SAP 2012 WORKSHEET (Version 9.94, September 2019) CALCULATION OF
ENERGY RATINGS 03 Dec 2020

Calculated by Lambda Calculation Engine SAP Engine version v94.0.1.1 RRN: 9023-3274-

9850-9744-9264

1. Overall dwelling dimensions

Ground floor(main)	37.07	2.14	79.3298	(1b)-	(3b)
First floor(main)	32.29	2.74	88.4746	(1c)-	(3c)

Total floor area 69.3600 (4)
Dwelling volume (m³) 167.8044 (5)

2. Ventilation rate

Number of chimneys	0	(6a) Number of open flues	20	(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 0.1192 (8)
Number of storeys 2 (9) Additional infiltration 0.1000 (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 12 (14) Window infiltration 0.2260 (15)
Infiltration rate.. 0.8452 (18)
Number of sides sheltered 2 (19) Shelter factor 0.8500 (20)
Infiltration rate incorporating shelter factor 0.7184 (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	0.9160	0.8980	0.8801	0.7902	0.7723	0.6825	0.6825	0.6645	0.7184	0.7723	0.8082	0.8441	(22b)
Effective ach	0.9195	0.9032	0.8872	0.8122	0.7982	0.7329	0.7329	0.7208	0.7581	0.7982	0.8266	0.8563	(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(1)	13.5000	4.0268	54.3624		(27)	
Windows(2)	1.8400	2.1898	4.0292		(27)	
Ground Floor	37.0700	0.4700	17.4229		(28a)	
Walls	41.8700	2.0200	84.5774		(29a)	
Roof	42.8000	2.3000	98.4400		(30)	

Total area of elements (whole dwelling) 140.7800 (31)
Party wall (main) 48.7000 0.2500 .... 12.1750 (32)
Fabric heat loss 282.1069 (33)
Thermal mass parameter... 250.0000 (35)
Thermal bridges (0.15 × total area) 21.1170 (36)
Total fabric heat loss.. 303.2239 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Vent loss	50.9178	50.0157	49.1316	44.9785	44.2015	40.5844	40.5844	39.9145	41.9777	44.2015	45.7734	47.4168	(38)
Heat transfer coeff	354.1417	353.2397	352.3555	348.2025	347.4254	343.8083	343.8083	343.1385	345.2016	347.4254	348.9973	350.6407	(39)
Heat transfer coeff (average)											348.1987		(39)
HLP	5.1058	5.0928	5.0801	5.0202	5.0090	4.9569	4.9569	4.9472	4.9770	5.0090	5.0317	5.0554	(40)
HLP (average)											5.0202		(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 2.2305 (42)
Average daily hot water use (litres/day) 91.7622 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	100.9384	97.2679	93.5974	89.9269	86.2564	82.5860	82.5860	86.2564	89.9269	93.5974	97.2679	100.9384	(44)
Energy content	149.6887	130.9187	135.0964	117.7803	113.0130	97.5216	90.3681	103.6987	104.9372	122.2942	133.4937	144.9655	(45)
Energy content(annual)											1443.7764		(45)
Distribution loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
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	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	127.2354	111.2809	114.8319	100.1133	96.0611	82.8934	76.8129	88.1439	89.1967	103.9501	113.4697	123.2207	(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 127.2354 111.2809 114.8319 100.1133 96.0611 82.8934 76.8129 88.1439 89.1967 103.9501 113.4697 123.2207 (64)

Output from water heater(annual) 1227.2099 (64)
Heat gains (kWh) 31.8089 27.8202 28.7080 25.0283 24.0153 20.7233 19.2032 22.0360 22.2992 25.9875 28.3674..30.8052 (65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic	133.8292	133.8292	133.8292	133.8292	133.8292	133.8292	133.8292	133.8292	133.8292	133.8292	133.8292	133.8292	(66)
Lighting	43.6390	38.7598	31.5216	23.8639	17.8385	15.0600	16.2729	21.1521	28.3903	36.0480	42.0734	44.8519	(67)
Appliances	292.2369	295.2695	287.6276	271.3591	250.8230	231.5220	218.6277	215.5952	223.2371	239.5056	260.0417	279.3427	(68)
Cooking	50.6134	50.6134	50.6134	50.6134	50.6134	50.6134	50.6134	50.6134	50.6134	50.6134	50.6134	50.6134	(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	-89.2195	-89.2195	-89.2195	-89.2195	-89.2195	-89.2195	-89.2195	-89.2195	-89.2195	-89.2195	-89.2195	-89.2195	(71)
Water heating	42.7538	41.3991	38.5860	34.7615	32.2786	28.7824	25.8108	29.6183	30.9711	34.9295	39.3992	41.4048	(72)
Total internal	473.8529	470.6515	452.9584	425.2077	396.1633	370.5876	355.9346	361.5888	377.8216	405.7062	436.7374	460.8225	(73)

6. Solar gains

(calculation for January)
Orientation Area Gains[W]
East/West(1)(main) 13.5000 .... 109.3280 (76)
East/West(2)(main) 1.8400 .... 13.3232 (76)
total:.. 122.6512 (83-1)

Solar gains	122.6512	239.9318	395.1335	576.2786	706.2511	722.9737	688.3004	591.2399	459.5566	284.6993	152.9316	100.8624	(83)
Total gains	596.5042	710.5833	848.0918	1001.4863	1102.4144	1093.5613	1044.2350	952.8286	837.3782	690.4055	589.6690	561.6849	(84)

7. Mean internal temperature

Living room temperature during heating periods Th1 ....21.0000 (85)
Heating system responsiveness 0.0000

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	tau						
tau	14.0097	14.0371	13.9532	13.8639									13.6010	13.6357	13.6699	13.8329	13.8639	14.0097	

14.0097 14.0371 13.9532 13.8639 13.8014 13.7368
alpha 1.9067 1.9090 1.9113 1.9222 1.9243 1.9340 1.9340 1.9358 1.9302 1.9243 1.9201 1.9158
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 0.9887 0.9835 0.9729 0.9511 0.9131 0.8507 0.7719 0.8070 0.9096 0.9663 0.9846 0.9900 (86)
MIT 1 18.6348 18.7639 19.0383 19.4333 19.8427 20.2193 20.4439 20.4028 20.0806 19.5566 19.0355 18.6198 (87)
th2 (88) util rest 0.9840 0.9764 0.9602 0.9237 0.8494 0.6893 0.4188 0.4904 0.8043 0.9415 0.9766 0.9858 (89)
MIT 2 16.1076 16.2371 16.5105 16.9050 17.2986 17.6385 17.7865 17.7731 17.5329 17.0336 16.5149 16.0978 (90)
Living area fraction =.. 0.3000 (91)
MIT 16.8658 16.9953 17.2689 17.6635 18.0619 18.4128 18.5838 18.5621 18.2973 17.7906 17.2712 16.8545 (92)
Temperature adjustment 0.3000
adjusted MIT 17.1658 17.2953 17.5689 17.9635 18.3619 18.7128 18.8838 18.8621 18.5973 18.0906 17.5712 17.1545 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9819	0.9738	0.9571	0.9221	0.8581	0.7396	0.5623	0.6191	0.8327	0.9416	0.9746	0.9840	(94)
Useful gains W	585.7343	691.9919	811.7363	923.4827	945.9908	808.8427	587.1880	589.8643	697.2653	650.0986	574.7003	552.6895	(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	4556.3242	4378.4968	3900.1926	3155.9440	2314.5242	1414.0081	785.1818	844.8279	1552.4608	2602.4182	3654.4109	4542.3634	(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	2954.1189	2477.3312	2297.8115	1607.3721	1018.1888	0.0000	0.0000	0.0000	0.0000	1452.5258	2217.3916	2968.3174	(98)

Space heating.. 16993.0574 (98)
Space heating per m2 .... 244.9979 (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 ....60.0000 (206)
Efficiency of secondary heating system..100.0000 (208)
Space heating requirement 25489.5861 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Space heating requirement	
	2954.1189	2477.3312	2297.8115	1607.3721	1018.1888	0.0000	0.0000	0.0000	0.0000	1452.5258	2217.3916	2968.3174	(98)	Space heating efficiency (main heating system)
	60.0000	60.0000	60.0000	60.0000	60.0000	0.0000	0.0000	0.0000	0.0000	60.0000	60.0000	60.0000	(210)	Space heating fuel (main heating system)
	4431.1783	3715.9969	3446.7172	2411.0582	1527.2833	0.0000	0.0000	0.0000	0.0000	2178.7887	3326.0874	4452.4761	(211)	Space heating fuel (secondary)
	295.4119	247.7331	229.7811	160.7372	101.8189	0.0000	0.0000	0.0000	0.0000	145.2526	221.7392	296.8317	(215)	Water heating requirement
	127.2354	111.2809	114.8319	100.1133	96.0611	82.8934	76.8129	88.1439	89.1967	103.9501	113.4697	123.2207	(64)	Efficiency of water heater 100.0000 (216)
	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	(217)	Water heating fuel
	127.2354	111.2809	114.8319	100.1133	96.0611	82.8934	76.8129	88.1439	89.1967	103.9501	113.4697	123.2207	(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 25489.5861 (211)
Space heating fuel - secondary 1699.3057 (215)
Water heating fuel..1227.2099 (219)
Electricity for pumps and fans 0.0000 (231)
Electricity for lighting..308.2714 (232)
Total delivered energy for all uses..28724.3731 (238)

10. Fuel costs

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year		
Space heating - main system	25489.5861	4.2300	1078.2095	(240)
Space heating - secondary	1699.3057	15.2900	259.8238	(242)
Water heating	1227.2099	0.0000	0.0000	(247)
Water heating:				
High-rate fraction			0.9000	(243)
Low-rate fraction			0.1000	(244)
High-rate cost	1104.4889	15.2900	168.8764	(245)
Low-rate cost	122.7210	5.5000	6.7497	(246)
Pumps and fans for heating	0.0000	0.0000	0.0000	(249)
Electricity for lighting	308.2714	14.3110	44.1167	(250)
Additional standing charges			24.0000	(251)
Total energy cost			1581.7761	(255)

11. SAP rating

Energy cost deflator	0.4200	(256)
Energy cost factor (ECF)	5.8093	(257)

SAP value 24.5415

SAP rating	25	(258) SAP BAND F	

12. Carbon dioxide emissions

	Energy kWh/year	Emission factor	Emissions kg/year		
Space heating - main system	25489.5861	0.0190	484.3021	(261)
Space heating - secondary	1699.3057	0.5190	881.9397	(263)
Water heating	1227.2099	0.5190	636.9219	(264)
Space and water heating			2003.1638	(265)
Energy for lighting	308.2714	0.5190	159.9928	(268)
Total kg/year			2163.1566	(272)

	kg/m2/year	
CO2 emissions per m2	31.19	(273)

EI value 74.6535

EI rating	75	(274) EI band C	

SAP 2012 WORKSHEET (Version 9.94, September 2019)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 03 Dec 2020

Calculated by Lambda Calculation Engine SAP Engine version v94.0.1.1 RRN: 9023-3274-

9850-9744-9264

1. Overall dwelling dimensions

Ground floor(main)	37.07	2.14	79.3298	(1b)-	(3b)
First floor(main)	32.29	2.74	88.4746	(1c)-	(3c)

Total floor area	69.3600	(4)
Dwelling volume (m³)	167.8044	(5)

2. Ventilation rate

Number of chimneys	0	(6a) Number of open flues	20	(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		0.1192	(8)
Number of storeys	2	(9) Additional infiltration ... 0.1000	(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	100	(14) Window infiltration ... 0.0500	(15)
Infiltration rate		0.6692	(18)
Number of sides sheltered	2	(19) Shelter factor ... 0.8500	(20)
Infiltration rate incorporating shelter factor		0.5688	(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	0.7252	0.7110	0.6968	0.6257	0.6115	0.5404	0.5404	0.5261	0.5688	0.6115	0.6399	0.6683	(22b)
Effective ach	0.7630	0.7528	0.7428	0.6957	0.6869	0.6460	0.6460	0.6384	0.6618	0.6869	0.7047	0.7233	(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	5.5500	
									(26)
Windows	1.8400	2.1898		4.0292					(27)

Windows	13.5000	1.5038	....	20.3008	(27)
Ground Floor	37.0700	0.2500	....	9.2675	(28a)
Walls	41.8700	0.3000	....	12.5610	(29a)
Roof	42.8000	0.1800	....	7.7040	(30)

Total area of elements (whole dwelling)	140.7800		(31)
Party wall (main)	48.7000	0.2500 .... 12.1750	(32)
Fabric heat loss	71.5874		(33)
Thermal mass parameter..	250.0000		(35)
Thermal bridges (0.15 × total area)	21.1170 (36)		
Total fabric heat loss..	92.7044	(37)	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Vent loss	42.2504	41.6849	41.1306	38.5271	38.0054	35.7725	35.7725	35.3526	36.6459	38.0400	39.0254	40.0556	(38)
Heat transfer coeff	134.9548	134.3893	133.8350	131.2316	130.7445	128.4769	128.4769	128.0570	129.3503	130.7445	131.7299	132.7600	(39)
Heat transfer coeff (average)...												131.2292	(39)
HLP	1.9457	1.9376	1.9296	1.8920	1.8850	1.8523	1.8523	1.8463	1.8649	1.8850	1.8992	1.9141	(40)
HLP (average)..												1.8920	(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 2.2305	(42)
Average daily hot water use (litres/day) 91.7622	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	100.9384	97.2679	93.5974	89.9269	86.2564	82.5860	82.5860	86.2564	89.9269	93.5974	97.2679	100.9384	(44)
Energy content	149.6887	130.9187	135.0964	117.7803	113.0130	97.5216	90.3681	103.6987	104.9372	122.2942	133.4937	144.9655	(45)
Energy content(annual)												1443.7764	(45)
Distribution loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
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	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	127.2354	111.2809	114.8319	100.1133	96.0611	82.8934	76.8129	88.1439	89.1967	103.9501	113.4697	123.2207	(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	23.2279	38.7607	66.0140	88.4717	109.2994	107.4587	106.0386	92.6464	72.5607	49.5504	27.5517	19.4378	(63)
Solar input(sum of months)												801.0180	(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	104.0075	72.5202	48.8180	11.6415	0.0000	0.0000	0.0000	0.0000	16.6359	54.3997	85.9180	103.7829	(64)
Output from water heater(annual)												497.7236	(64)
Heat gains (kWh)	31.8089	27.8202	28.7080	25.0283	24.0153	20.7233	19.2032	22.0360	22.2992	25.9875	28.3674	30.8052	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic	133.8292	133.8292	133.8292	133.8292	133.8292	133.8292	133.8292	133.8292	133.8292	133.8292	133.8292	133.8292	(66)
Lighting	43.6472	38.7671	31.5275	23.8684	17.8419	15.0629	16.2760	21.1561	28.3957	36.0548	42.0813	44.8603	(67)
Appliances	292.2369	295.2695	287.6276	271.3591	250.8230	231.5220	218.6277	215.5952	223.2371	239.5056	260.0417	279.3427	(68)
Cooking	50.6134	50.6134	50.6134	50.6134	50.6134	50.6134	50.6134	50.6134	50.6134	50.6134	50.6134	50.6134	(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	-89.2195	-89.2195	-89.2195	-89.2195	-89.2195	-89.2195	-89.2195	-89.2195	-89.2195	-89.2195	-89.2195	89.2195	(71)
Water heating	42.7538	41.3991	38.5860	34.7615	32.2786	28.7824	25.8108	29.6183	30.9711	34.9295	39.3992	41.4048	(72)
Total internal	473.8612	470.6588	452.9643	425.2122	396.1666	370.5905	355.9376	361.5928	377.8269	405.7130	436.7453	460.8310	(73)

6. Solar gains

(calculation for January)

Orientation	Area	Gains[W]			
East	13.5000	.... 81.0313		(76)	
East	1.8400	.... 13.3232		(76)	
		total:.. 94.3545		(83-1)	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	94.3546	184.5775	303.9729	443.3264	543.3131	556.1777	529.5038	454.8359	353.5331	219.0168	117.6490	77.5926	(83)
Total gains	568.2157	655.2364	756.9372	868.5386	939.4798	926.7681	885.4415	816.4287	731.3600	624.7298	554.3944	538.4236	(84)

7. Mean internal temperature

Living room temperature during heating periods Th1 .... 21.0000	(85)
Heating system responsiveness 0.0000	

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.6910	35.8411	35.9896	36.7036	36.8403	37.4905	37.4905	37.6135	37.2374	36.8403	36.5647	36.2810	
alpha	3.3794	3.3894	3.3993	3.4469	3.4560	3.4994	3.4994	3.5076	3.4825	3.4560	3.4376	3.4187	
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	0.9929	0.9878	0.9747	0.9392	0.8635	0.7291	0.5831	0.6385	0.8471	0.9620	0.9885	0.9941	(86)
MIT 1	19.8413	19.9430	20.1283	20.3830	20.6023	20.7578	20.8163	20.8054	20.6815	20.3908	20.0787	19.8348	(87)
th2				0.9903	0.9833	0.9649	0.9137	0.8021	0.6048	0.4002	0.4573	0.7531	0.9409	(88) util rest
												0.9834	0.9920	(89)
MIT 2	18.3403	18.4458	18.6330	18.9007	19.1029	19.2431	19.2735	19.2745	19.1873	18.9181	18.6038	18.3523	(90)
Living area fraction =												0.3000	(91)
MIT	18.7907	18.8950	19.0816	19.3454	19.5528	19.6975	19.7364	19.7338	19.6356	19.3600	19.0464	18.7971	(92)
Temperature adjustment 0.3000													
adjusted MIT	19.0907	19.1950	19.3816	19.6454	19.8528	19.9975	20.0364	20.0338	19.9356	19.6600	19.3464	19.0971	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9897	0.9826	0.9649	0.9183	0.8218	0.6546	0.4757	0.5329	0.7890	0.9450	0.9832	0.9915	(94)
Useful gains W	562.3707	643.8666	730.3563	797.5451	772.0829	606.6373	421.2290	435.0805	577.0567	590.3934	545.0590	533.8235	(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	1996.0701	1921.0966	1724.0123	1410.1419	1065.9310	693.4602	441.5001	465.3349	754.8355	1184.5401	1613.2101	1977.7331	(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	1066.6723	858.2985	739.2801	441.0697	218.6230	0.0000	0.0000	0.0000	0.0000	442.0451	769.0688	1074.2688	(98)

```
Space heating..............................................................................................................................................5609.3262        (98)
Space heating per m2 ....................................................................................................................................80.8726         (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 ..............................................................................................................60.0000        (206)
Efficiency of secondary heating system........................................................................................................100.0000       (208)
Space heating requirement ...........................................................................................................................8413.9893       (211)
```

```
        Jan     Feb     Mar     Apr     May     Jun     Jul     Aug     Sep     Oct     Nov     Dec     Space heating requirement
     1066.6723 858.2985 739.2801 441.0697 218.6230 0.0000  0.0000  0.0000  0.0000  442.0451 769.0688 1074.2688   (98)    Space heating efficiency (main heating system)
      60.0000  60.0000  60.0000  60.0000  60.0000  0.0000  0.0000  0.0000  0.0000  60.0000  60.0000  60.0000   (210)   Space heating fuel (main heating system)
     1600.0085 1287.4478 1108.9201 661.6045 327.9344 0.0000  0.0000  0.0000  0.0000  663.0677 1153.6031 1611.4031   (211)   Space heating fuel (secondary)
      106.6672 85.8299  73.9280  44.1070  21.8623  0.0000  0.0000  0.0000  0.0000  44.2045 76.9069  107.4269   (215)   Water heating requirement
      104.0075 72.5202  48.8180  11.6415  0.0000  0.0000  0.0000  0.0000  16.6359 54.3997  85.9180  103.7829   (64)    Efficiency of water heater 100.0000 (216)
      100.0000 100.0000 100.0000 100.0000 100.0000 100.0000 100.0000 100.0000 100.0000 100.0000 100.0000 100.0000   (217) Water heating fuel
      104.0075 72.5202  48.8180  11.6415  0.0000  0.0000  0.0000  0.0000  16.6359 54.3997  85.9180  103.7829   (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 .................................................................................................................8413.9893       (211)
Space heating fuel - secondary ....................................................................................................................560.9326        (215)
Water heating fuel ........................................................................................................................................497.7236        (219)
pump for solar water heating .......................................................................................................................50.0000         (230g)
Electricity for pumps and fans .....................................................................................................................50.0000         (231)
Electricity for lighting...................................................................................................................................308.3296        (232)
PV generation ...............................................................................................................................................1727.2394       (233)
Wind generation ...........................................................................................................................................3575.5408       (234)
Total delivered energy for all uses..............................................................................................................4528.1949       (238)
```

10. Fuel costs

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year		
Space heating - main system	8413.9893	4.2300	...............355.9117	(240)
Space heating - secondary	560.9326	15.2900	...............85.7666	(242)
Water heating	497.7236	0.0000	...............0.0000	(247)
Water heating:				
High-rate fraction			...............0.9000	(243)
Low-rate fraction			...............0.1000	(244)
High-rate cost	447.9513	15.2900	...............68.4917	(245)
Low-rate cost	49.7724	5.5000	...............2.7375	(246)
Pumps and fans for heating	0.0000	50.0000	...............7.1555	(249)
Electricity for lighting	308.3296	14.3110	...............44.1250	(250)
Additional standing charges			...............24.0000	(251)
Electricity generated - PVs	-1727.2394	13.7505	...............237.5041	(252)
Electricity generated - wind	-3575.5408	13.9747	...............499.6711	(252)
Total energy cost			...............148.9870	(255)

11. SAP rating

```
Energy cost deflator..........................................................................................................................................0.4200        (256)
Energy cost factor (ECF)....................................................................................................................................0.5472        (257)
SAP value  107.6330
SAP rating                                        108              (258) SAP BAND  A
```

12. Carbon dioxide emissions

	Energy kWh/year	Emission factor	Emissions kg/year		
Space heating - main system	8413.9893	0.0190	...............159.8658	(261)
Space heating - secondary	560.9326	0.5190	...............291.1240	(263)
Water heating	497.7236	0.5190	...............258.3186	(264)
Space and water heating			...............709.3084	(265)
Pumps and fans	0.5190	50.0000	...............25.9500	(267)
Energy for lighting	308.3296	0.5190	...............160.0231	(268)
Electricity generated - PVs	-1727.2394	0.5190	...............896.4372	(269)
Electricity generated - wind	-3575.5408	0.5190	...............1855.7056	(269)
Total kg/year			...............1856.8614	(272)

```
                                         kg/m2/year
CO2 emissions per m2 ....................................................................................................................................26.77  (273)
EI value  121.7576
EI rating                                        122              (274) EI band  A
```