000	0.0500	0.2950
E4 Jamb	37.6000	0.0500	1.8800
E5 Ground floor (normal)	8.2000	0.1600	1.3120
E6 Intermediate floor within a dwelling	14.8000	0.0000	0.0000
E13 Gable (insulation at rafter level)	9.6000	0.0800	0.7680
E15 Flat roof with parapet	3.7000	0.5600	2.0720
E16 Corner (normal)	2.5000	0.0900	0.2250
E18 Party wall between dwellings	2.5000	0.0600	0.1500
E25 Staggered party wall between dwellings	29.2000	0.0600	1.7520
P1 Party wall - Ground floor	15.2000	0.0800	1.2160
P2 Party wall - Intermediate floor within a dwelling	26.4000	0.0000	0.0000
P4 Party wall - Roof (insulation at ceiling level)	6.6000	0.1200	0.7920
P5 Party wall - Roof (insulation at rafter level)	9.6000	0.0800	0.7680

R1 Head of roof window	3.1000	0.0800	0.2480	
R2 Sill of roof window	3.1000	0.0600	0.1860	
R3 Jamb of roof window	4.8000	0.0800	0.3840	
R4 Ridge (vaulted ceiling)	4.8000	0.0800	0.3840	
E17 Corner (inverted – internal area greater than external area)	2.5000	-0.0900	-0.2250	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 12.7270 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 52.1892 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	41.3516	41.1069	40.8671	39.7406	39.5298	38.5487	38.5487	38.3670	38.9266	39.5298	39.9562	40.4019	(38)
Heat transfer coeff	93.5408	93.2961	93.0563	91.9298	91.7191	90.7380	90.7380	90.5563	91.1159	91.7191	92.1454	92.5912	(39)

Average = Sum(39)m / 12 = 91.9288

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1931	1.1900	1.1869	1.1726	1.1699	1.1574	1.1574	1.1551	1.1622	1.1699	1.1753	1.1810	(40)
HLP (average)												1.1726	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.4318 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usage for baths	28.0723	27.6554	27.0683	25.9858	25.1752	24.2765	23.7910	24.3740	25.0087	25.9705	27.0753	27.9774	(42b)
Hot water usage for other uses	39.5341	38.0965	36.6589	35.2213	33.7837	32.3461	32.3461	33.7837	35.2213	36.6589	38.0965	39.5341	(42c)
Average daily hot water use (litres/day)												61.9676	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	67.6064	65.7519	63.7272	61.2071	58.9589	56.6225	56.1370	58.1576	60.2300	62.6294	65.1718	67.5115	(44)
Energy conte	107.0720	93.6298	97.9463	83.7894	79.3700	69.6240	67.8929	72.0113	74.2696	84.9874	92.8491	105.7067	(45)
Energy content (annual)										Total = Sum(45)m =		1029.1487	
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(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	91.0112	79.5854	83.2544	71.2210	67.4645	59.1804	57.7089	61.2096	63.1292	72.2393	78.9217	89.8507	(62)
WWHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63a)
PV diverter	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63b)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	91.0112	79.5854	83.2544	71.2210	67.4645	59.1804	57.7089	61.2096	63.1292	72.2393	78.9217	89.8507	(64)
								Total per year (kWh/year) = Sum(64)m =				874.7764	(64)
12Total per year (kWh/year)												875	(64)
Electric shower(s)	52.0486	46.3757	50.6405	48.3256	49.2324	46.9629	48.5284	49.2324	48.3256	50.6405	49.6883	52.0486	(64a)
						Total Energy used by instantaneous electric shower(s) (kWh/year) = Sum(64a)m =						592.0494	(64a)
Heat gains from water heating, kWh/month	35.7650	31.4903	33.4737	29.8867	29.1742	26.5358	26.5593	27.6105	27.8637	30.7200	32.1525	35.4748	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	121.5901	121.5901	121.5901	121.5901	121.5901	121.5901	121.5901	121.5901	121.5901	121.5901	121.5901	121.5901	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	108.9795	120.6559	108.9795	112.6122	108.9795	112.6122	108.9795	108.9795	112.6122	108.9795	112.6122	108.9795	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	216.0641	218.3061	212.6562	200.6281	185.4449	171.1748	161.6414	159.3994	165.0493	177.0774	192.2606	206.5308	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.1590	35.1590	35.1590	35.1590	35.1590	35.1590	35.1590	35.1590	35.1590	35.1590	35.1590	35.1590	(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)	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	(71)
Water heating gains (Table 5)	48.0712	46.8605	44.9916	41.5092	39.2127	36.8553	35.6980	37.1109	38.6996	41.2903	44.6563	47.6812	(72)
Total internal gains	432.5918	445.2996	426.1043	414.2266	393.1141	380.1193	365.7960	364.9668	375.8381	386.8242	409.0061	422.6685	(73)

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6. Solar gains

[Jan]	Area	Solar flux	g	FF	Access	Gains

	m2	Table 6a W/m2	Specific data or Table 6b	Specific data or Table 6c	factor Table 6d	W
North	6.0100	10.6334	0.6300	0.7000	0.7700	19.5307 (74)
South	10.3400	46.7521	0.6300	0.7000	0.7700	147.7383 (78)
East	3.2600	26.2379	0.6300	0.7000	1.0000	33.9491 (82)

Solar gains	201.2182	347.4272	488.2685	627.3964	723.7537	727.9155	697.8671	624.4441	536.1560	387.4140	241.8534	171.6633 (83)
Total gains	633.8099	792.7267	914.3728	1041.6229	1116.8678	1108.0347	1063.6631	989.4109	911.9941	774.2382	650.8594	594.3318 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	40.7620	40.8689	40.9743	41.4764	41.5717	42.0212	42.0212	42.1055	41.8469	41.5717	41.3793	41.1801	
alpha	3.7175	3.7246	3.7316	3.7651	3.7714	3.8014	3.8014	3.8070	3.7898	3.7714	3.7586	3.7453	
util living area	0.9789	0.9541	0.9103	0.8153	0.6735	0.5017	0.3696	0.4118	0.6265	0.8640	0.9598	0.9830	(86)
MIT	19.3299	19.6764	20.0818	20.5310	20.8203	20.9556	20.9891	20.9837	20.8975	20.4919	19.8314	19.2724	(87)
Th 2	19.9255	19.9280	19.9305	19.9420	19.9442	19.9543	19.9543	19.9561	19.9504	19.9442	19.9398	19.9352	(88)
util rest of house	0.9741	0.9443	0.8917	0.7798	0.6176	0.4275	0.2844	0.3224	0.5501	0.8286	0.9495	0.9791	(89)
MIT 2	18.4283	18.7681	19.1588	19.5806	19.8257	19.9326	19.9509	19.9507	19.8944	19.5598	18.9332	18.3789	(90)
Living area fraction										fLA = Living area / (4) =		0.3515	(91)
MIT	18.7452	19.0874	19.4833	19.9147	20.1753	20.2922	20.3159	20.3138	20.2470	19.8875	19.2490	18.6930	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7452	19.0874	19.4833	19.9147	20.1753	20.2922	20.3159	20.3138	20.2470	19.8875	19.2490	18.6930	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9672	0.9348	0.8826	0.7788	0.6304	0.4521	0.3142	0.3536	0.5728	0.8264	0.9410	0.9731	(94)
Useful gains	613.0508	741.0290	807.0398	811.2420	704.1117	500.9524	334.2383	349.8227	522.3797	639.8339	612.4681	578.3197	(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	1351.2186	1323.6315	1208.1765	1012.5784	777.3502	516.4999	337.1712	354.4216	560.0916	851.8381	1119.4715	1341.9224	(97)
Space heating kWh	549.1968	391.5089	298.4456	144.9622	54.4895	0.0000	0.0000	0.0000	0.0000	157.7312	365.0424	568.1204	(98a)
Space heating requirement - total per year (kWh/year)												2529.4970	
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	549.1968	391.5089	298.4456	144.9622	54.4895	0.0000	0.0000	0.0000	0.0000	157.7312	365.0424	568.1204	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2529.4970	
Space heating per m2											(98c) / (4) =	32.2640	(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	852.9367	671.4608	688.2276	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9048	0.9441	0.9277	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	771.7621	633.9078	638.4779	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1214.2314	1166.5656	1087.8504	0.0000	0.0000	0.0000	0.0000	(103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	318.5779	396.2974	334.3331	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	79.6445	99.0744	83.5833	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling requirement												262.3021	(107)
Energy for space heating												32.2640	(99)
Energy for space cooling												3.3457	(108)
Total												35.6097	(109)
Fabric Energy Efficiency (TFEE)												35.6	(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	29.5600 (1b)	x	2.5000 (2b)	=	73.9000 (1b) -	
First floor	31.0800 (1c)	x	2.8000 (2c)	=	87.0240 (1c) -	
Second floor	17.7600 (1d)	x	2.9000 (2d)	=	51.5040 (1d) -	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 78.4000						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		212.4280	(5)

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	3 * 10 =	30.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1412	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		4.0000	(17)
Infiltration rate		0.3412	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2900	(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	0.3698	0.3626	0.3553	0.3190	0.3118	0.2755	0.2755	0.2683	0.2900	0.3118	0.3263	0.3408	(22b)
Effective ac	0.5684	0.5657	0.5631	0.5509	0.5486	0.5380	0.5380	0.5360	0.5421	0.5486	0.5532	0.5581	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows/Doors (Uw = 1.20)			20.3700	1.1450	23.3244			(27)
Rooflights			4.0600	1.5918	6.4625			(27a)
Ground Floor			29.5600	0.1000	2.9560	110.0000	3251.6000	(28a)
External Wall	62.6800	20.3700	42.3100	0.1500	6.3465	9.0000	380.7900	(29a)
External Roof - Sloping	23.1800	4.0600	19.1200	0.1500	2.8680	9.0000	172.0800	(30)
External Roof - Flat Roof	13.3200		13.3200	0.1500	1.9980	9.0000	119.8800	(30)
Total net area of external elements Aum(A, m2)			128.7400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	43.9555			(33)
Party Wall 1			108.2400	0.0000	0.0000	70.0000	7576.8000	(32)
Internal Walls - Timber			105.3000			9.0000	947.7000	(32c)
Internal Floor - 1st Floor			29.5600			18.0000	532.0800	(32d)
Internal Floor - 2nd Floor			17.7600			18.0000	319.6800	(32d)
Internal Ceiling - G Floor			29.5600			9.0000	266.0400	(32e)
Internal Ceiling - 1st Floor			17.7600			9.0000	159.8400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 13726.4900	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	175.0828	(35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	10.4000	0.0580	0.6032
E3 Sill	5.9000	0.0450	0.2655
E4 Jamb	37.6000	0.0500	1.8800
E5 Ground floor (normal)	8.2000	0.0550	0.4510
E6 Intermediate floor within a dwelling	14.8000	0.0000	0.0000
E13 Gable (insulation at rafter level)	9.6000	0.0690	0.6624
E15 Flat roof with parapet	3.7000	0.3000	1.1100
E16 Corner (normal)	2.5000	0.0440	0.1100
E18 Party wall between dwellings	2.5000	0.0370	0.0925
E25 Staggered party wall between dwellings	29.2000	0.0370	1.0804
P1 Party wall - Ground floor	15.2000	0.0490	0.7448
P2 Party wall - Intermediate floor within a dwelling	26.4000	0.0000	0.0000
P4 Party wall - Roof (insulation at ceiling level)	6.6000	0.0770	0.5082
P5 Party wall - Roof (insulation at rafter level)	9.6000	0.0710	0.6816
R1 Head of roof window	3.1000	0.2400	0.7440
R2 Sill of roof window	3.1000	0.2400	0.7440
R3 Jamb of roof window	4.8000	0.2400	1.1520
R4 Ridge (vaulted ceiling)	4.8000	0.1200	0.5760

```
        E17 Corner (inverted – internal area greater than external area)                    2.5000        -0.0530        -0.1325
Thermal bridges (Sum(L x Psi) calculated using Appendix K)                                                                  11.2731 (36)
Point Thermal bridges                                                                                          (36a) =       0.0000
Total fabric heat loss                                                                     (33) + (36) + (36a) =          55.2286 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(38)m          39.8439    39.6578    39.4753    38.6184    38.4581    37.7117    37.7117    37.5735    37.9992    38.4581    38.7824    39.1215 (38)
Heat transfer coeff
               95.0725    94.8864    94.7039    93.8470    93.6867    92.9403    92.9403    92.8021    93.2278    93.6867    94.0110    94.3501 (39)
Average = Sum(39)m / 12 =                                                                                                                93.8462

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
HLP            1.2127     1.2103     1.2080     1.1970     1.1950     1.1855     1.1855     1.1837     1.1891     1.1950     1.1991     1.2034 (40)
HLP (average)                                                                                                                            1.1970
Days in mont        31         28         31         30         31         30         31         31         30         31         30         31
```

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4. Water heating energy requirements (kWh/year)

```
Assumed occupancy                                                                                                                        2.4318 (42)
Hot water usage for mixer showers
                 0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (42a)
Hot water usage for baths
               78.8836    77.7121    76.0623    73.0204    70.7427    68.2171    66.8529    68.4911    70.2748    72.9773    76.0818    78.6169 (42b)
Hot water usage for other uses
               41.6148    40.1016    38.5883    37.0750    35.5618    34.0485    34.0485    35.5618    37.0750    38.5883    40.1016    41.6148 (42c)
Average daily hot water use (litres/day)                                                                                               110.9692 (43)

                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Daily hot water use
              120.4984   117.8136   114.6506   110.0955   106.3045   102.2656   100.9014   104.0529   107.3499   111.5656   116.1834   120.2317 (44)
Energy conte  190.8400   167.7650   176.2137   150.7152   143.1063   125.7475   122.0315   128.8392   132.3731   151.3935   165.5245   188.2538 (45)
Energy content (annual)                                                                                   Total = Sum(45)m =   1842.8033
Distribution loss  (46)m = 0.15 x (45)m
               28.6260    25.1648    26.4321    22.6073    21.4659    18.8621    18.3047    19.3259    19.8560    22.7090    24.8287    28.2381 (46)
Water storage loss:
Store volume                                                                                                                           150.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                                            1.8600 (48)
  Temperature factor from Table 2b                                                                                                       0.5400 (49)
Enter (49) or (54) in (55)                                                                                                               1.0044 (55)
Total storage loss
               31.1364    28.1232    31.1364    30.1320    31.1364    30.1320    31.1364    31.1364    30.1320    31.1364    30.1320    31.1364 (56)
If cylinder contains dedicated solar storage
               31.1364    28.1232    31.1364    30.1320    31.1364    30.1320    31.1364    31.1364    30.1320    31.1364    30.1320    31.1364 (57)
Primary loss   23.2624    21.0112    23.2624    22.5120    23.2624    22.5120    23.2624    23.2624    22.5120    23.2624    22.5120    23.2624 (59)
Combi loss      0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000     0.0000 (61)
Total heat required for water heating calculated for each month
              245.2388   216.8994   230.6125   203.3592   197.5051   178.3915   176.4303   183.2380   185.0171   205.7923   218.1685   242.6526 (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
              245.2388   216.8994   230.6125   203.3592   197.5051   178.3915   176.4303   183.2380   185.0171   205.7923   218.1685   242.6526 (64)
                                                                                                   Total per year (kWh/year) = Sum(64)m =   2483.3053 (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
              106.9734    95.0894   102.1101    92.2280    91.1019    83.9262    84.0945    86.3581    86.1293    93.8574    97.1521   106.1134 (65)
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5. Internal gains (see Table 5 and 5a)

```
Metabolic gains (Table 5), Watts
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m         145.9081   145.9081   145.9081   145.9081   145.9081   145.9081   145.9081   145.9081   145.9081   145.9081   145.9081   145.9081 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                24.7259    21.9613    17.8601    13.5213    10.1073     8.5330     9.2202    11.9848    16.0860    20.4248    23.8388    25.4131 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              322.4837   325.8301   317.3973   299.4450   276.7834   255.4847   241.2559   237.9095   246.3423   264.2946   286.9562   308.2549 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                52.0226    52.0226    52.0226    52.0226    52.0226    52.0226    52.0226    52.0226    52.0226    52.0226    52.0226    52.0226 (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)
              -97.2720   -97.2720   -97.2720   -97.2720   -97.2720   -97.2720   -97.2720   -97.2720   -97.2720   -97.2720   -97.2720   -97.2720 (71)
Water heating gains (Table 5)
              143.7814   141.5021   137.2447   128.0944   122.4488   116.5642   113.0302   116.0727   119.6240   126.1524   134.9335   142.6256 (72)
Total internal gains
              591.6496   589.9520   573.1608   541.7193   509.9981   481.2406   464.1650   466.6256   482.7108   511.5304   546.3871   576.9521 (73)
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6. Solar gains

```
[Jan]                                      Area        Solar flux                g                FF            Access            Gains
                                            m2          Table 6a     Specific data    Specific data            factor                W
```

	W/m2	or Table 6b	or Table 6c	Table 6d		
North	7.4800	10.6334	0.6300	0.7000	0.7700	24.3078 (74)
South	12.8900	46.7521	0.6300	0.7000	0.7700	184.1728 (78)
East	4.0600	26.2379	0.6300	0.7000	1.0000	42.2802 (82)

Solar gains	250.7608	432.9496	608.4127	781.7002	901.6928	906.8515	869.4273	777.9973	668.0582	482.7666	301.3974	213.9314	(83)
Total gains	842.4104	1022.9016	1181.5735	1323.4195	1411.6909	1388.0920	1333.5923	1244.6229	1150.7690	994.2970	847.7845	790.8835	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	40.1053	40.1840	40.2614	40.6291	40.6986	41.0254	41.0254	41.0865	40.8989	40.6986	40.5582	40.4124	
alpha	3.6737	3.6789	3.6841	3.7086	3.7132	3.7350	3.7350	3.7391	3.7266	3.7132	3.7039	3.6942	
util living area													
	0.9518	0.9108	0.8413	0.7236	0.5733	0.4180	0.3041	0.3388	0.5288	0.7798	0.9186	0.9601	(86)
Living	19.8755	20.1266	20.4137	20.6805	20.8346	20.8980	20.9128	20.9106	20.8711	20.6524	20.2155	19.8208	
Non living	18.6289	18.9376	19.2816	19.5907	19.7506	19.8140	19.8240	19.8244	19.7917	19.5725	19.0606	18.5668	
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	20.4247	20.1266	20.4137	20.6805	20.8346	20.8980	20.9128	20.9106	20.8711	20.6524	20.2155	19.9857	(87)
Th 2	19.9099	19.9118	19.9136	19.9224	19.9240	19.9316	19.9316	19.9331	19.9287	19.9240	19.9207	19.9172	(88)
util rest of house													
	0.9419	0.8941	0.8140	0.6819	0.5180	0.3520	0.2314	0.2621	0.4565	0.7341	0.9004	0.9517	(89)
MIT 2	19.3992	18.9376	19.2816	19.5907	19.7506	19.8140	19.8240	19.8244	19.7917	19.5725	19.0606	18.8102	(90)
Living area fraction										fLA = Living area / (4) =		0.3515	(91)
MIT	19.7597	19.3556	19.6795	19.9738	20.1316	20.1950	20.2067	20.2062	20.1711	19.9521	19.4666	19.2234	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.7597	19.3556	19.6795	19.9738	20.1316	20.1950	20.2067	20.2062	20.1711	19.9521	19.4666	19.2234	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9403	0.8843	0.8075	0.6840	0.5290	0.3686	0.2503	0.2820	0.4734	0.7354	0.8913	0.9452	(94)
Useful gains	792.1507	904.5130	954.1465	905.2677	746.8524	511.6162	333.7647	350.9424	544.8242	731.2349	755.6475	747.5820	(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													
	1469.7916	1371.6390	1248.1548	1039.2415	789.9323	520.0044	335.2112	353.2279	565.9994	876.1657	1162.5957	1417.4601	(97)
Space heating kWh													
	504.1648	313.9087	218.7422	96.4611	32.0514	0.0000	0.0000	0.0000	0.0000	107.8285	293.0027	498.3893	(98a)
Space heating requirement - total per year (kWh/year)												2064.5486	
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													
	504.1648	313.9087	218.7422	96.4611	32.0514	0.0000	0.0000	0.0000	0.0000	107.8285	293.0027	498.3893	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2064.5486	
Space heating per m2											(98c) / (4) =	26.3335	(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 %)	353.6553 (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													
	504.1648	313.9087	218.7422	96.4611	32.0514	0.0000	0.0000	0.0000	0.0000	107.8285	293.0027	498.3893	(98)
Space heating efficiency (main heating system 1)													
	353.6553	353.6553	353.6553	353.6553	353.6553	0.0000	0.0000	0.0000	0.0000	353.6553	353.6553	353.6553	(210)
Space heating fuel (main heating system)													
	142.5582	88.7612	61.8518	27.2755	9.0629	0.0000	0.0000	0.0000	0.0000	30.4897	82.8498	140.9252	(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													
	245.2388	216.8994	230.6125	203.3592	197.5051	178.3915	176.4303	183.2380	185.0171	205.7923	218.1685	242.6526	(64)
Efficiency of water heater												189.9190	(216)
(217)m	189.9190	189.9190	189.9190	189.9190	189.9190	189.9190	189.9190	189.9190	189.9190	189.9190	189.9190	189.9190	(217)
Fuel for water heating, kWh/month													
	129.1281	114.2063	121.4268	107.0768	103.9944	93.9303	92.8976	96.4822	97.4190	108.3579	114.8745	127.7664	(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	21.6424	17.3623	15.6329	11.4533	8.8469	7.2280	8.0704	10.4902	13.6258	17.8777	20.1928	22.2439	(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	583.7743	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	189.9190	
Water heating fuel used	1307.5603	(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)	174.6666	(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	2066.0012	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	583.7743	16.4900	96.2644	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1307.5603	16.4900	215.6167	(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	174.6666	16.4900	28.8025	(250)
Additional standing charges			0.0000	(251)
Total energy cost			340.6836	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.9939	(257)
SAP value		83.8890	
SAP rating (Section 12)		84	(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	583.7743	0.1570	91.6265	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1307.5603	0.1408	184.1215	(264)
Space and water heating			275.7480	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	174.6666	0.1443	25.2098	(268)
Total CO2, kg/year			300.9578	(272)
CO2 emissions per m2			3.8400	(273)
EI value			96.7319	
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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	29.5600 (1b)	x	2.5000 (2b)	=	73.9000 (1b)	-
First floor	31.0800 (1c)	x	2.8000 (2c)	=	87.0240 (1c)	-
Second floor	17.7600 (1d)	x	2.9000 (2d)	=	51.5040 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	78.4000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		212.4280	(5)

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	3 * 10 =	30.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1412	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		4.0000	(17)
Infiltration rate		0.3412	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2900	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.3000	4.1000	4.1000	3.8000	3.9000	3.4000	3.4000	3.3000	3.4000	3.8000	3.7000	4.0000	(22)
Wind factor	1.0750	1.0250	1.0250	0.9500	0.9750	0.8500	0.8500	0.8250	0.8500	0.9500	0.9250	1.0000	(22a)
Adj infilt rate	0.3118	0.2973	0.2973	0.2755	0.2828	0.2465	0.2465	0.2393	0.2465	0.2755	0.2683	0.2900	(22b)
Effective ac	0.5486	0.5442	0.5442	0.5380	0.5400	0.5304	0.5304	0.5286	0.5304	0.5380	0.5360	0.5421	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows/Doors (Uw = 1.20)			20.3700	1.1450	23.3244			(27)
Rooflights			4.0600	1.5918	6.4625			(27a)
Ground Floor			29.5600	0.1000	2.9560	110.0000	3251.6000	(28a)
External Wall	62.6800	20.3700	42.3100	0.1500	6.3465	9.0000	380.7900	(29a)
External Roof - Sloping	23.1800	4.0600	19.1200	0.1500	2.8680	9.0000	172.0800	(30)
External Roof - Flat Roof	13.3200		13.3200	0.1500	1.9980	9.0000	119.8800	(30)
Total net area of external elements Aum(A, m2)			128.7400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	43.9555			(33)
Party Wall 1			108.2400	0.0000	0.0000	70.0000	7576.8000	(32)
Internal Walls - Timber			105.3000			9.0000	947.7000	(32c)
Internal Floor - 1st Floor			29.5600			18.0000	532.0800	(32d)
Internal Floor - 2nd Floor			17.7600			18.0000	319.6800	(32d)
Internal Ceiling - G Floor			29.5600			9.0000	266.0400	(32e)
Internal Ceiling - 1st Floor			17.7600			9.0000	159.8400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 13726.4900	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	175.0828	(35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	10.4000	0.0580	0.6032
E3 Sill	5.9000	0.0450	0.2655
E4 Jamb	37.6000	0.0500	1.8800
E5 Ground floor (normal)	8.2000	0.0550	0.4510
E6 Intermediate floor within a dwelling	14.8000	0.0000	0.0000
E13 Gable (insulation at rafter level)	9.6000	0.0690	0.6624
E15 Flat roof with parapet	3.7000	0.3000	1.1100
E16 Corner (normal)	2.5000	0.0440	0.1100
E18 Party wall between dwellings	2.5000	0.0370	0.0925
E25 Staggered party wall between dwellings	29.2000	0.0370	1.0804
P1 Party wall - Ground floor	15.2000	0.0490	0.7448
P2 Party wall - Intermediate floor within a dwelling	26.4000	0.0000	0.0000
P4 Party wall - Roof (insulation at ceiling level)	6.6000	0.0770	0.5082
P5 Party wall - Roof (insulation at rafter level)	9.6000	0.0710	0.6816

R1 Head of roof window	3.1000	0.2400	0.7440	
R2 Sill of roof window	3.1000	0.2400	0.7440	
R3 Jamb of roof window	4.8000	0.2400	1.1520	
R4 Ridge (vaulted ceiling)	4.8000	0.1200	0.5760	
E17 Corner (inverted – internal area greater than external area)	2.5000	-0.0530	-0.1325	

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 11.2731 (36)
Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 55.2286 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	38.4581	38.1485	38.1485	37.7117	37.8536	37.1810	37.1810	37.0575	37.1810	37.7117	37.5735	37.9992	(38)
Heat transfer coeff	93.6867	93.3771	93.3771	92.9403	93.0822	92.4095	92.4095	92.2861	92.4095	92.9403	92.8021	93.2278	(39)

Average = Sum(39)m / 12 = 92.9123

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1950	1.1910	1.1910	1.1855	1.1873	1.1787	1.1787	1.1771	1.1787	1.1855	1.1837	1.1891	(40)
HLP (average)												1.1851	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.4318 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usage for baths	78.8836	77.7121	76.0623	73.0204	70.7427	68.2171	66.8529	68.4911	70.2748	72.9773	76.0818	78.6169	(42b)
Hot water usage for other uses	41.6148	40.1016	38.5883	37.0750	35.5618	34.0485	34.0485	35.5618	37.0750	38.5883	40.1016	41.6148	(42c)

Average daily hot water use (litres/day) 110.9692 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	120.4984	117.8136	114.6506	110.0955	106.3045	102.2656	100.9014	104.0529	107.3499	111.5656	116.1834	120.2317	(44)
Energy conte	190.8400	167.7650	176.2137	150.7152	143.1063	125.7475	122.0315	128.8392	132.3731	151.3935	165.5245	188.2538	(45)

Energy content (annual) Total = Sum(45)m = 1842.8033

Distribution loss (46)m = 0.15 x (45)m	28.6260	25.1648	26.4321	22.6073	21.4659	18.8621	18.3047	19.3259	19.8560	22.7090	24.8287	28.2381	(46)

Water storage loss:
Store volume 150.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.8600 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 1.0044 (55)

Total storage loss	31.1364	28.1232	31.1364	30.1320	31.1364	30.1320	31.1364	31.1364	30.1320	31.1364	30.1320	31.1364	(56)
If cylinder contains dedicated solar storage	31.1364	28.1232	31.1364	30.1320	31.1364	30.1320	31.1364	31.1364	30.1320	31.1364	30.1320	31.1364	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Combi loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(61)
Total heat required for water heating calculated for each month	245.2388	216.8994	230.6125	203.3592	197.5051	178.3915	176.4303	183.2380	185.0171	205.7923	218.1685	242.6526	(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	245.2388	216.8994	230.6125	203.3592	197.5051	178.3915	176.4303	183.2380	185.0171	205.7923	218.1685	242.6526	(64)

Total per year (kWh/year) = Sum(64)m = 2483.3053 (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	106.9734	95.0894	102.1101	92.2280	91.1019	83.9262	84.0945	86.3581	86.1293	93.8574	97.1521	106.1134	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	145.9081	145.9081	145.9081	145.9081	145.9081	145.9081	145.9081	145.9081	145.9081	145.9081	145.9081	145.9081	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	24.7259	21.9613	17.8601	13.5213	10.1073	8.5330	9.2202	11.9848	16.0860	20.4248	23.8388	25.4131	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	322.4837	325.8301	317.3973	299.4450	276.7834	255.4847	241.2559	237.9095	246.3423	264.2946	286.9562	308.2549	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	52.0226	52.0226	52.0226	52.0226	52.0226	52.0226	52.0226	52.0226	52.0226	52.0226	52.0226	52.0226	(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)	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	(71)
Water heating gains (Table 5)	143.7814	141.5021	137.2447	128.0944	122.4488	116.5642	113.0302	116.0727	119.6240	126.1524	134.9335	142.6256	(72)
Total internal gains	591.6496	589.9520	573.1608	541.7193	509.9981	481.2406	464.1650	466.6256	482.7108	511.5304	546.3871	576.9521	(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	7.4800	12.7650	0.6300	0.7000	0.7700	29.1807 (74)
South	12.8900	54.2217	0.6300	0.7000	0.7700	213.5984 (78)
East	4.0600	31.9987	0.6300	0.7000	1.0000	51.5631 (82)

Solar gains	294.3422	444.4478	622.1894	816.8042	923.0272	984.2344	933.3910	852.5936	729.9828	532.4200	348.5537	252.5548 (83)
Total gains	885.9917	1034.3998	1195.3502	1358.5236	1433.0252	1465.4750	1397.5560	1319.2192	1212.6936	1043.9504	894.9407	829.5070 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	40.6986	40.8335	40.8335	41.0254	40.9629	41.2610	41.2610	41.3162	41.2610	41.0254	41.0865	40.8989	
alpha	3.7132	3.7222	3.7222	3.7350	3.7309	3.7507	3.7507	3.7544	3.7507	3.7350	3.7391	3.7266	
util living area	0.9356	0.8940	0.8114	0.6696	0.5023	0.3245	0.2176	0.2370	0.4437	0.7183	0.8884	0.9459	(86)
Living	20.0385	20.2465	20.5179	20.7550	20.8718	20.9112	20.9167	20.9164	20.8959	20.7402	20.3691	19.9883	
Non living	18.8424	19.0964	19.4147	19.6783	19.7907	19.8284	19.8313	19.8326	19.8190	19.6716	19.2554	18.7851	
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	20.5081	20.2465	20.5179	20.7550	20.8718	20.9112	20.9167	20.9164	20.8959	20.7402	20.3691	20.1299	(87)
Th 2	19.9240	19.9272	19.9272	19.9316	19.9302	19.9371	19.9371	19.9383	19.9371	19.9316	19.9331	19.9287	(88)
util rest of house	0.9225	0.8742	0.7796	0.6228	0.4430	0.2596	0.1478	0.1634	0.3702	0.6643	0.8639	0.9345	(89)
MIT 2	19.4928	19.0964	19.4147	19.6783	19.7907	19.8284	19.8313	19.8326	19.8190	19.6716	19.2554	18.9912	(90)
Living area fraction									fLA = Living area / (4) =			0.3515	(91)
MIT	19.8497	19.5007	19.8025	20.0568	20.1707	20.2090	20.2129	20.2136	20.1976	20.0472	19.6469	19.3914	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.8497	19.5007	19.8025	20.0568	20.1707	20.2090	20.2129	20.2136	20.1976	20.0472	19.6469	19.3914	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9214	0.8652	0.7756	0.6286	0.4566	0.2764	0.1660	0.1826	0.3886	0.6706	0.8563	0.9278	(94)
Useful gains	816.3941	894.9414	927.0989	853.9707	654.3896	405.0142	231.9835	240.8630	471.2011	700.0629	766.3811	769.5837	(95)
Ext temp.	5.1000	5.7000	7.4000	9.9000	12.9000	15.8000	17.7000	17.6000	15.0000	11.5000	8.0000	5.1000	(96)
Heat loss rate W	1381.8530	1288.6688	1158.1120	943.9765	676.7756	407.4379	232.2145	241.1974	480.3043	794.3837	1080.8566	1332.3598	(97)
Space heating kWh	420.7014	264.5848	171.8738	64.8042	16.6552	0.0000	0.0000	0.0000	0.0000	70.1747	226.4224	418.7054	(98a)
Space heating requirement - total per year (kWh/year)												1653.9219	
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	420.7014	264.5848	171.8738	64.8042	16.6552	0.0000	0.0000	0.0000	0.0000	70.1747	226.4224	418.7054	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1653.9219	
Space heating per m2											(98c) / (4) =	21.0959	(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 %)	353.8927 (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	420.7014	264.5848	171.8738	64.8042	16.6552	0.0000	0.0000	0.0000	0.0000	70.1747	226.4224	418.7054	(98)
Space heating efficiency (main heating system 1)	353.8927	353.8927	353.8927	353.8927	353.8927	0.0000	0.0000	0.0000	0.0000	353.8927	353.8927	353.8927	(210)
Space heating fuel (main heating system)	118.8782	74.7641	48.5666	18.3118	4.7063	0.0000	0.0000	0.0000	0.0000	19.8294	63.9805	118.3142	(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	245.2388	216.8994	230.6125	203.3592	197.5051	178.3915	176.4303	183.2380	185.0171	205.7923	218.1685	242.6526	(64)
Efficiency of water heater												190.0169	(216)
(217)m	190.0169	190.0169	190.0169	190.0169	190.0169	190.0169	190.0169	190.0169	190.0169	190.0169	190.0169	190.0169	(217)

Fuel for water heating, kWh/month													
	129.0616	114.1474	121.3642	107.0216	103.9408	93.8819	92.8498	96.4325	97.3688	108.3021	114.8154	127.7006	(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	21.6424	17.3623	15.6329	11.4533	8.8469	7.2280	8.0704	10.4902	13.6258	17.8777	20.1928	22.2439	(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	467.3512	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	190.0169	
Water heating fuel used	1306.8867	(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)	174.6666	(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	1948.9044	(238)

10a. Fuel costs - using BEDF prices (511)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	467.3512	18.3900	85.9459	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1306.8867	18.3900	240.3365	(247)
Energy for instantaneous electric shower(s)	0.0000	18.3900	0.0000	(247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(249)
Energy for lighting	174.6666	18.3900	32.1212	(250)
Additional standing charges			0.0000	(251)
Total energy cost			358.4035	(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	467.3512	0.1576	73.6530	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	1306.8867	0.1408	184.0266	(264)
Space and water heating			257.6796	(265)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(267)
Energy for lighting	174.6666	0.1443	25.2098	(268)
Total CO2, kg/year			282.8894	(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	467.3512	1.5834	739.9910	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	1306.8867	1.5207	1987.3446	(278)
Space and water heating			2727.3356	(279)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(281)
Energy for lighting	174.6666	1.5338	267.9094	(282)
Total Primary energy kWh/year			2995.2450	(286)

SAP 10 EPC IMPROVEMENTS

P22691(4)

Current energy efficiency rating: B 84
Current environmental impact rating: A 97

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	+ 2.1	-£ 58	-39 kg (13.8%)
U Solar photovoltaic panels	+ 6.3	-£ 157	-115 kg (47.1%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£58	0.50 kg/m²	B 86	A 97
Solar photovoltaic panels	£157	1.46 kg/m²	A 92	A 98
Total Savings	£214	1.96 kg/m²		

Potential energy efficiency rating: A 92
Potential environmental impact rating: A 98

Fuel prices for cost data on this page from database revision number 511 TEST (31 Jan 2023)
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	£358	£301	£58
Space heating	£86	£101	-£15
Water heating	£240	£168	£73
Lighting	£32	£32	£0
Generated (PV)	-£0	-£157	£157
Total cost of fuels	£358	£144	£215
Total cost of uses	£358	£144	£215
Delivered energy	25 kWh/m²	10 kWh/m²	15 kWh/m²
Carbon dioxide emissions	0.3 tonnes	0.1 tonnes	0.2 tonnes
CO2 emissions per m²	4 kg/m²	2 kg/m²	2 kg/m²
Primary energy	38 kWh/m²	16 kWh/m²	22 kWh/m²

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 (m2)		Storey height (m)		Volume (m3)	
Ground floor	29.5600 (1b)	x	2.5000 (2b)	=	73.9000 (1b)	-
First floor	31.0800 (1c)	x	2.8000 (2c)	=	87.0240 (1c)	-
Second floor	17.7600 (1d)	x	2.9000 (2d)	=	51.5040 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	78.4000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		212.4280	(5)

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	3 * 10 =	30.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1412	(8)
Pressure test		Yes	

Pressure Test Method	Blower Door	
Measured/design AP50	4.0000	(17)
Infiltration rate	0.3412	(18)
Number of sides sheltered	2	(19)
Shelter factor (20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor (21) = (18) x (20) =	0.2900	(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	0.3698	0.3626	0.3553	0.3190	0.3118	0.2755	0.2755	0.2683	0.2900	0.3118	0.3263	0.3408	(22b)
Effective ac	0.5684	0.5657	0.5631	0.5509	0.5486	0.5380	0.5380	0.5360	0.5421	0.5486	0.5532	0.5581	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows/Doors (Uw = 1.20)			20.3700	1.1450	23.3244			(27)
Rooflights			4.0600	1.5918	6.4625			(27a)
Ground Floor			29.5600	0.1000	2.9560	110.0000	3251.6000	(28a)
External Wall	62.6800	20.3700	42.3100	0.1500	6.3465	9.0000	380.7900	(29a)
External Roof - Sloping	23.1800	4.0600	19.1200	0.1500	2.8680	9.0000	172.0800	(30)
External Roof - Flat Roof	13.3200		13.3200	0.1500	1.9980	9.0000	119.8800	(30)
Total net area of external elements Aum(A, m2)			128.7400					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	43.9555			(33)
Party Wall 1			108.2400	0.0000	0.0000	70.0000	7576.8000	(32)
Internal Walls - Timber			105.3000			9.0000	947.7000	(32c)
Internal Floor - 1st Floor			29.5600			18.0000	532.0800	(32d)
Internal Floor - 2nd Floor			17.7600			18.0000	319.6800	(32d)
Internal Ceiling - G Floor			29.5600			9.0000	266.0400	(32e)
Internal Ceiling - 1st Floor			17.7600			9.0000	159.8400	(32e)

Heat capacity Cm = Sum(A x k) (28)...(30) + (32) + (32a)...(32e) = 13726.4900 (34)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K 175.0828 (35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	10.4000	0.0580	0.6032
E3 Sill	5.9000	0.0450	0.2655
E4 Jamb	37.6000	0.0500	1.8800
E5 Ground floor (normal)	8.2000	0.0550	0.4510
E6 Intermediate floor within a dwelling	14.8000	0.0000	0.0000
E13 Gable (insulation at rafter level)	9.6000	0.0690	0.6624
E15 Flat roof with parapet	3.7000	0.3000	1.1100
E16 Corner (normal)	2.5000	0.0440	0.1100
E18 Party wall between dwellings	2.5000	0.0370	0.0925
E25 Staggered party wall between dwellings	29.2000	0.0370	1.0804
P1 Party wall - Ground floor	15.2000	0.0490	0.7448
P2 Party wall - Intermediate floor within a dwelling	26.4000	0.0000	0.0000
P4 Party wall - Roof (insulation at ceiling level)	6.6000	0.0770	0.5082
P5 Party wall - Roof (insulation at rafter level)	9.6000	0.0710	0.6816
R1 Head of roof window	3.1000	0.2400	0.7440
R2 Sill of roof window	3.1000	0.2400	0.7440
R3 Jamb of roof window	4.8000	0.2400	1.1520
R4 Ridge (vaulted ceiling)	4.8000	0.1200	0.5760
E17 Corner (inverted – internal area greater than external area)	2.5000	-0.0530	-0.1325

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 11.2731 (36)

Point Thermal bridges (36a) = 0.0000

Total fabric heat loss (33) + (36) + (36a) = 55.2286 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.8439	39.6578	39.4753	38.6184	38.4581	37.7117	37.7117	37.5735	37.9992	38.4581	38.7824	39.1215	(38)
Heat transfer coeff	95.0725	94.8864	94.7039	93.8470	93.6867	92.9403	92.9403	92.8021	93.2278	93.6867	94.0110	94.3501	(39)

Average = Sum(39)m / 12 = 93.8462

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2127	1.2103	1.2080	1.1970	1.1950	1.1855	1.1855	1.1837	1.1891	1.1950	1.1991	1.2034	(40)
HLP (average)												1.1970	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.4318 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usage for baths	78.8836	77.7121	76.0623	73.0204	70.7427	68.2171	66.8529	68.4911	70.2748	72.9773	76.0818	78.6169	(42b)
Hot water usage for other uses	41.6148	40.1016	38.5883	37.0750	35.5618	34.0485	34.0485	35.5618	37.0750	38.5883	40.1016	41.6148	(42c)

Average daily hot water use (litres/day) 110.9692 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

	120.4984	117.8136	114.6506	110.0955	106.3045	102.2656	100.9014	104.0529	107.3499	111.5656	116.1834	120.2317	(44)
Energy conte	190.8400	167.7650	176.2137	150.7152	143.1063	125.7475	122.0315	128.8392	132.3731	151.3935	165.5245	188.2538	(45)
Energy content (annual)										Total = Sum(45)m =		1842.8033	
Distribution loss (46)m = 0.15 x (45)m													
	28.6260	25.1648	26.4321	22.6073	21.4659	18.8621	18.3047	19.3259	19.8560	22.7090	24.8287	28.2381	(46)
Water storage loss:													
Store volume												150.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.8600	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.0044	(55)
Total storage loss													
	31.1364	28.1232	31.1364	30.1320	31.1364	30.1320	31.1364	31.1364	30.1320	31.1364	30.1320	31.1364	(56)
If cylinder contains dedicated solar storage													
	31.1364	28.1232	31.1364	30.1320	31.1364	30.1320	31.1364	31.1364	30.1320	31.1364	30.1320	31.1364	(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													
	245.2388	216.8994	229.2167	196.6056	184.7107	165.7848	163.4033	171.1415	179.6142	204.3966	218.1685	242.6526	(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												608.3186	(H24)
Heat delivered to space heating												0.0000	(H29)
Solar input												608.3186	
Solar input	-0.0000	-16.2332	-57.6078	-78.5959	-101.7763	-93.7363	-93.0624	-81.7977	-56.9312	-28.5780	-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													
	245.2388	200.6662	171.6090	118.0097	82.9345	72.0485	70.3409	89.3439	122.6830	175.8186	218.1685	242.6526	(64)
								Total per year (kWh/year) = Sum(64)m =				1809.5143	(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													
	106.9734	95.0894	100.9935	86.8251	80.8664	73.8409	73.6729	76.6809	81.8070	92.7408	97.1521	106.1134	(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	145.9081	145.9081	145.9081	145.9081	145.9081	145.9081	145.9081	145.9081	145.9081	145.9081	145.9081	145.9081	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.7259	21.9613	17.8601	13.5213	10.1073	8.5330	9.2202	11.9848	16.0860	20.4248	23.8388	25.4131	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	322.4837	325.8301	317.3973	299.4450	276.7834	255.4847	241.2559	237.9095	246.3423	264.2946	286.9562	308.2549	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.0226	52.0226	52.0226	52.0226	52.0226	52.0226	52.0226	52.0226	52.0226	52.0226	52.0226	52.0226	(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)													
	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	(71)
Water heating gains (Table 5)													
	143.7814	141.5021	135.7439	120.5904	108.6914	102.5567	99.0228	103.0657	113.6208	124.6516	134.9335	142.6256	(72)
Total internal gains													
	591.6496	589.9520	571.6600	534.2153	496.2408	467.2331	450.1575	453.6187	476.7076	510.0296	546.3871	576.9521	(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	7.4800	10.6334	0.6300	0.7000	0.7700	24.3078	(74)
South	12.8900	46.7521	0.6300	0.7000	0.7700	184.1728	(78)
East	4.0600	26.2379	0.6300	0.7000	1.0000	42.2802	(82)

Solar gains	250.7608	432.9496	608.4127	781.7002	901.6928	906.8515	869.4273	777.9973	668.0582	482.7666	301.3974	213.9314	(83)
Total gains	842.4104	1022.9016	1180.0727	1315.9155	1397.9335	1374.0846	1319.5848	1231.6160	1144.7658	992.7962	847.7845	790.8835	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

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

tau	40.1053	40.1840	40.2614	40.6291	40.6986	41.0254	41.0254	41.0865	40.8989	40.6986	40.5582	40.4124	
alpha	3.6737	3.6789	3.6841	3.7086	3.7132	3.7350	3.7350	3.7391	3.7266	3.7132	3.7039	3.6942	
util living area													
	0.9518	0.9108	0.8417	0.7261	0.5778	0.4219	0.3072	0.3423	0.5312	0.7804	0.9186	0.9601	(86)
Living	19.8755	20.1266	20.4127	20.6776	20.8324	20.8973	20.9127	20.9104	20.8704	20.6516	20.2155	19.8208	
Non living	18.6289	18.9376	19.2804	19.5878	19.7487	19.8136	19.8239	19.8243	19.7912	19.5717	19.0606	18.5668	
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	20.4247	20.1266	20.4127	20.6776	20.8324	20.8973	20.9127	20.9104	20.8704	20.6516	20.2155	19.9857	(87)
Th 2	19.9099	19.9118	19.9136	19.9224	19.9240	19.9316	19.9316	19.9331	19.9287	19.9240	19.9207	19.9172	(88)
util rest of house													
	0.9419	0.8941	0.8145	0.6845	0.5223	0.3555	0.2339	0.2648	0.4587	0.7348	0.9004	0.9517	(89)
MIT 2	19.3992	18.9376	19.2804	19.5878	19.7487	19.8136	19.8239	19.8243	19.7912	19.5717	19.0606	18.8102	(90)
Living area fraction										fLA = Living area / (4) =		0.3515	(91)
MIT	19.7597	19.3556	19.6785	19.9709	20.1297	20.1946	20.2066	20.2061	20.1706	19.9513	19.4666	19.2234	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.7597	19.3556	19.6785	19.9709	20.1297	20.1946	20.2066	20.2061	20.1706	19.9513	19.4666	19.2234	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9403	0.8843	0.8080	0.6865	0.5333	0.3721	0.2529	0.2849	0.4756	0.7360	0.8913	0.9452	(94)
Useful gains	792.1507	904.5130	953.4569	903.3732	745.5258	511.3009	333.7027	350.8470	544.4539	730.7442	755.6475	747.5820	(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													
	1469.7916	1371.6390	1248.0508	1038.9689	789.7487	519.9609	335.2020	353.2140	565.9481	876.0938	1162.5957	1417.4601	(97)
Space heating kWh													
	504.1648	313.9087	219.1778	97.6289	32.9018	0.0000	0.0000	0.0000	0.0000	108.1401	293.0027	498.3893	(98a)
Space heating requirement - total per year (kWh/year)												2067.3141	
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													
	504.1648	313.9087	219.1778	97.6289	32.9018	0.0000	0.0000	0.0000	0.0000	108.1401	293.0027	498.3893	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												2067.3141	
Space heating per m2											(98c) / (4) =	26.3688	(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 %)	353.6553	(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													
	504.1648	313.9087	219.1778	97.6289	32.9018	0.0000	0.0000	0.0000	0.0000	108.1401	293.0027	498.3893	(98)
Space heating efficiency (main heating system 1)													
	353.6553	353.6553	353.6553	353.6553	353.6553	0.0000	0.0000	0.0000	0.0000	353.6553	353.6553	353.6553	(210)
Space heating fuel (main heating system)													
	142.5582	88.7612	61.9750	27.6057	9.3034	0.0000	0.0000	0.0000	0.0000	30.5778	82.8498	140.9252	(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													
	245.2388	200.6662	171.6090	118.0097	82.9345	72.0485	70.3409	89.3439	122.6830	175.8186	218.1685	242.6526	(64)
Efficiency of water heater												189.9190	(216)
(217)m	189.9190	189.9190	189.9190	189.9190	189.9190	189.9190	189.9190	189.9190	189.9190	189.9190	189.9190	189.9190	(217)
Fuel for water heating, kWh/month													
	129.1281	105.6589	90.3590	62.1369	43.6683	37.9364	37.0373	47.0432	64.5976	92.5756	114.8745	127.7664	(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	21.6424	17.3623	15.6329	11.4533	8.8469	7.2280	8.0704	10.4902	13.6258	17.8777	20.1928	22.2439	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-37.1119	-54.1936	-79.3048	-88.8444	-93.8691	-86.7204	-85.5073	-81.2346	-72.8659	-61.6055	-41.2083	-31.7716	(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	584.5563	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	189.9190	
Water heating fuel used	952.7822	(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)	174.6666	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-814.2372	(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	977.7678	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	584.5563	16.4900	96.3933	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	952.7822	16.4900	157.1138	(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	174.6666	16.4900	28.8025	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-814.2372	16.4900	-134.2677	
PV Unit electricity exported	0.0000	5.5900	0.0000	
Total			-134.2677	(252)
Total energy cost			161.2339	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.3600	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.4704	(257)
SAP value		92.3752	
SAP rating (Section 12)		92	(258)
SAP band		A	

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	584.5563	0.1569	91.7363	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	952.7822	0.1459	139.0035	(264)
Space and water heating			230.7399	(265)
Pumps, fans and electric keep-hot	80.0000	0.1387	11.0970	(267)
Energy for lighting	174.6666	0.1443	25.2098	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-814.2372	0.1346	-109.6145	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-109.6145	(269)
Total CO2, kg/year			157.4321	(272)
CO2 emissions per m2			2.0100	(273)
EI value			98.2904	
EI rating			98	(274)
EI band			A	

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

1. Overall dwelling characteristics

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	29.5600 (1b)	x	2.5000 (2b)	=	73.9000 (1b)	-
First floor	31.0800 (1c)	x	2.8000 (2c)	=	87.0240 (1c)	-
Second floor	17.7600 (1d)	x	2.9000 (2d)	=	51.5040 (1d)	-
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 78.4000						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		212.4280	(5)

2. Ventilation rate

		m3 per hour	
Number of open chimneys	0 * 80 =	0.0000	(6a)
Number of open flues	0 * 20 =	0.0000	(6b)
Number of chimneys / flues attached to closed fire	0 * 10 =	0.0000	(6c)
Number of flues attached to solid fuel boiler	0 * 20 =	0.0000	(6d)
Number of flues attached to other heater	0 * 35 =	0.0000	(6e)
Number of blocked chimneys	0 * 20 =	0.0000	(6f)
Number of intermittent extract fans	3 * 10 =	30.0000	(7a)
Number of passive vents	0 * 10 =	0.0000	(7b)
Number of flueless gas fires	0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(6c)+(6d)+(6e)+(6f)+(6g)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1412	(8)
Pressure test		Yes	
Pressure Test Method		Blower Door	
Measured/design AP50		4.0000	(17)
Infiltration rate		0.3412	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2900	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.3000	4.1000	4.1000	3.8000	3.9000	3.4000	3.4000	3.3000	3.4000	3.8000	3.7000	4.0000	(22)
Wind factor	1.0750	1.0250	1.0250	0.9500	0.9750	0.8500	0.8500	0.8250	0.8500	0.9500	0.9250	1.0000	(22a)
Adj infilt rate	0.3118	0.2973	0.2973	0.2755	0.2828	0.2465	0.2465	0.2393	0.2465	0.2755	0.2683	0.2900	(22b)
Effective ac	0.5486	0.5442	0.5442	0.5380	0.5400	0.5304	0.5304	0.5286	0.5304	0.5380	0.5360	0.5421	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Windows/Doors (Uw = 1.20)			20.3700	1.1450	23.3244			(27)
Rooflights			4.0600	1.5918	6.4625			(27a)
Ground Floor			29.5600	0.1000	2.9560	110.0000	3251.6000	(28a)
External Wall	62.6800	20.3700	42.3100	0.1500	6.3465	9.0000	380.7900	(29a)
External Roof - Sloping	23.1800	4.0600	19.1200	0.1500	2.8680	9.0000	172.0800	(30)
External Roof - Flat Roof	13.3200		13.3200	0.1500	1.9980	9.0000	119.8800	(30)
Total net area of external elements Aum(A, m2)			128.7400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		43.9555			(33)
Party Wall 1			108.2400	0.0000	0.0000	70.0000	7576.8000	(32)
Internal Walls - Timber			105.3000			9.0000	947.7000	(32c)
Internal Floor - 1st Floor			29.5600			18.0000	532.0800	(32d)
Internal Floor - 2nd Floor			17.7600			18.0000	319.6800	(32d)
Internal Ceiling - G Floor			29.5600			9.0000	266.0400	(32e)
Internal Ceiling - 1st Floor			17.7600			9.0000	159.8400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 13726.4900	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	175.0828	(35)

List of Thermal Bridges

K1 Element	Length	Psi-value	Total
E1 Steel lintel with perforated steel base plate	10.4000	0.0580	0.6032
E3 Sill	5.9000	0.0450	0.2655
E4 Jamb	37.6000	0.0500	1.8800
E5 Ground floor (normal)	8.2000	0.0550	0.4510
E6 Intermediate floor within a dwelling	14.8000	0.0000	0.0000
E13 Gable (insulation at rafter level)	9.6000	0.0690	0.6624
E15 Flat roof with parapet	3.7000	0.3000	1.1100
E16 Corner (normal)	2.5000	0.0440	0.1100
E18 Party wall between dwellings	2.5000	0.0370	0.0925
E25 Staggered party wall between dwellings	29.2000	0.0370	1.0804
P1 Party wall - Ground floor	15.2000	0.0490	0.7448
P2 Party wall - Intermediate floor within a dwelling	26.4000	0.0000	0.0000
P4 Party wall - Roof (insulation at ceiling level)	6.6000	0.0770	0.5082
P5 Party wall - Roof (insulation at rafter level)	9.6000	0.0710	0.6816
R1 Head of roof window	3.1000	0.2400	0.7440
R2 Sill of roof window	3.1000	0.2400	0.7440
R3 Jamb of roof window	4.8000	0.2400	1.1520
R4 Ridge (vaulted ceiling)	4.8000	0.1200	0.5760
E17 Corner (inverted – internal area greater than external area)	2.5000	-0.0530	-0.1325

Thermal bridges (Sum(L x Psi) calculated using Appendix K) 11.2731 (36)

Point Thermal bridges (36a) = 0.0000
Total fabric heat loss (33) + (36) + (36a) = 55.2286 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	38.4581	38.1485	38.1485	37.7117	37.8536	37.1810	37.1810	37.0575	37.1810	37.7117	37.5735	37.9992	(38)
Heat transfer coeff	93.6867	93.3771	93.3771	92.9403	93.0822	92.4095	92.4095	92.2861	92.4095	92.9403	92.8021	93.2278	(39)
Average = Sum(39)m / 12 =												92.9123	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1950	1.1910	1.1910	1.1855	1.1873	1.1787	1.1787	1.1771	1.1787	1.1855	1.1837	1.1891	(40)
HLP (average)												1.1851	
Days in mont	31	28	31	30	31	30	31	31	30	31	30	31	

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4. Water heating energy requirements (kWh/year)

Assumed occupancy 2.4318 (42)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage for mixer showers	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(42a)
Hot water usage for baths	78.8836	77.7121	76.0623	73.0204	70.7427	68.2171	66.8529	68.4911	70.2748	72.9773	76.0818	78.6169	(42b)
Hot water usage for other uses	41.6148	40.1016	38.5883	37.0750	35.5618	34.0485	34.0485	35.5618	37.0750	38.5883	40.1016	41.6148	(42c)
Average daily hot water use (litres/day)												110.9692	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	120.4984	117.8136	114.6506	110.0955	106.3045	102.2656	100.9014	104.0529	107.3499	111.5656	116.1834	120.2317	(44)
Energy conte	190.8400	167.7650	176.2137	150.7152	143.1063	125.7475	122.0315	128.8392	132.3731	151.3935	165.5245	188.2538	(45)
Energy content (annual)										Total = Sum(45)m =		1842.8033	
Distribution loss (46)m = 0.15 x (45)m	28.6260	25.1648	26.4321	22.6073	21.4659	18.8621	18.3047	19.3259	19.8560	22.7090	24.8287	28.2381	(46)
Water storage loss:													
Store volume												150.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.8600	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.0044	(55)
Total storage loss	31.1364	28.1232	31.1364	30.1320	31.1364	30.1320	31.1364	31.1364	30.1320	31.1364	30.1320	31.1364	(56)
If cylinder contains dedicated solar storage	31.1364	28.1232	31.1364	30.1320	31.1364	30.1320	31.1364	31.1364	30.1320	31.1364	30.1320	31.1364	(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	245.2388	216.8994	229.2167	196.6056	184.7107	165.7848	163.4033	171.1415	179.6142	204.3966	218.1685	242.6526	(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												685.2993	(H24)
Heat delivered to space heating												0.0000	(H29)
Solar input												685.2993	
Solar input	-1.1283	-19.5722	-62.2216	-85.3941	-106.4170	-103.9604	-102.0756	-93.3518	-67.2179	-38.2388	-5.7217	-0.0000	(63c)
FGHRS	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63d)
Output from w/h	244.1105	197.3272	166.9952	111.2115	78.2937	61.8244	61.3277	77.7897	112.3964	166.1577	212.4469	242.6526	(64)
								Total per year (kWh/year) = Sum(64)m =				1732.5336	(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	106.9734	95.0894	100.9935	86.8251	80.8664	73.8409	73.6729	76.6809	81.8070	92.7408	97.1521	106.1134	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	145.9081	145.9081	145.9081	145.9081	145.9081	145.9081	145.9081	145.9081	145.9081	145.9081	145.9081	145.9081	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	24.7259	21.9613	17.8601	13.5213	10.1073	8.5330	9.2202	11.9848	16.0860	20.4248	23.8388	25.4131	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	322.4837	325.8301	317.3973	299.4450	276.7834	255.4847	241.2559	237.9095	246.3423	264.2946	286.9562	308.2549	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	52.0226	52.0226	52.0226	52.0226	52.0226	52.0226	52.0226	52.0226	52.0226	52.0226	52.0226	52.0226	(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)													

	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	-97.2720	(71)
Water heating gains (Table 5)													
	143.7814	141.5021	135.7439	120.5904	108.6914	102.5567	99.0228	103.0657	113.6208	124.6516	134.9335	142.6256	(72)
Total internal gains													
	591.6496	589.9520	571.6600	534.2153	496.2408	467.2331	450.1575	453.6187	476.7076	510.0296	546.3871	576.9521	(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	7.4800	12.7650	0.6300	0.7000	0.7700	29.1807	(74)
South	12.8900	54.2217	0.6300	0.7000	0.7700	213.5984	(78)
East	4.0600	31.9987	0.6300	0.7000	1.0000	51.5631	(82)

Solar gains	294.3422	444.4478	622.1894	816.8042	923.0272	984.2344	933.3910	852.5936	729.9828	532.4200	348.5537	252.5548	(83)
Total gains	885.9917	1034.3998	1193.8494	1351.0196	1419.2679	1451.4675	1383.5485	1306.2122	1206.6904	1042.4496	894.9407	829.5070	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	40.6986	40.8335	40.8335	41.0254	40.9629	41.2610	41.2610	41.3162	41.2610	41.0254	41.0865	40.8989	
alpha	3.7132	3.7222	3.7222	3.7350	3.7309	3.7507	3.7507	3.7544	3.7507	3.7350	3.7391	3.7266	
util living area													
	0.9356	0.8940	0.8119	0.6722	0.5065	0.3275	0.2198	0.2394	0.4457	0.7190	0.8884	0.9459	(86)
Living	20.0385	20.2465	20.5170	20.7529	20.8705	20.9109	20.9167	20.9163	20.8956	20.7396	20.3691	19.9883	
Non living	18.8424	19.0964	19.4138	19.6763	19.7897	19.8283	19.8313	19.8326	19.8188	19.6711	19.2554	18.7851	
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	20.5081	20.2465	20.5170	20.7529	20.8705	20.9109	20.9167	20.9163	20.8956	20.7396	20.3691	20.1299	(87)
Th 2	19.9240	19.9272	19.9272	19.9316	19.9302	19.9371	19.9371	19.9383	19.9371	19.9316	19.9331	19.9287	(88)
util rest of house													
	0.9225	0.8742	0.7801	0.6254	0.4469	0.2621	0.1493	0.1650	0.3719	0.6650	0.8639	0.9345	(89)
MIT 2	19.4928	19.0964	19.4138	19.6763	19.7897	19.8283	19.8313	19.8326	19.8188	19.6711	19.2554	18.9912	(90)
Living area fraction										fLA = Living area / (4) =		0.3515	(91)
MIT	19.8497	19.5007	19.8016	20.0547	20.1696	20.2089	20.2129	20.2136	20.1973	20.0467	19.6469	19.3914	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.8497	19.5007	19.8016	20.0547	20.1696	20.2089	20.2129	20.2136	20.1973	20.0467	19.6469	19.3914	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9214	0.8652	0.7761	0.6311	0.4606	0.2790	0.1677	0.1844	0.3904	0.6712	0.8563	0.9278	(94)
Useful gains	816.3941	894.9414	926.5055	852.5968	653.6514	404.9216	231.9734	240.8488	471.0366	699.7149	766.3811	769.5837	(95)
Ext temp.	5.1000	5.7000	7.4000	9.9000	12.9000	15.8000	17.7000	17.6000	15.0000	11.5000	8.0000	5.1000	(96)
Heat loss rate W													
	1381.8530	1288.6688	1158.0244	943.7834	676.6747	407.4248	232.2127	241.1951	480.2816	794.3341	1080.8566	1332.3598	(97)
Space heating kWh													
	420.7014	264.5848	172.2501	65.6544	17.1293	0.0000	0.0000	0.0000	0.0000	70.3967	226.4224	418.7054	(98a)
Space heating requirement - total per year (kWh/year)												1655.8445	
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													
	420.7014	264.5848	172.2501	65.6544	17.1293	0.0000	0.0000	0.0000	0.0000	70.3967	226.4224	418.7054	(98c)
Space heating requirement after solar contribution - total per year (kWh/year)												1655.8445	
Space heating per m2											(98c) / (4) =	21.1205	(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 %)	353.8927	(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													
	420.7014	264.5848	172.2501	65.6544	17.1293	0.0000	0.0000	0.0000	0.0000	70.3967	226.4224	418.7054	(98)
Space heating efficiency (main heating system 1)													
	353.8927	353.8927	353.8927	353.8927	353.8927	0.0000	0.0000	0.0000	0.0000	353.8927	353.8927	353.8927	(210)
Space heating fuel (main heating system)													
	118.8782	74.7641	48.6730	18.5521	4.8403	0.0000	0.0000	0.0000	0.0000	19.8921	63.9805	118.3142	(211)
Space heating efficiency (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(212)

Space heating fuel (main heating system 2)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(213)
Space heating fuel (secondary)													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	244.1105	197.3272	166.9952	111.2115	78.2937	61.8244	61.3277	77.7897	112.3964	166.1577	212.4469	242.6526	(64)
Efficiency of water heater												190.0169	(216)
(217)m	190.0169	190.0169	190.0169	190.0169	190.0169	190.0169	190.0169	190.0169	190.0169	190.0169	190.0169	190.0169	(217)
Fuel for water heating, kWh/month													
	128.4678	103.8472	87.8844	58.5272	41.2036	32.5362	32.2749	40.9383	59.1507	87.4437	111.8042	127.7006	(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	21.6424	17.3623	15.6329	11.4533	8.8469	7.2280	8.0704	10.4902	13.6258	17.8777	20.1928	22.2439	(232)
Electricity generated by PVs (Appendix M) (negative quantity)													
(233a)m	-42.7422	-55.5938	-80.4620	-90.3731	-94.1999	-89.3689	-87.8028	-84.6214	-76.8162	-65.9312	-46.4862	-36.8739	(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	467.8944	(211)
Space heating fuel - main system 2	0.0000	(213)
Space heating fuel - secondary	0.0000	(215)
Efficiency of water heater	190.0169	
Water heating fuel used	911.7788	(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)	174.6666	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV generation	-851.2715	(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	783.0682	(238)

10a. Fuel costs - using BEDF prices (511)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	467.8944	18.3900	86.0458	(240)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	911.7788	18.3900	167.6761	(247)
Energy for instantaneous electric shower(s)	0.0000	18.3900	0.0000	(247a)
Pumps, fans and electric keep-hot	0.0000	0.0000	0.0000	(249)
Pump for solar water heating	80.0000	18.3900	14.7120	(249)
Energy for lighting	174.6666	18.3900	32.1212	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-851.2715	18.3900	-156.5488	
PV Unit electricity exported	0.0000	5.8100	0.0000	
Total			-156.5488	(252)
Total energy cost			144.0062	(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	467.8944	0.1576	73.7298	(261)
Total CO2 associated with community systems			0.0000	(373)
Water heating (other fuel)	911.7788	0.1466	133.6887	(264)
Space and water heating			207.4185	(265)
Pumps, fans and electric keep-hot	80.0000	0.1387	11.0970	(267)
Energy for lighting	174.6666	0.1443	25.2098	(268)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-851.2715	0.1349	-114.8465	
PV Unit electricity exported	0.0000	0.0000	0.0000	

Total	-114.8465	(269)
Total CO2, kg/year	128.8788	(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	467.8944	1.5833	740.8188	(275)
Total CO2 associated with community systems			0.0000	(473)
Water heating (other fuel)	911.7788	1.5424	1406.3386	(278)
Space and water heating			2147.1574	(279)
Pumps, fans and electric keep-hot	80.0000	1.5128	121.0240	(281)
Energy for lighting	174.6666	1.5338	267.9094	(282)
Energy saving/generation technologies				
PV Unit electricity used in dwelling	-851.2715	1.4986	-1275.7354	
PV Unit electricity exported	0.0000	0.0000	0.0000	
Total			-1275.7354	(283)
Total Primary energy kWh/year			1260.3554	(286)