SAP 2012 WORKSHEET (Version 9.94, September 2019) CALCULATION OF ENERGY RATINGS 04 Dec 2020

Calculated by Lambda Calculation Engine SAP Engine version v94.0.1.1 RRN: 9029-0268-0760-9434-3894

1. Overall dwelling dimensions

Ground floor(main)	40.39	2.83	114.3037 (1b)-	(3b)
First floor(main)	22.26	2.97	66.1122 (1c)-	(3c)
Room(s)-in-roof	22.17	2.45	54.3165	
Ground floor (extension 1)	28.45	2.76	78.522 (1b)-	(3b)
First floor (extension 1)	19.61	2.9	56.869 (1c)-	(3c)
Ground floor (extension 2)	21.69	2.3	49.887 (1b)-	(3b)

Total floor area 154.5700 (4)
Dwelling volume (m³) 420.0104 (5)

2. Ventilation rate

Number of chimneys 40 (6a) Number of open flues 0 (6b)
Number of intermittent fans 0 (7a) Number of passive vents 0
(7b) Number of flueless gas fires 0 (7c)

ach

Infiltration due to chimneys, flues and fans 0.0952 (8)
Number of storeys 3 (9) Additional infiltration 0.2000 (10)
Structural infiltration 0.3500 (11)
Floor infiltration 0.0000 (12)
0.05 if no draught lobby 0.0500 (13)
% of windows and doors draught proofed 71 (14) Window infiltration 0.1080 (15)
Infiltration rate 0.8032 (18)
Number of sides sheltered 2 (19) Shelter factor 0.8500 (20)
Infiltration rate incorporating shelter factor 0.6828 (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	0.8705	0.8534	0.8364	0.7510	0.7340	0.6486	0.6486	0.6315	0.6828	0.7340	0.7681		0.8022	(22b)
Effective ach	0.8789	0.8642	0.8498	0.7820	0.7693	0.7103	0.7103	0.6994	0.7331	0.7693	0.7950		0.8218	(25)

3. Heat losses and heat loss parameter

Element	Net U-value	A x U	K-value	A xK	
(Main) Doors	3.7000	3.0000	11.1000		(26)
Windows(1)	4.0900	4.0268	16.4698		(27)
Windows(2)	10.0300	2.7580	27.6628		(27)
Ground Floor	40.3900	0.5300	21.4067		(28a)
Walls	36.0100	2.0400	73.4604		(29a)
Roof	18.2200	0.2100	3.8262		(30)
Roofroom flat ceiling	22.1700	0.2100	4.6557		(30a)
Roofroom walls	42.2900	0.3000	12.6870		(30e)
Element (extension 1)					
Windows(1)	2.3200	4.0268	9.3423		(27)
Windows(2)	5.6800	2.7580	15.6655		(27)
Ground Floor	28.4500	0.3900	11.0955		(28a)
Walls	40.4000	2.0000	80.8000		(29a)
Alternative wall	0.0000	0.0000	0.0000		(29b)
Roof	28.4500	0.2100	5.9745		(30)
Element (extension 2)					
Windows(1)	1.0500	4.0268	4.2282		(27)
Windows(2)	2.5600	2.7580	7.0605		(27)
Ground Floor	21.6900	0.8600	18.6534		(28a)
Walls	33.5600	0.6000	20.1360		(29a)
Roof	21.6900	0.2100	4.5549		(30)

Total area of elements (whole dwelling) 362.7500 (31)
Party wall (main) 36.9800 0.2500 ..... 9.2450 (32)
Party wall (extn 1) 43.3100 0.2500 ..... 10.8275 (32)
Fabric heat loss 368.8519 (33)
Thermal mass parameter 250.0000 (35)
Thermal bridges (0.15 × total area) 54.4125 (36)
Total fabric heat loss 423.2644 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Vent loss	121.8173	119.7781	117.7792	108.3906	106.6340	98.4569	98.4569	96.9426	101.6066	106.6340	110.1876		113.9026	(38)
Heat transfer coeff	545.0817	543.0424	541.0436	531.6550	529.8984	521.7212	521.7212	520.2069	524.8709	529.8984	533.4519		537.1670	(39)
Heat transfer coeff (average)													531.6465	(39)
HLP	3.5264	3.5132	3.5003	3.4396	3.4282	3.3753	3.3753	3.3655	3.3957	3.4282	3.4512		3.4752	(40)
HLP (average)													3.4395	(40)
Days in month	31.0000	28.0000	31.0000	30.0000	31.0000	30.0000	31.0000	31.0000	30.0000	31.0000	30.0000		31.0000	(41)

4. Water heating energy requirements

Assumed occupancy 2.9411 (42)
Average daily hot water use (litres/day) 109.5277 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Daily hot water use	120.4805	116.0994	111.7183	107.3371	102.9560	98.5749	98.5749	102.9560	107.3371	111.7183	116.0994		120.4805	(44)
Energy content	178.6691	156.2651	161.2516	140.5830	134.8928	116.4022	107.8638	123.7752	125.2535	145.9709	159.3386		173.0314	(45)
Energy content(annual)													1723.2972	(45)
Distribution loss	26.8004	23.4398	24.1877	21.0875	20.2339	17.4603	16.1796	18.5663	18.7880	21.8956	23.9008		25.9547	(46)
Cylinder volume													0.0000	(47)
Energy lost from cylinder in kWh/day													0.0000	(55)
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)
Net 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	(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	39.5080	35.6540	39.4035	38.0396	39.2453	37.8846	39.0739	39.1786	37.9476	39.3118	38.1521		39.4742	(61)
Total	218.1770	191.9190	200.6551	178.6226	174.1381	154.2868	146.9377	162.9539	163.2011	185.2827	197.4908		212.5056	(62)
WW heat rec.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	(G10)
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	(63)
Solar input(sum of months)													0.0000	(63)
Flue gas heat rec.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	(G6)
Fghrs PV	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	
Output from w/h	218.1770	191.9190	200.6551	178.6226	174.1381	154.2868	146.9377	162.9539	163.2011	185.2827	197.4908		212.5056	(64)
Output from water heater(annual)													2186.1703	(64)
Heat gains (kWh)	69.2845	60.8716	63.4670	56.2538	54.6632	48.1749	45.6332	50.9499	51.1337	58.3633	62.5181		67.4015	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Metabolic	176.4665	176.4665	176.4665	176.4665	176.4665	176.4665	176.4665	176.4665	176.4665	176.4665	176.4665		176.4665	(66)
Lighting	87.0526	77.3194	62.8803	47.6044	35.5849	30.0423	32.4617	42.1950	56.6340	71.9099	83.9294		89.4721	(67)
Appliances	485.7473	490.7878	478.0858	451.0448	416.9103	384.8288	363.3963	358.3558	371.0578	398.0988	432.2332		464.3148	(68)
Cooking	55.5878	55.5878	55.5878	55.5878	55.5878	55.5878	55.5878	55.5878	55.5878	55.5878	55.5878		55.5878	(69)
Pumps, fans	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000		10.0000	(70)
Losses	-117.6443	-117.6443	-117.6443	-117.6443	-117.6443	-117.6443	-117.6443	-117.6443	-117.6443	-117.6443	-117.6443		117.6443	(71)
Water heating	93.1243	90.5828	85.3051	78.1302	73.4720	66.9095	61.3349	68.4811	71.0190	78.4453	86.8307		90.5934	(72)
Total internal	790.3341	783.0999	750.6812	701.1894	650.3771	606.1905	581.6029	593.4417	623.1207	672.8638	727.4033		768.7902	(73)

6. Solar gains

(calculation for January)

Orientation	Area	Gains[W]		
East/West(1)(main)	4.0900	33.1223	(76)	
East/West(2)(main)	10.0300	72.6262	(76)	
East/West(1)(extn 1)	2.3200	18.7882	(76)	
East/West(2)(extn 1)	5.6800	41.1283	(76)	
East/West(1)(extn 2)	1.0500	8.5033	(76)	
East/West(2)(extn 2)	2.5600	18.5367	(76)	
	total:	192.7050		(83-1)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Solar gains	192.7050	376.9718	620.8188	905.4272	1109.6351	1135.9089	1081.4316	928.9338	722.0380	447.3088	240.2804		158.4712	(83)
Total gains	983.0390	1160.0716	1371.5000	1606.6166	1760.0122	1742.0994	1663.0345	1522.3755	1345.1587	1120.1726	967.6838		927.2614	(84)

7. Mean internal temperature

Living room temperature during heating periods Th1 ..... 21.0000 (85)
Heating system responsiveness 1.0000

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
tau	19.6925	19.7665	19.8395	20.1898	20.2568	20.5743	20.5743	20.6342	20.4508	20.2568			20.1218	19.9827
alpha	2.3128	2.3178	2.3226	2.3460	2.3505	2.3716	2.3716	2.3756	2.3634	2.3505	2.3415		2.3322	
external 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	
util living area	0.9948	0.9920	0.9856	0.9708	0.9410	0.8849	0.8064	0.8413	0.9373	0.9811	0.9926		0.9955	(86)
MIT 1	17.5546	17.7751	18.2373	18.9104	19.5950	20.2229	20.5873	20.5185	19.9820	19.1055	18.2366		17.5422	(87)

th2	(88)	util rest	0.9926	0.9885	0.9786	0.9539	0.8969	0.7619	0.5249	0.5948	0.8643	0.9670	0.9887	0.9937 (89)

MIT 2	15.6392	15.8618	16.3247	17.0045	17.6701	18.2515	18.5062	18.4798	18.0559	17.2071	16.3379		15.6387 (90)
Living area fraction =.....													0.1800 (91)
MIT	15.9839	16.2062	16.6689	17.3475	18.0166	18.6063	18.8807	18.8467	18.4026	17.5487	16.6796		15.9813 (92)
Temperature adjustment	0.0000												
adjusted MIT	15.9839	16.2062	16.6689	17.3475	18.0166	18.6063	18.8807	18.8467	18.4026	17.5487	16.6796		15.9813 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation	0.9887	0.9829	0.9699	0.9405	0.8816	0.7644	0.5795	0.6386	0.8559	0.9568	0.9835		0.9903	(94)
Useful gains W	971.9770	1140.2117	1330.2217	1511.0220	1551.6177	1331.6863	963.7145	972.1728	1151.3693	1071.7392	951.6865		918.2695	(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	6368.6923	6139.7442	5501.8281	4491.1524	3347.1331	2090.1765	1189.9132	1272.8053	2258.3049	3682.1305	5110.2508		6328.5049	(97)
Month fraction	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000		1.0000	(97a)
Space heating kWh	4015.1562	3359.6858	3103.6752	2145.6939	1335.8635	0.0000	0.0000	0.0000	0.0000	1942.1311	2994.1663		4025.2152	(98)
Space heating													22921.5871	(98)
Space heating per m2													148.2926	(99)

8c. Space cooling requirement

- not applicable

9. Energy requirements

Fraction of space heat from secondary	0.1000	(201)
Fraction of space heat from main system	0.9000	(202)
Fraction of total space heat from main system 1	0.9000	(204)
Efficiency of main heating system 1	90.0000	(206)
Efficiency of secondary heating system.....	32.0000	(208)
Space heating requirement	22921.5871	(211)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Space heating requirement
4015.1562	3359.6858	3103.6752	2145.6939	1335.8635	0.0000	0.0000	0.0000	0.0000	1942.1311	2994.1663	4025.2152	(98)

Space heating efficiency (main heating system)

90.0000 90.0000 90.0000 90.0000 90.0000 0.0000 0.0000 0.0000 0.0000 90.0000 90.0000 90.0000 (210) Space heating fuel (main heating system)
4015.1562 3359.6858 3103.6752 2145.6939 1335.8635 0.0000 0.0000 0.0000 0.0000 1942.1311 2994.1663 4025.2152 (211) Space heating fuel (secondary)
1254.7363 1049.9018 969.8985 670.5293 417.4573 0.0000 0.0000 0.0000 0.0000 606.9160 935.6770 1257.8797 (215) Water heating requirement
218.1770 191.9190 200.6551 178.6226 174.1381 154.2868 146.9377 162.9539 163.2011 185.2827 197.4908 212.5056 (64) Efficiency of water heater 89.8054 (216)
89.8054 89.7960 89.7710 89.7109 89.5687 86.7000 86.7000 86.7000 86.7000 89.6729 89.7667 89.8106 (217) Water heating fuel
242.9443 213.7278 223.5188 199.1092 194.4185 177.9547 169.4783 187.9514 188.2366 206.6207 220.0045 236.6153 (219) Space cooling fuel 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)

Annual totals: kWh/year

Space heating fuel - main system	22921.5871	(211)
Space heating fuel - secondary	7162.9960	(215)
Water heating fuel	2460.5801	(219)
central heating pump	120.0000	(230c)
boiler flue fan	45.0000	(230e)
Electricity for pumps and fans	165.0000	(231)
Electricity for lighting	614.9505	(232)
Total delivered energy for all uses	33325.1136	(238)

10. Fuel costs

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year		
Space heating - main system	22921.5871	3.4800		797.6712	(240)
Space heating - secondary	7162.9960	3.9900		285.8035	(242)
Water heating	2460.5801	3.4800		85.6282	(247)
Pumps and fans for heating	0.0000	165.0000		21.7635	(249)
Electricity for lighting	614.9505	13.1900		81.1120	(250)
Additional standing charges				120.0000	(251)
Total energy cost				1391.9784	(255)

11. SAP rating

Energy cost deflator	0.4200	(256)
Energy cost factor (ECF)	2.9295	(257)

SAP value 59.1341
SAP rating 59 (258) SAP BAND D

12. Carbon dioxide emissions

	Energy kWh/year	Emission factor	Emissions kg/year		
Space heating - main system	22921.5871	0.2160		4951.0628	(261)
Space heating - secondary	7162.9960	0.2260		1618.8371	(263)
Water heating	2460.5801	0.2160		531.4853	(264)
Space and water heating				7101.3852	(265)
Pumps and fans	0.5190	165.0000		85.6350	(267)
Energy for lighting	614.9505	0.5190		319.1593	(268)
Total kg/year				7506.1795	(272)

kg/m2/year

CO2 emissions per m2 48.56 (273)
EI value 50.3442
EI rating 50 (274) EI band E

SAP 2012 WORKSHEET (Version 9.94, September 2019)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 04 Dec 2020

Calculated by Lambda Calculation Engine SAP Engine version v94.0.1.1 RRN: 9029-0268-

0760-9434-3894

1. Overall dwelling dimensions

Ground floor(main)	40.39	2.83	114.3037	(1b)-	(3b)
First floor(main)	22.26	2.97	66.1122	(1c)-	(3c)
Room(s)-in-roof	22.17		2.45	54.3165	
Ground floor (extension 1)	28.45	2.76	78.522	(1b)-	(3b)
First floor (extension 1)	19.61	2.9	56.869	(1c)-	(3c)
Ground floor (extension 2)	21.69	2.3	49.887	(1b)-	(3b)

Total floor area	154.5700	(4)
Dwelling volume (m³)	420.0104	(5)

2. Ventilation rate

Number of chimneys	40	(6a) Number of open flues	0 (6b)
Number of intermittent fans	0	(7a) Number of passive vents	0
(7b) Number of flueless gas fires 0 (7c)			

ach

Infiltration due to chimneys, flues and fans	0.0952	(8)
Number of storeys	3	(9)

Additional infiltration												0.2000	(10)
Structural infiltration												0.3500	(11)
Floor infiltration												0.0000	(12)
0.05 if no draught lobby												0.0500	(13)
% of windows and doors draught proofed											71	(14) Window infiltration 0.1080	(15)
Infiltration rate												0.8032	(18)
Number of sides sheltered											2	(19) Shelter factor 0.8500	(20)
Infiltration rate incorporating shelter factor												0.6828	(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	0.8705	0.8534	0.8364	0.7510	0.7340	0.6486	0.6486	0.6315	0.6828	0.7340	0.7681		0.8022	(22b)
Effective ach	0.8789	0.8642	0.8498	0.7820	0.7693	0.7103	0.7103	0.6994	0.7331	0.7693	0.7950		0.8218	(25)

3. Heat losses and heat loss parameter

Element	Net U-value	A x U	K-value	A xK	
Element		(Main) Doors	3.7000	3.0000	11.1000 (26)
Windows	10.0300	2.7580			27.6628 (27)
Windows	4.0900	1.5038			6.1504 (27)
Ground Floor	40.3900	0.2500			10.0975 (28a)
Walls	36.0100	0.3000			10.8030 (29a)
Roof	18.2200	0.2100			3.8262 (30)
Roofroom flat ceiling	22.1700	0.2100			4.6557 (30a)
Roofroom walls	42.2900	0.3000			12.6870 (30e)
Element (extension 1)					
Windows	5.6800	2.7580			15.6655 (27)
Windows	2.3200	1.5038			3.4887 (27)
Ground Floor	28.4500	0.2500			7.1125 (28a)
Walls	40.4000	0.3000			12.1200 (29a)
Alternative wall	0.0000	0.0000			0.0000 (29b)
Roof	28.4500	0.2100			5.9745 (30)
Element (extension 2)					
Windows	2.5600	2.7580			7.0605 (27)
Windows	1.0500	1.5038			1.5789 (27)
Ground Floor	21.6900	0.2500			5.4225 (28a)
Walls	33.5600	0.6000			20.1360 (29a)
Roof	21.6900	0.2100			4.5549 (30)

Total area of elements (whole dwelling)	362.7500		(31)
Party wall (main)	36.9800	0.2500	9.2450 (32)
Party wall (extn 1)	43.3100	0.2500	10.8275 (32)
Fabric heat loss			190.1691 (33)
Thermal mass parameter			250.0000 (35)
Thermal bridges (0.15 × total area)			54.4125 (36)
Total fabric heat loss			244.5816 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Vent loss	121.8173	119.7781	117.7792	108.3906	106.6340	98.4569	98.4569	96.9426	101.6066	106.6340	110.1876		113.9026	(38)
Heat transfer coeff	366.3989	364.3597	362.3608	352.9722	351.2157	343.0385	343.0385	341.5242	346.1882	351.2157	354.7692		358.4843	(39)
Heat transfer coeff (average)													352.9638	(39)
HLP	2.3704	2.3572	2.3443	2.2836	2.2722	2.2193	2.2193	2.2095	2.2397	2.2722	2.2952		2.3192	(40)
HLP (average)													2.2835	(40)
Days in month	31.0000	28.0000	31.0000	30.0000	31.0000	30.0000	31.0000	31.0000	30.0000	31.0000	30.0000		31.0000	(41)

4. Water heating energy requirements

Assumed occupancy			2.9411 (42)
Average daily hot water use (litres/day)			109.5277 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Daily hot water use	120.4805	116.0994	111.7183	107.3371	102.9560	98.5749	98.5749	102.9560	107.3371	111.7183	116.0994		120.4805	(44)
Energy content	178.6691	156.2651	161.2516	140.5830	134.8928	116.4022	107.8638	123.7752	125.2535	145.9709	159.3386		173.0314	(45)
Energy content(annual)													1723.2972	(45)
Distribution loss	26.8004	23.4398	24.1877	21.0875	20.2339	17.4603	16.1796	18.5663	18.7880	21.8956	23.9008		25.9547	(46)
Cylinder volume													0.0000	(47)
Energy lost from cylinder in kWh/day													0.0000	(55)
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)
Net 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	(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	39.5080	35.6540	39.4035	38.0396	39.2453	37.8846	39.0739	39.1786	37.9476	39.3118	38.1521		39.4742	(61)
Total	218.1770	191.9190	200.6551	178.6226	174.1381	154.2868	146.9377	162.9539	163.2011	185.2827	197.4908		212.5056	(62)
WW heat rec.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	(G10)
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	(63)
Solar input(sum of months)													0.0000	(63)
Flue gas heat rec.	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	(G6)
Fghrs PV	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000		0.0000	
Output from w/h	218.1770	191.9190	200.6551	178.6226	174.1381	154.2868	146.9377	162.9539	163.2011	185.2827	197.4908		212.5056	(64)
Output from water heater(annual)													2186.1703	(64)
Heat gains (kWh)	69.2845	60.8716	63.4670	56.2538	54.6632	48.1749	45.6332	50.9499	51.1337	58.3633	62.5181		67.4015	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Metabolic	176.4665	176.4665	176.4665	176.4665	176.4665	176.4665	176.4665	176.4665	176.4665	176.4665	176.4665		176.4665	(66)
Lighting	87.6173	77.8209	63.2882	47.9133	35.8157	30.2371	32.6723	42.4687	57.0014	72.3764	84.4739		90.0525	(67)
Appliances	485.7473	490.7878	478.0858	451.0448	416.9103	384.8288	363.3963	358.3558	371.0578	398.0988	432.2332		464.3148	(68)
Cooking	55.5878	55.5878	55.5878	55.5878	55.5878	55.5878	55.5878	55.5878	55.5878	55.5878	55.5878		55.5878	(69)
Pumps, fans	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000	10.0000		10.0000	(70)
Losses	-117.6443	-117.6443	-117.6443	-117.6443	-117.6443	-117.6443	-117.6443	-117.6443	-117.6443	-117.6443	-117.6443		117.6443	(71)
Water heating	93.1243	90.5828	85.3051	78.1302	73.4720	66.9095	61.3349	68.4811	71.0190	78.4453	86.8307		90.5934	(72)
Total internal	790.8988	783.6014	751.0891	701.4982	650.6080	606.3854	581.8134	593.7155	623.4881	673.3303	727.9478		769.3706	(73)

6. Solar gains

(calculation for January)

Orientation	Area	Gains[W]		
East	4.0900	24.5495	(76)	
East	10.0300	72.6262	(76)	
East	2.3200	13.9254	(76)	
East	5.6800	41.1283	(76)	
East	1.0500	6.3024	(76)	
East	2.5600	18.5367	(76)	
	total:	177.0685		(83-1)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Solar gains	177.0684	346.3834	570.4442	831.9588	1019.5968	1043.7387	993.6818	853.5580	663.4502	411.0131	220.7835		145.6125	(83)
Total gains	967.9672	1129.9848	1321.5333	1533.4570	1670.2047	1650.1241	1575.4952	1447.2734	1286.9383	1084.3434	948.7313		914.9831	(84)

7. Mean internal temperature

Living room temperature during heating periods Th1 ..... 21.0000 (85)
Heating system responsiveness 1.0000

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
tau	29.2960	29.4600	29.6225	30.4104	30.5625	31.2910	31.2910	31.4298	31.0063	30.5625			30.2564	29.9428
alpha	2.9531	2.9640	2.9748	3.0274	3.0375	3.0861	3.0861	3.0953	3.0671	3.0375	3.0171		2.9962	
external 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	
util living area	0.9964	0.9939	0.9876	0.9707	0.9317	0.8506	0.7388	0.7859	0.9247	0.9823	0.9944		0.9970	(86)
MIT 1	18.4378	18.6376	19.0293	19.5987	20.1373	20.5973	20.8244	20.7792	20.3923	19.6947	18.9952		18.4402	(87)
th2												(88)		
util rest	0.9949	0.9914	0.9821	0.9558	0.8897	0.7374	0.5177	0.5842	0.8568	0.9706	0.9917		0.9958	(89)
MIT 2	16.8813	17.0857	17.4804	18.0669	18.5863	19.0090	19.1539	19.1414	18.8460	18.1727	17.4687		16.9046	(90)
Living area fraction =													0.1800	(91)
MIT	17.1615	17.3650	17.7592	18.3426	18.8654	19.2949	19.4545	19.4362	19.1244	18.4466	17.7435		17.1810	(92)
Temperature adjustment	0.0000													
adjusted MIT	17.1615	17.3650	17.7592	18.3426	18.8654	19.2949	19.4545	19.4362	19.1244	18.4466	17.7435		17.1810	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Utilisation	0.9926	0.9878	0.9761	0.9462	0.8803	0.7460	0.5583	0.6193	0.8538	0.9635	0.9884		0.9938	(94)
Useful gains W	960.7736	1116.1849	1289.9370	1450.8961	1470.3133	1231.0171	879.5224	896.2747	1098.8157	1044.7401	937.6839		909.3521	(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	4712.4282	4541.7556	4079.8927	3332.9638	2516.6069	1610.5156	979.2136	1036.9211	1739.3712	2755.8514	3775.9721		4653.4763	(97)
Month fraction	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000		1.0000	(97a)
Space heating kWh	2791.2310	2301.9835	2075.7271	1355.0888	778.4424	0.0000	0.0000	0.0000	0.0000	1273.0668	2043.5675		2785.6284	(98)
Space heating													15404.7355	(98)
Space heating per m2													99.6619	(99)

8c. Space cooling requirement

- not applicable

9. Energy requirements

Fraction of space heat from secondary	0.1000	(201)
Fraction of space heat from main system	0.9000	(202)
Fraction of total space heat from main system 1	0.9000	(204)
Efficiency of main heating system 1	90.0000	(206)
Efficiency of secondary heating system	32.0000	(208)
Space heating requirement	15404.7355	(211)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
2791.2310	2301.9835	2075.7271	1355.0888	778.4424	0.0000	0.0000	0.0000	0.0000	1273.0668	2043.5675	2785.6284	(98)	Space heating efficiency (main heating system)
90.0000	90.0000	90.0000	90.0000	90.0000	0.0000	0.0000	0.0000	0.0000	90.0000	90.0000	90.0000	(210)	Space heating fuel (main heating system)
2791.2310	2301.9835	2075.7271	1355.0888	778.4424	0.0000	0.0000	0.0000	0.0000	1273.0668	2043.5675	2785.6284	(211)	Space heating fuel (secondary)
872.2597	719.3699	648.6647	423.4652	243.2633	0.0000	0.0000	0.0000	0.0000	397.8334	638.6149	870.5089	(215)	Water heating requirement
218.1770	191.9190	200.6551	178.6226	174.1381	154.2868	146.9377	162.9539	163.2011	185.2827	197.4908	212.5056	(64)	Efficiency of water heater 89.7271 (216)
89.7271	89.7105	89.6690	89.5645	89.3232	86.7000	86.7000	86.7000	86.7000	89.5257	89.6691	89.7331	(217)	Water heating fuel
243.1563	213.9315	223.7731	199.4347	194.9529	177.9547	169.4783	187.9514	188.2366	206.9604	220.2441	236.8196	(219)	Space cooling fuel 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)

Annual totals: kWh/year

Space heating fuel - main system	15404.7355	(211)
Space heating fuel - secondary	4813.9798	(215)
Water heating fuel	2462.8935	(219)
central heating pump	120.0000	(230c)
boiler flue fan	45.0000	(230e)
Electricity for pumps and fans	165.0000	(231)
Electricity for lighting	618.9397	(232)
PV generation	1727.2394	(233)
Total delivered energy for all uses	21738.3091	(238)

10. Fuel costs

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year		
Space heating - main system	15404.7355	3.4800	536.0848		(240)
Space heating - secondary	4813.9798	3.9900	192.0778		(242)
Water heating	2462.8935	3.4800	85.7087		(247)
Pumps and fans for heating	0.0000	165.0000	21.7635		(249)
Electricity for lighting	618.9397	13.1900	81.6381		(250)
Additional standing charges			120.0000		(251)
Electricity generated - PVs	-1727.2394	13.1900	227.8229		(252)
Total energy cost			809.4501		(255)

11. SAP rating

Energy cost deflator	0.4200	(256)
Energy cost factor (ECF)	1.7035	(257)

SAP value 76.2361
SAP rating 76 (258) SAP BAND C

12. Carbon dioxide emissions

	Energy kWh/year	Emission factor	Emissions kg/year		
Space heating - main system	15404.7355	0.2160		3327.4229	(261)
Space heating - secondary	4813.9798	0.2260		1087.9594	(263)
Water heating	2462.8935	0.2160		531.9850	(264)
Space and water heating				4947.3673	(265)
Pumps and fans	0.5190	165.0000		85.6350	(267)
Energy for lighting	618.9397	0.5190		321.2297	(268)
Electricity generated - PVs	-1727.2394	0.5190		896.4372	(269)
Total kg/year				4457.7947	(272)

	kg/m2/year	
CO2 emissions per m2	28.84	(273)

EI value 70.0684
EI rating 70 (274) EI band C