FULL SAP CALCULATION PRINTOUT
Calculation Type: New Build (As Built)

Design SAP
elmhurst energy

Property Reference	97a Nags Head Hill	**Issued on Date**	17/11/2023
Assessment Reference	As built 2	**Prop Type Ref**	Semi
Property	97a, Nags Head Hill, Kingswood, Bristol, BS5 8QN		

SAP Rating	93 A	**DER**	9.37	**TER**	18.49
Environmental	94 A	**% DER<TER**	49.32		
CO_2 Emissions (t/year)	0.35	**DFEE**	53.36	**TFEE**	54.44
General Requirements Compliance	Pass	**% DFEE<TFEE**	1.99		

Assessor Details	Mr. Paul Taylerson, Paul Taylerson, Tel: 07904 120 408, paultaylerson@gmail.com	**Assessor ID**	U796-0001
Client			

REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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DWELLING AS BUILT

Semi-Detached House, total floor area 84 m²

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

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 18.49 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 9.37 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)54.4 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)53.4 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.22 (max. 0.30)	0.22 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.10 (max. 0.25)	0.10 (max. 0.70)	OK
Roof	0.13 (max. 0.20)	0.15 (max. 0.35)	OK
Openings	1.44 (max. 2.00)	1.80 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated from linear thermal transmittances for each junction

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3 Air permeability
Air permeability at 50 pascals: 7.85 (measured in this dwelling)
Maximum 10.0 OK

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4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal ATLANTIC COMBI 30
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

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5 Cylinder insulation
Hot water storage No cylinder

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6 Controls
Space heating controls: Programmer, room thermostat and TRVs OK

Hot water controls: No cylinder

Boiler interlock Yes OK

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7 Low energy lights
Percentage of fixed lights with low-energy fittings:100%
Minimum 75% OK

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8 Mechanical ventilation
Not applicable

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9 Summertime temperature
Overheating risk (Severn Valley): Not significant OK
Based on:
Overshading: Average
Windows facing North: 12.20 m², No overhang
Windows facing South: 6.68 m², No overhang
Air change rate: 8.00 ach
Blinds/curtains: None

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10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.10 W/m²K
Photovoltaic array 2.00 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	46.6100	(1b)	x 2.4000	(2b) =	111.8640	(1b) - (3b)
First floor	36.9500	(1c)	x 2.6000	(2c) =	96.0700	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	83.5600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.9340	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent 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)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1443	(8)
Pressure test		Yes	
Measured/design AP50		7.8500	
Infiltration rate		0.5368	(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) =	0.4563	(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	0.5817	0.5703	0.5589	0.5019	0.4905	0.4334	0.4334	0.4220	0.4563	0.4905	0.5133	0.5361	(22b)
Effective ac	0.6692	0.6626	0.6562	0.6259	0.6203	0.5939	0.5939	0.5891	0.6041	0.6203	0.6317	0.6437	(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	
Door			1.9400	1.8000	3.4920			(26)
Windows (Uw = 1.40)			10.8800	1.3258	14.4242			(27)
Bi fold doors (Uw = 1.40)			8.0000	1.3258	10.6061			(27)
Heat Loss Floor 1			46.6100	0.1000	4.6610			(28a)
External Wall 1	106.7500	20.8200	85.9300	0.2200	18.9046			(29a)
External Roof 1	9.6600		9.6600	0.1500	1.4490			(30)
External Roof 2	36.9500		36.9500	0.1300	4.8035			(30)
Total net area of external elements Aum(A, m2)			199.9700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		58.3404			(33)
Party Wall 1			36.4000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	12.8111	(36)
Total fabric heat loss	(33) + (36) = 71.1515	(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	45.9197	45.4689	45.0269	42.9512	42.5629	40.7550	40.7550	40.4202	41.4513	42.5629	43.3485	44.1699	(38)
Heat transfer coeff	117.0712	116.6204	116.1784	114.1027	113.7144	111.9065	111.9065	111.5717	112.6029	113.7144	114.5000	115.3214	(39)
Average = Sum(39)m / 12 =												114.1009	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4010	1.3956	1.3904	1.3655	1.3609	1.3392	1.3392	1.3352	1.3476	1.3609	1.3703	1.3801	(40)
HLP (average)												1.3655	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.5269 (42)
Average daily hot water use (litres/day)	94.2150 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	103.6365	99.8679	96.0993	92.3307	88.5621	84.7935	84.7935	88.5621	92.3307	96.0993	99.8679	103.6365	(44)
Energy conte	153.6899	134.4182	138.7075	120.9286	116.0339	100.1284	92.7837	106.4706	107.7422	125.5632	137.0620	148.8405	(45)
Energy content (annual)										Total = Sum(45)m =		1482.3688	(45)
Distribution loss (46)m = 0.15 x (45)m	23.0535	20.1627	20.8061	18.1393	17.4051	15.0193	13.9176	15.9706	16.1613	18.8345	20.5593	22.3261	(46)
Water storage loss:													

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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)
Combi loss 46.4028 41.9008 46.3518 44.8132 46.2755 44.7464 46.2153 46.2543 44.7828 46.3202 44.8763 46.3907 (61)
Total heat required for water heating calculated for each month
200.0927 176.3190 185.0594 165.7418 162.3093 144.8748 138.9989 152.7249 152.5250 171.8834 181.9383 195.2312 (62)
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) = Sum(63)m = 0.0000 (63)
Output from w/h
200.0927 176.3190 185.0594 165.7418 162.3093 144.8748 138.9989 152.7249 152.5250 171.8834 181.9383 195.2312 (64)
Total per year (kWh/year) = Sum(64)m = 2027.6988 (64)
Heat gains from water heating, kWh/month
62.7026 55.1692 57.7082 51.4121 50.1501 44.4793 42.4044 46.9651 47.0200 53.3298 56.7922 61.0871 (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	126.3474	126.3474	126.3474	126.3474	126.3474	126.3474	126.3474	126.3474	126.3474	126.3474	126.3474	126.3474	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
20.2086 17.9491 14.5972 11.0510 8.2608 6.9741 7.5357 9.7952 13.1472 16.6933 19.4836 20.7703 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
226.7198 229.0724 223.1438 210.5226 194.5905 179.6166 169.6132 167.2605 173.1891 185.8103 201.7424 216.7163 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
35.6347 35.6347 35.6347 35.6347 35.6347 35.6347 35.6347 35.6347 35.6347 35.6347 35.6347 35.6347 (69)
Pumps, fans 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
-101.0779 -101.0779 -101.0779 -101.0779 -101.0779 -101.0779 -101.0779 -101.0779 -101.0779 -101.0779 -101.0779 -101.0779 (71)
Water heating gains (Table 5)
84.2777 82.0971 77.5648 71.4056 67.4061 61.7768 56.9951 63.1251 65.3055 71.6799 78.8781 82.1064 (72)
Total internal gains
395.1103 393.0228 379.2100 356.8834 334.1616 312.2717 298.0483 304.0850 315.5460 338.0877 364.0083 383.4971 (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	4.2000	10.6334	0.7600	0.7000	0.7700	16.4652	(74)
South	6.6800	46.7521	0.7600	0.7000	0.7700	115.1389	(78)
North	8.0000	10.6334	0.7600	0.7000	0.7700	31.3622	(74)

Solar gains	162.9663	279.9684	395.5139	520.9511	618.9593	632.0143	601.8908	524.8106	437.6546	312.1886	195.4801	139.3619	(83)
Total gains	558.0766	672.9912	774.7239	877.8346	953.1209	944.2860	899.9391	828.8956	753.2006	650.2763	559.4884	522.8590	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	49.5662	49.7578	49.9471	50.8557	51.0294	51.8538	51.8538	52.0094	51.5331	51.0294	50.6793	50.3183	
alpha	4.3044	4.3172	4.3298	4.3904	4.4020	4.4569	4.4569	4.4673	4.4355	4.4020	4.3786	4.3546	
util living area	0.9968	0.9923	0.9810	0.9454	0.8546	0.6899	0.5296	0.5893	0.8285	0.9663	0.9933	0.9976	(86)
MIT	19.4966	19.6985	20.0044	20.4044	20.7370	20.9296	20.9829	20.9731	20.8341	20.4001	19.8807	19.4727	(87)
Th 2	19.7625	19.7667	19.7707	19.7899	19.7935	19.8102	19.8102	19.8133	19.8038	19.7935	19.7862	19.7786	(88)
util rest of house	0.9956	0.9896	0.9741	0.9246	0.8003	0.5878	0.3952	0.4516	0.7458	0.9494	0.9905	0.9967	(89)
MIT 2	18.4141	18.6180	18.9231	19.3238	19.6230	19.7798	19.8063	19.8063	19.7164	19.3301	18.8154	18.4028	(90)
Living area fraction										fLA = Living area / (4) =		0.1387	(91)
MIT	18.5643	18.7679	19.0731	19.4737	19.7775	19.9393	19.9695	19.9681	19.8714	19.4785	18.9632	18.5512	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.4143	18.6179	18.9231	19.3237	19.6275	19.7893	19.8195	19.8181	19.7214	19.3285	18.8132	18.4012	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9938	0.9861	0.9675	0.9143	0.7915	0.5858	0.3963	0.4522	0.7389	0.9403	0.9872	0.9953	(94)
Useful gains	554.6097	663.6196	749.5447	802.5956	754.3869	553.1617	356.6036	374.8550	556.5726	611.4691	552.3306	520.3866	(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	1652.3732	1599.7834	1443.2980	1189.3704	901.4691	580.7119	360.2811	381.3678	632.9873	992.5583	1341.1589	1637.7027	(97)
Month fracti	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	816.7360	629.1020	516.1525	278.4778	109.4292	0.0000	0.0000	0.0000	0.0000	283.5304	567.9564	831.2832	(98)
Space heating												4032.6675	(98)
Space heating per m2											(98) / (4) =	48.2607	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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 %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4455.9862	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	816.7360	629.1020	516.1525	278.4778	109.4292	0.0000	0.0000	0.0000	0.0000	283.5304	567.9564	831.2832	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	902.4708	695.1404	570.3342	307.7103	120.9162	0.0000	0.0000	0.0000	0.0000	313.2933	627.5762	918.5449	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	200.0927	176.3190	185.0594	165.7418	162.3093	144.8748	138.9989	152.7249	152.5250	171.8834	181.9383	195.2312	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8519	89.7796	89.6329	89.2790	88.5610	87.3000	87.3000	87.3000	87.3000	89.2651	89.7023	89.8735	(217)
Fuel for water heating, kWh/month													
	222.6917	196.3910	206.4636	185.6448	183.2740	165.9505	159.2199	174.9427	174.7137	192.5540	202.8247	217.2290	(219)
Water heating fuel used												2281.8994	(219)
Annual totals kWh/year													
Space heating fuel - main system												4455.9862	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.8903	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.00 * 1080 * 1.00) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												5442.5365	(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	4455.9862	0.2160	962.4930	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2281.8994	0.2160	492.8903	(264)
Space and water heating			1455.3833	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.8903	0.5190	185.2261	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total CO2, kg/year			783.0971	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			9.3700	(273)

16 CO2 EMISSIONS ASSOCIATED WITH APPLIANCES AND COOKING AND SITE-WIDE ELECTRICITY GENERATION TECHNOLOGIES

DER		9.3700	ZC1
Total Floor Area	TFA	83.5600	
Assumed number of occupants	N	2.5269	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.0782	ZC2
CO2 emissions from cooking, equation (L16)		2.1499	ZC3
Total CO2 emissions		27.5981	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		27.5981	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	46.6100	(1b)	x 2.4000	(2b) =	111.8640	(1b) - (3b)
First floor	36.9500	(1c)	x 2.6000	(2c) =	96.0700	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	83.5600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.9340	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent 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)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1443	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3943	(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) =	0.3351	(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	0.4273	0.4189	0.4105	0.3686	0.3603	0.3184	0.3184	0.3100	0.3351	0.3603	0.3770	0.3938	(22b)
Effective ac	0.5913	0.5877	0.5843	0.5680	0.5649	0.5507	0.5507	0.5480	0.5562	0.5649	0.5711	0.5775	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			1.9400	1.0000	1.9400			(26)
TER Opening Type (Uw = 1.40)			18.8800	1.3258	25.0303			(27)
Heat Loss Floor 1			46.6100	0.1300	6.0593			(28a)
External Wall 1	106.7500	20.8200	85.9300	0.1800	15.4674			(29a)
External Roof 1	9.6600		9.6600	0.1300	1.2558			(30)
External Roof 2	36.9500		36.9500	0.1300	4.8035			(30)
Total net area of external elements Aum(A, m2)			199.9700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	54.5563			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.5292	(36)
Total fabric heat loss (33) + (36) =	63.0855	(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	40.5734	40.3301	40.0917	38.9718	38.7622	37.7868	37.7868	37.6062	38.1626	38.7622	39.1861	39.6293	(38)
Heat transfer coeff	103.6589	103.4156	103.1772	102.0573	101.8478	100.8723	100.8723	100.6917	101.2481	101.8478	102.2716	102.7148	(39)
Average = Sum(39)m / 12 =												102.0563	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2405	1.2376	1.2348	1.2214	1.2189	1.2072	1.2072	1.2050	1.2117	1.2189	1.2239	1.2292	(40)
HLP (average)												1.2214	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.5269 (42)
Average daily hot water use (litres/day)	94.2150 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	103.6365	99.8679	96.0993	92.3307	88.5621	84.7935	84.7935	88.5621	92.3307	96.0993	99.8679	103.6365	(44)
Energy conte	153.6899	134.4182	138.7075	120.9286	116.0339	100.1284	92.7837	106.4706	107.7422	125.5632	137.0620	148.8405	(45)
Energy content (annual)										Total = Sum(45)m =		1482.3688	(45)
Distribution loss (46)m = 0.15 x (45)m	23.0535	20.1627	20.8061	18.1393	17.4051	15.0193	13.9176	15.9706	16.1613	18.8345	20.5593	22.3261	(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)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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	(57)
Combi loss	50.9589	45.9666	48.9711	45.5329	45.1303	41.8160	43.2098	45.1303	45.5329	48.9711	49.2499	50.9589 (61)
Total heat required for water heating calculated for each month												
	204.6488	180.3848	187.6787	166.4615	161.1641	141.9444	135.9935	151.6009	153.2752	174.5343	186.3120	199.7994 (62)
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) = Sum(63)m =				0.0000 (63)
Output from w/h												
	204.6488	180.3848	187.6787	166.4615	161.1641	141.9444	135.9935	151.6009	153.2752	174.5343	186.3120	199.7994 (64)
								Total per year (kWh/year) = Sum(64)m =				2043.7977 (64)
Heat gains from water heating, kWh/month												
	63.8416	56.1857	58.3630	51.5920	49.8638	43.7467	41.6530	46.6841	47.2075	53.9925	57.8856	62.2292 (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	126.3474	126.3474	126.3474	126.3474	126.3474	126.3474	126.3474	126.3474	126.3474	126.3474	126.3474	126.3474	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2086	17.9491	14.5972	11.0510	8.2608	6.9741	7.5357	9.7952	13.1472	16.6933	19.4836	20.7703	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	226.7198	229.0724	223.1438	210.5226	194.5905	179.6166	169.6132	167.2605	173.1891	185.8103	201.7424	216.7163	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.6347	35.6347	35.6347	35.6347	35.6347	35.6347	35.6347	35.6347	35.6347	35.6347	35.6347	35.6347	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	(71)
Water heating gains (Table 5)													
	85.8086	83.6097	78.4450	71.6555	67.0213	60.7593	55.9853	62.7474	65.5660	72.5706	80.3967	83.6414	(72)
Total internal gains													
	396.6412	394.5354	380.0902	357.1333	333.7768	311.2542	297.0384	303.7074	315.8065	338.9785	365.5269	385.0321	(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	12.2000	10.6334	0.6300	0.7000	0.7700	39.6464	(74)
South	6.8000	46.7521	0.6300	0.7000	0.7700	95.4441	(78)

Solar gains	135.0905	232.0791	327.8602	431.8411	513.0847	523.9066	498.9358	435.0404	362.7926	258.7879	162.0427	115.5237	(83)
Total gains	531.7317	626.6145	707.9504	788.9744	846.8614	835.1608	795.9742	738.7477	678.5991	597.7664	527.5696	500.5558	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.9796	56.1112	56.2409	56.8580	56.9750	57.5260	57.5260	57.6291	57.3125	56.9750	56.7389	56.4941	
alpha	4.7320	4.7407	4.7494	4.7905	4.7983	4.8351	4.8351	4.8419	4.8208	4.7983	4.7826	4.7663	
util living area	0.9974	0.9939	0.9847	0.9544	0.8704	0.7080	0.5425	0.6009	0.8400	0.9710	0.9945	0.9981	(86)
MIT	19.6723	19.8470	20.1157	20.4653	20.7668	20.9396	20.9866	20.9785	20.8571	20.4685	20.0053	19.6416	(87)
Th 2	19.8877	19.8900	19.8923	19.9029	19.9049	19.9143	19.9143	19.9160	19.9107	19.9049	19.9009	19.8967	(88)
util rest of house	0.9965	0.9918	0.9792	0.9370	0.8220	0.6127	0.4163	0.4720	0.7643	0.9565	0.9922	0.9974	(89)
MIT 2	18.1291	18.3852	18.7760	19.2795	19.6781	19.8746	19.9095	19.9073	19.7972	19.2938	18.6247	18.0905	(90)
Living area fraction										fLA = Living area / (4) =		0.1387	(91)
MIT	18.3431	18.5880	18.9619	19.4440	19.8291	20.0223	20.0589	20.0559	19.9442	19.4567	18.8162	18.3057	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3431	18.5880	18.9619	19.4440	19.8291	20.0223	20.0589	20.0559	19.9442	19.4567	18.8162	18.3057	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9946	0.9882	0.9727	0.9277	0.8180	0.6230	0.4337	0.4896	0.7670	0.9484	0.9888	0.9959	(94)
Useful gains	528.8479	619.2133	688.6285	731.9195	692.7741	520.3234	345.2406	361.6756	520.4972	566.9304	521.6786	498.4841	(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	1455.6957	1415.5511	1285.7794	1076.0891	827.9277	546.9632	348.9036	368.1202	591.7176	902.0398	1198.2341	1448.8589	(97)
Month fracti	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	689.5748	535.1390	444.2803	247.8021	100.5543	0.0000	0.0000	0.0000	0.0000	249.3214	487.1199	707.0788	(98)
Space heating												3460.8707	(98)
Space heating per m2											(98) / (4) =	41.4178	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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 %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3705.4290	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	689.5748	535.1390	444.2803	247.8021	100.5543	0.0000	0.0000	0.0000	0.0000	249.3214	487.1199	707.0788	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	738.3028	572.9540	475.6749	265.3127	107.6598	0.0000	0.0000	0.0000	0.0000	266.9393	521.5417	757.0437	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	204.6488	180.3848	187.6787	166.4615	161.1641	141.9444	135.9935	151.6009	153.2752	174.5343	186.3120	199.7994	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.8706	87.6216	87.1448	86.0509	83.9015	80.3000	80.3000	80.3000	80.3000	85.9485	87.3601	87.9625	(217)
Fuel for water heating, kWh/month													
	232.8979	205.8679	215.3641	193.4454	192.0872	176.7676	169.3568	188.7932	190.8782	203.0685	213.2690	227.1416	(219)
Water heating fuel used												2408.9375	(219)
Annual totals kWh/year													
Space heating fuel - main system												3705.4290	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.8903	(232)
Total delivered energy for all uses												6546.2567	(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	3705.4290	0.2160	800.3727	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2408.9375	0.2160	520.3305	(264)
Space and water heating			1320.7032	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.8903	0.5190	185.2261	(268)
Total CO2, kg/m2/year			1544.8542	(272)
Emissions per m2 for space and water heating			15.8054	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2167	(272b)
Emissions per m2 for pumps and fans			0.4658	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.8054 * 1.00) + 2.2167 + 0.4658, rounded to 2 d.p.			18.4900	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	46.6100 (1b)	x	2.4000 (2b)	=	111.8640	(1b) - (3b)
First floor	36.9500 (1c)	x	2.6000 (2c)	=	96.0700	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	83.5600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.9340	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent 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)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1443	(8)
Pressure test		Yes	
Measured/design AP50		7.8500	
Infiltration rate		0.5368	(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) =	0.4563	(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	0.5817	0.5703	0.5589	0.5019	0.4905	0.4334	0.4334	0.4220	0.4563	0.4905	0.5133	0.5361	(22b)
Effective ac	0.6692	0.6626	0.6562	0.6259	0.6203	0.5939	0.5939	0.5891	0.6041	0.6203	0.6317	0.6437	(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	
Door			1.9400	1.8000	3.4920			(26)
Windows (Uw = 1.40)			10.8800	1.3258	14.4242			(27)
Bi fold doors (Uw = 1.40)			8.0000	1.3258	10.6061			(27)
Heat Loss Floor 1			46.6100	0.1000	4.6610			(28a)
External Wall 1	106.7500	20.8200	85.9300	0.2200	18.9046			(29a)
External Roof 1	9.6600		9.6600	0.1500	1.4490			(30)
External Roof 2	36.9500		36.9500	0.1300	4.8035			(30)
Total net area of external elements Aum(A, m2)			199.9700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		58.3404			(33)
Party Wall 1			36.4000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	12.8111	(36)
Total fabric heat loss	(33) + (36) = 71.1515	(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	45.9197	45.4689	45.0269	42.9512	42.5629	40.7550	40.7550	40.4202	41.4513	42.5629	43.3485	44.1699	(38)
Heat transfer coeff	117.0712	116.6204	116.1784	114.1027	113.7144	111.9065	111.9065	111.5717	112.6029	113.7144	114.5000	115.3214	(39)
Average = Sum(39)m / 12 =												114.1009	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4010	1.3956	1.3904	1.3655	1.3609	1.3392	1.3392	1.3352	1.3476	1.3609	1.3703	1.3801	(40)
HLP (average)												1.3655	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.5269 (42)
Average daily hot water use (litres/day)	94.2150 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	103.6365	99.8679	96.0993	92.3307	88.5621	84.7935	84.7935	88.5621	92.3307	96.0993	99.8679	103.6365	(44)
Energy conte	153.6899	134.4182	138.7075	120.9286	116.0339	100.1284	92.7837	106.4706	107.7422	125.5632	137.0620	148.8405	(45)
Energy content (annual)										Total = Sum(45)m =		1482.3688	(45)
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:													

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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)

Heat gains from water heating, kWh/month

32.6591	28.5639	29.4754	25.6973	24.6572	21.2773	19.7165	22.6250	22.8952	26.6822	29.1257	31.6286	(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	126.3474	126.3474	126.3474	126.3474	126.3474	126.3474	126.3474	126.3474	126.3474	126.3474	126.3474	126.3474	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

20.2086	17.9491	14.5972	11.0510	8.2608	6.9741	7.5357	9.7952	13.1472	16.6933	19.4836	20.7703	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

226.7198	229.0724	223.1438	210.5226	194.5905	179.6166	169.6132	167.2605	173.1891	185.8103	201.7424	216.7163	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

35.6347	35.6347	35.6347	35.6347	35.6347	35.6347	35.6347	35.6347	35.6347	35.6347	35.6347	35.6347	(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)

-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	(71)

Water heating gains (Table 5)

43.8967	42.5058	39.6174	35.6907	33.1414	29.5518	26.5007	30.4100	31.7989	35.8631	40.4523	42.5116	(72)

Total internal gains

351.7292	350.4315	338.2626	318.1685	296.8969	277.0467	264.5538	268.3699	279.0394	299.2710	322.5825	340.9023	(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	4.2000	10.6334	0.7600	0.7000	0.7700	16.4652	(74)
South	6.8000	46.7521	0.7600	0.7000	0.7700	115.1389	(78)
North	8.0000	10.6334	0.7600	0.7000	0.7700	31.3622	(74)

Solar gains	162.9663	279.9684	395.5139	520.9511	618.9593	632.0143	601.8908	524.8106	437.6546	312.1886	195.4801	139.3619	(83)
Total gains	514.6955	630.3999	733.7765	839.1197	915.8562	909.0610	866.4446	793.1805	716.6940	611.4596	518.0626	480.2642	(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	49.5662	49.7578	49.9471	50.8557	51.0294	51.8538	51.8538	52.0094	51.5331	51.0294	50.6793	50.3183	
alpha	4.3044	4.3172	4.3298	4.3904	4.4020	4.4569	4.4569	4.4673	4.4355	4.4020	4.3786	4.3546	
util living area	0.9976	0.9940	0.9844	0.9527	0.8683	0.7085	0.5476	0.6111	0.8474	0.9728	0.9950	0.9983	(86)
MIT	19.4506	19.6542	19.9638	20.3714	20.7161	20.9216	20.9805	20.9690	20.8159	20.3638	19.8372	19.4273	(87)
Th 2	19.7625	19.7667	19.7707	19.7899	19.7935	19.8102	19.8102	19.8133	19.8038	19.7935	19.7862	19.7786	(88)
util rest of house	0.9968	0.9919	0.9785	0.9341	0.8169	0.6065	0.4098	0.4705	0.7687	0.9586	0.9929	0.9977	(89)
MIT 2	18.3684	18.5742	18.8837	19.2938	19.6071	19.7758	19.8057	19.8051	19.7047	19.2963	18.7724	18.3575	(90)
Living area fraction									fLA = Living area / (4) =			0.1387	(91)
MIT	18.5185	18.7240	19.0335	19.4432	19.7609	19.9347	19.9686	19.9665	19.8588	19.4444	18.9201	18.5059	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5185	18.7240	19.0335	19.4432	19.7609	19.9347	19.9686	19.9665	19.8588	19.4444	18.9201	18.5059	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9956	0.9894	0.9738	0.9274	0.8152	0.6182	0.4290	0.4899	0.7730	0.9529	0.9907	0.9967	(94)
Useful gains	512.4174	623.6909	714.5539	778.1781	746.6337	562.0102	371.6979	388.6072	554.0268	582.6895	513.2628	478.6835	(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	1664.5723	1612.1580	1456.1274	1203.0134	916.6397	596.9901	376.9711	397.9212	648.4577	1005.7324	1353.4037	1649.7732	(97)
Month fracti	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	857.2032	664.2499	551.7307	305.8814	126.4845	0.0000	0.0000	0.0000	0.0000	314.7439	604.9014	871.2907	(98)
Space heating												4296.4858	(98)
Space heating per m2											(98) / (4) =	51.4180	(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	1051.9209	828.1080	847.9449	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8534	0.9127	0.8841	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	897.6932	755.7868	749.6910	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1157.0171	1105.2304	1021.1832	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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Space cooling kWh
                0.0000     0.0000     0.0000     0.0000     0.0000   186.7131   259.9860   201.9902     0.0000     0.0000     0.0000     0.0000 (104)
Space cooling                                                                                                                              648.6894 (104)
Cooled fraction                                                                                          fC = cooled area / (4) =        1.0000 (105)
Intermittency factor (Table 10b)
                0.0000     0.0000     0.0000     0.0000     0.0000     0.2500     0.2500     0.2500     0.0000     0.0000     0.0000     0.0000 (106)
Space cooling kWh
                0.0000     0.0000     0.0000     0.0000     0.0000    46.6783    64.9965    50.4975     0.0000     0.0000     0.0000     0.0000 (107)
Space cooling                                                                                                                              162.1723 (107)
Space cooling per m2                                                                                                                         1.9408 (108)
Energy for space heating                                                                                                                    51.4180 (99)
Energy for space cooling                                                                                                                     1.9408 (108)
Total                                                                                                                                       53.3588 (109)
Dwelling Fabric Energy Efficiency (DFEE)                                                                                                    53.4 (109)


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CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	46.6100	(1b)	x 2.4000	(2b) =	111.8640	(1b) - (3b)
First floor	36.9500	(1c)	x 2.6000	(2c) =	96.0700	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	83.5600					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	207.9340	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent 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)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1443	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3943	(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) =	0.3351	(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	0.4273	0.4189	0.4105	0.3686	0.3603	0.3184	0.3184	0.3100	0.3351	0.3603	0.3770	0.3938	(22b)
Effective ac	0.5913	0.5877	0.5843	0.5680	0.5649	0.5507	0.5507	0.5480	0.5562	0.5649	0.5711	0.5775	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			1.9400	1.0000	1.9400			(26)
TER Opening Type (Uw = 1.40)			18.8800	1.3258	25.0303			(27)
Heat Loss Floor 1			46.6100	0.1300	6.0593			(28a)
External Wall 1	106.7500	20.8200	85.9300	0.1800	15.4674			(29a)
External Roof 1	9.6600		9.6600	0.1300	1.2558			(30)
External Roof 2	36.9500		36.9500	0.1300	4.8035			(30)
Total net area of external elements Aum(A, m2)			199.9700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	54.5563			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.5292	(36)
Total fabric heat loss (33) + (36) =	63.0855	(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	40.5734	40.3301	40.0917	38.9718	38.7622	37.7868	37.7868	37.6062	38.1626	38.7622	39.1861	39.6293	(38)
Heat transfer coeff	103.6589	103.4156	103.1772	102.0573	101.8478	100.8723	100.8723	100.6917	101.2481	101.8478	102.2716	102.7148	(39)
Average = Sum(39)m / 12 =												102.0563	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2405	1.2376	1.2348	1.2214	1.2189	1.2072	1.2072	1.2050	1.2117	1.2189	1.2239	1.2292	(40)
HLP (average)												1.2214	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.5269 (42)
Average daily hot water use (litres/day)	94.2150 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	103.6365	99.8679	96.0993	92.3307	88.5621	84.7935	84.7935	88.5621	92.3307	96.0993	99.8679	103.6365	(44)
Energy conte	153.6899	134.4182	138.7075	120.9286	116.0339	100.1284	92.7837	106.4706	107.7422	125.5632	137.0620	148.8405	(45)
Energy content (annual)										Total = Sum(45)m =		1482.3688	(45)
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)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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)
Heat gains from water heating, kWh/month													
	32.6591	28.5639	29.4754	25.6973	24.6572	21.2773	19.7165	22.6250	22.8952	26.6822	29.1257	31.6286	(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	126.3474	126.3474	126.3474	126.3474	126.3474	126.3474	126.3474	126.3474	126.3474	126.3474	126.3474	126.3474	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.2086	17.9491	14.5972	11.0510	8.2608	6.9741	7.5357	9.7952	13.1472	16.6933	19.4836	20.7703	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	226.7198	229.0724	223.1438	210.5226	194.5905	179.6166	169.6132	167.2605	173.1891	185.8103	201.7424	216.7163	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.6347	35.6347	35.6347	35.6347	35.6347	35.6347	35.6347	35.6347	35.6347	35.6347	35.6347	35.6347	(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)													
	-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	(71)
Water heating gains (Table 5)													
	43.8967	42.5058	39.6174	35.6907	33.1414	29.5518	26.5007	30.4100	31.7989	35.8631	40.4523	42.5116	(72)
Total internal gains													
	351.7292	350.4315	338.2626	318.1685	296.8969	277.0467	264.5538	268.3699	279.0394	299.2710	322.5825	340.9023	(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	12.2000	10.6334	0.6300	0.7000	0.7700	39.6464	(74)
South	6.6800	46.7521	0.6300	0.7000	0.7700	95.4441	(78)

Solar gains	135.0905	232.0791	327.8602	431.8411	513.0847	523.9066	498.9358	435.0404	362.7926	258.7879	162.0427	115.5237	(83)
Total gains	486.8197	582.5106	666.1228	750.0096	809.9816	800.9533	763.4896	703.4103	641.8320	558.0589	484.6252	456.4260	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	55.9796	56.1112	56.2409	56.8580	56.9750	57.5260	57.5260	57.6291	57.3125	56.9750	56.7389	56.4941	
alpha	4.7320	4.7407	4.7494	4.7905	4.7983	4.8351	4.8351	4.8419	4.8208	4.7983	4.7826	4.7663	
util living area													
	0.9982	0.9955	0.9880	0.9619	0.8854	0.7290	0.5629	0.6259	0.8613	0.9776	0.9962	0.9987	(86)
MIT	19.6232	19.7996	20.0725	20.4303	20.7446	20.9314	20.9843	20.9745	20.8380	20.4298	19.9589	19.5932	(87)
Th 2	19.8877	19.8900	19.8923	19.9029	19.9049	19.9143	19.9143	19.9160	19.9107	19.9049	19.9009	19.8967	(88)
util rest of house													
	0.9976	0.9940	0.9836	0.9468	0.8402	0.6341	0.4333	0.4941	0.7903	0.9660	0.9945	0.9982	(89)
MIT 2	18.6381	18.8156	19.0880	19.4449	19.7328	19.8830	19.9104	19.9088	19.8205	19.4514	18.9836	18.6152	(90)
Living area fraction									fLA = Living area / (4) =			0.1387	(91)
MIT	18.7747	18.9521	19.2246	19.5816	19.8731	20.0284	20.0593	20.0566	19.9617	19.5871	19.1188	18.7508	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7747	18.9521	19.2246	19.5816	19.8731	20.0284	20.0593	20.0566	19.9617	19.5871	19.1188	18.7508	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9967	0.9921	0.9800	0.9412	0.8386	0.6451	0.4514	0.5123	0.7942	0.9615	0.9929	0.9976	(94)
Useful gains	485.2183	577.9086	652.7746	705.9457	679.2837	516.6701	344.6062	360.3761	509.7688	536.5637	481.1856	455.3137	(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													
	1500.4354	1453.2034	1312.8881	1090.1358	832.4130	547.5732	348.9508	368.1917	593.4811	915.3178	1229.1853	1494.5845	(97)
Month fracti	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													
	755.3215	588.1981	491.1245	276.6169	113.9282	0.0000	0.0000	0.0000	0.0000	281.7931	538.5598	773.2175	(98)
Space heating												3818.7595	(98)
Space heating per m2											(98) / (4) =	45.7008	(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	948.2001	746.4554	765.2571	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8612	0.9209	0.8941	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	816.6306	687.4404	684.2270	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1030.6574	984.8933	916.2569	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	154.0993	221.3050	172.6303	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												548.0346	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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Cooled fraction                                                                  fC = cooled area / (4) =      1.0000 (105)
Intermittency factor (Table 10b)
                0.0000     0.0000     0.0000     0.0000     0.0000     0.2500     0.2500     0.2500     0.0000     0.0000     0.0000     0.0000 (106)
Space cooling kWh
                0.0000     0.0000     0.0000     0.0000     0.0000    38.5248    55.3262    43.1576     0.0000     0.0000     0.0000     0.0000 (107)
Space cooling                                                                                                                    137.0086 (107)
Space cooling per m2                                                                                                               1.6396 (108)
Energy for space heating                                                                                                          45.7008 (99)
Energy for space cooling                                                                                                           1.6396 (108)
Total                                                                                                                             47.3405 (109)
Target Fabric Energy Efficiency (TFEE)                                                                                             54.4 (109)


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CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF HEAT DEMAND 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	46.6100	(1b)	x 2.4000	(2b) =	111.8640	(1b) - (3b)
First floor	36.9500	(1c)	x 2.6000	(2c) =	96.0700	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	83.5600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.9340	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent 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)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1443	(8)
Pressure test		Yes	
Measured/design AP50		7.8500	
Infiltration rate		0.5368	(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) =	0.4563	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	3.9000	3.7000	3.8000	3.7000	3.7000	3.3000	3.4000	3.1000	3.1000	3.3000	3.2000	3.5000	(22)
Wind factor	0.9750	0.9250	0.9500	0.9250	0.9250	0.8250	0.8500	0.7750	0.7750	0.8250	0.8000	0.8750	(22a)
Adj infilt rate	0.4449	0.4220	0.4334	0.4220	0.4220	0.3764	0.3878	0.3536	0.3536	0.3764	0.3650	0.3992	(22b)
Effective ac	0.5989	0.5891	0.5939	0.5891	0.5891	0.5708	0.5752	0.5625	0.5625	0.5708	0.5666	0.5797	(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	
Door			1.9400	1.8000	3.4920			(26)
Windows (Uw = 1.40)			10.8800	1.3258	14.4242			(27)
Bi fold doors (Uw = 1.40)			8.0000	1.3258	10.6061			(27)
Heat Loss Floor 1			46.6100	0.1000	4.6610			(28a)
External Wall 1	106.7500	20.8200	85.9300	0.2200	18.9046			(29a)
External Roof 1	9.6600		9.6600	0.1500	1.4490			(30)
External Roof 2	36.9500		36.9500	0.1300	4.8035			(30)
Total net area of external elements Aum(A, m2)			199.9700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		58.3404			(33)
Party Wall 1			36.4000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	12.8111	(36)
Total fabric heat loss (33) + (36) =	71.1515	(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	41.0987	40.4202	40.7550	40.4202	40.4202	39.1703	39.4694	38.5989	38.5989	39.1703	38.8801	39.7774	(38)
Heat transfer coeff	112.2502	111.5717	111.9065	111.5717	111.5717	110.3218	110.6209	109.7504	109.7504	110.3218	110.0316	110.9289	(39)
Average = Sum(39)m / 12 =												110.8831	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3433	1.3352	1.3392	1.3352	1.3352	1.3203	1.3238	1.3134	1.3134	1.3203	1.3168	1.3275	(40)
HLP (average)												1.3270	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.5269 (42)
Average daily hot water use (litres/day)	94.2150 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	103.6365	99.8679	96.0993	92.3307	88.5621	84.7935	84.7935	88.5621	92.3307	96.0993	99.8679	103.6365	(44)
Energy conte	153.6899	134.4182	138.7075	120.9286	116.0339	100.1284	92.7837	106.4706	107.7422	125.5632	137.0620	148.8405	(45)
Energy content (annual)										Total = Sum(45)m =		1482.3688	(45)
Distribution loss (46)m = 0.15 x (45)m	23.0535	20.1627	20.8061	18.1393	17.4051	15.0193	13.9176	15.9706	16.1613	18.8345	20.5593	22.3261	(46)
Water storage loss:													

CALCULATION OF HEAT DEMAND 09 Jan 2014

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)
Combi loss 46.4028 41.9008 46.3518 44.8132 46.2755 44.7464 46.2153 46.2543 44.7828 46.3202 44.8763 46.3907 (61)
Total heat required for water heating calculated for each month
200.0927 176.3190 185.0594 165.7418 162.3093 144.8748 138.9989 152.7249 152.5250 171.8834 181.9383 195.2312 (62)
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) = Sum(63)m = 0.0000 (63)
Output from w/h
200.0927 176.3190 185.0594 165.7418 162.3093 144.8748 138.9989 152.7249 152.5250 171.8834 181.9383 195.2312 (64)
Total per year (kWh/year) = Sum(64)m = 2027.6988 (64)
RHI water heating demand 2028 (64)
Heat gains from water heating, kWh/month
62.7026 55.1692 57.7082 51.4121 50.1501 44.4793 42.4044 46.9651 47.0200 53.3298 56.7922 61.0871 (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	151.6168	151.6168	151.6168	151.6168	151.6168	151.6168	151.6168	151.6168	151.6168	151.6168	151.6168	151.6168	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	50.5215	44.8728	36.4930	27.6275	20.6519	17.4352	18.8394	24.4881	32.8679	41.7333	48.7090	51.9257	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	338.3877	341.8991	333.0505	314.2128	290.4336	268.0845	253.1540	249.6426	258.4912	277.3289	301.1081	323.4571	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.6886	52.6886	52.6886	52.6886	52.6886	52.6886	52.6886	52.6886	52.6886	52.6886	52.6886	52.6886	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)													
	-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	(71)
Water heating gains (Table 5)													
	84.2777	82.0971	77.5648	71.4056	67.4061	61.7768	56.9951	63.1251	65.3055	71.6799	78.8781	82.1064	(72)
Total internal gains													
	579.4145	575.0965	553.3358	519.4736	484.7192	453.5241	435.2160	443.4833	462.8922	496.9696	534.9227	563.7167	(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	4.2000	12.7650	0.7600	0.7000	0.7700	19.7659	(74)
South	6.8000	54.2217	0.7600	0.7000	0.7700	133.5348	(78)
North	8.0000	12.7650	0.7600	0.7000	0.7700	37.6493	(74)

Solar gains	190.9500	287.3313	405.6324	564.6535	634.9037	715.8410	657.0563	578.9922	483.9766	340.0426	225.7469	157.8653	(83)
Total gains	770.3645	862.4278	958.9682	1084.1270	1119.6229	1169.3651	1092.2723	1022.4755	946.8688	837.0122	760.6696	721.5821	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	51.6950	52.0094	51.8538	52.0094	52.0094	52.5987	52.4564	52.8725	52.8725	52.5987	52.7374	52.3108	
alpha	4.4463	4.4673	4.4569	4.4673	4.4673	4.5066	4.4971	4.5248	4.5248	4.5066	4.5158	4.4874	
util living area													
	0.9856	0.9748	0.9462	0.8639	0.7205	0.4717	0.3425	0.3832	0.6481	0.8940	0.9705	0.9887	(86)
MIT	19.9110	20.0824	20.3566	20.6839	20.8945	20.9880	20.9978	20.9964	20.9511	20.6852	20.2690	19.8806	(87)
Th 2	19.8070	19.8133	19.8102	19.8133	19.8133	19.8250	19.8222	19.8303	19.8303	19.8250	19.8277	19.8193	(88)
util rest of house													
	0.9808	0.9665	0.9280	0.8211	0.6423	0.3676	0.2248	0.2604	0.5413	0.8498	0.9589	0.9848	(89)
MIT 2	18.8594	19.0318	19.2926	19.5908	19.7566	19.8216	19.8219	19.8298	19.8111	19.6112	19.2278	18.8395	(90)
Living area fraction									fLA = Living area / (4) =			0.1387	(91)
MIT	19.0052	19.1775	19.4402	19.7424	19.9144	19.9834	19.9850	19.9916	19.9692	19.7602	19.3722	18.9839	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.8552	19.0275	19.2902	19.5924	19.7644	19.8334	19.8350	19.8416	19.8192	19.6102	19.2222	18.8339	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9755	0.9592	0.9181	0.8118	0.6387	0.3684	0.2261	0.2616	0.5402	0.8399	0.9509	0.9803	(94)
Useful gains	751.4570	827.1989	880.3966	880.0814	715.1441	430.7922	247.0015	267.5087	511.4679	702.9911	723.3207	707.3319	(95)
Ext temp.	5.3000	5.9000	7.6000	10.0000	12.9000	15.9000	17.6000	17.4000	15.0000	11.6000	8.2000	5.3000	(96)
Heat loss rate W													
	1521.5777	1464.6596	1308.2047	1070.2396	765.8732	433.9377	247.2415	267.9710	528.9108	883.6981	1212.7899	1501.2965	(97)
Month fracti	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													
	572.9698	428.3736	318.2892	136.9139	37.7425	0.0000	0.0000	0.0000	0.0000	134.4460	352.4178	590.7097	(98)
Space heating												2571.8626	(98)
RHI space heating demand												2572	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	46.6100	(1b)	x 2.4000	(2b) =	111.8640	(1b) - (3b)
First floor	36.9500	(1c)	x 2.6000	(2c) =	96.0700	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	83.5600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.9340	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent 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)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1443	(8)
Pressure test		Yes	
Measured/design AP50		7.8500	
Infiltration rate		0.5368	(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) =	0.4563	(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	0.5817	0.5703	0.5589	0.5019	0.4905	0.4334	0.4334	0.4220	0.4563	0.4905	0.5133	0.5361	(22b)
Effective ac	0.6692	0.6626	0.6562	0.6259	0.6203	0.5939	0.5939	0.5891	0.6041	0.6203	0.6317	0.6437	(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	
Door			1.9400	1.8000	3.4920			(26)
Windows (Uw = 1.40)			10.8800	1.3258	14.4242			(27)
Bi fold doors (Uw = 1.40)			8.0000	1.3258	10.6061			(27)
Heat Loss Floor 1			46.6100	0.1000	4.6610			(28a)
External Wall 1	106.7500	20.8200	85.9300	0.2200	18.9046			(29a)
External Roof 1	9.6600		9.6600	0.1500	1.4490			(30)
External Roof 2	36.9500		36.9500	0.1300	4.8035			(30)
Total net area of external elements Aum(A, m2)			199.9700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		58.3404			(33)
Party Wall 1			36.4000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	12.8111	(36)
Total fabric heat loss (33) + (36) =	71.1515	(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	45.9197	45.4689	45.0269	42.9512	42.5629	40.7550	40.7550	40.4202	41.4513	42.5629	43.3485	44.1699	(38)
Heat transfer coeff	117.0712	116.6204	116.1784	114.1027	113.7144	111.9065	111.9065	111.5717	112.6029	113.7144	114.5000	115.3214	(39)
Average = Sum(39)m / 12 =												114.1009	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4010	1.3956	1.3904	1.3655	1.3609	1.3392	1.3392	1.3352	1.3476	1.3609	1.3703	1.3801	(40)
HLP (average)												1.3655	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.5269 (42)
Average daily hot water use (litres/day)	94.2150 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	103.6365	99.8679	96.0993	92.3307	88.5621	84.7935	84.7935	88.5621	92.3307	96.0993	99.8679	103.6365	(44)
Energy conte	153.6899	134.4182	138.7075	120.9286	116.0339	100.1284	92.7837	106.4706	107.7422	125.5632	137.0620	148.8405	(45)
Energy content (annual)										Total = Sum(45)m =		1482.3688	(45)
Distribution loss (46)m = 0.15 x (45)m	23.0535	20.1627	20.8061	18.1393	17.4051	15.0193	13.9176	15.9706	16.1613	18.8345	20.5593	22.3261	(46)
Water storage loss:													

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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)
Combi loss 46.4028 41.9008 46.3518 44.8132 46.2755 44.7464 46.2153 46.2543 44.7828 46.3202 44.8763 46.3907 (61)
Total heat required for water heating calculated for each month
200.0927 176.3190 185.0594 165.7418 162.3093 144.8748 138.9989 152.7249 152.5250 171.8834 181.9383 195.2312 (62)
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) = Sum(63)m = 0.0000 (63)
Output from w/h
200.0927 176.3190 185.0594 165.7418 162.3093 144.8748 138.9989 152.7249 152.5250 171.8834 181.9383 195.2312 (64)
Total per year (kWh/year) = Sum(64)m = 2027.6988 (64)
Heat gains from water heating, kWh/month
62.7026 55.1692 57.7082 51.4121 50.1501 44.4793 42.4044 46.9651 47.0200 53.3298 56.7922 61.0871 (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	151.6168	151.6168	151.6168	151.6168	151.6168	151.6168	151.6168	151.6168	151.6168	151.6168	151.6168	151.6168	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	50.5215	44.8728	36.4930	27.6275	20.6519	17.4352	18.8394	24.4881	32.8679	41.7333	48.7090	51.9257	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	338.3877	341.8991	333.0505	314.2128	290.4336	268.0845	253.1540	249.6426	258.4912	277.3289	301.1081	323.4571	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	52.6886	52.6886	52.6886	52.6886	52.6886	52.6886	52.6886	52.6886	52.6886	52.6886	52.6886	52.6886	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)

Losses e.g. evaporation (negative values) (Table 5)

	-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	(71)

Water heating gains (Table 5)

	84.2777	82.0971	77.5648	71.4056	67.4061	61.7768	56.9951	63.1251	65.3055	71.6799	78.8781	82.1064	(72)
Total internal gains													
	579.4145	575.0965	553.3358	519.4736	484.7192	453.5241	435.2160	443.4833	462.8922	496.9696	534.9227	563.7167	(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	4.2000	10.6334	0.7600	0.7000	0.7700	16.4652	(74)
South	6.6800	46.7521	0.7600	0.7000	0.7700	115.1389	(78)
North	8.0000	10.6334	0.7600	0.7000	0.7700	31.3622	(74)

Solar gains	162.9663	279.9684	395.5139	520.9511	618.9593	632.0143	601.8908	524.8106	437.6546	312.1886	195.4801	139.3619	(83)
Total gains	742.3808	855.0650	948.8497	1040.4247	1103.6785	1085.5383	1037.1069	968.2939	900.5468	809.1582	730.4028	703.0786	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	49.5662	49.7578	49.9471	50.8557	51.0294	51.8538	51.8538	52.0094	51.5331	51.0294	50.6793	50.3183	
alpha	4.3044	4.3172	4.3298	4.3904	4.4020	4.4569	4.4569	4.4673	4.4355	4.4020	4.3786	4.3546	
util living area													
	0.9903	0.9815	0.9618	0.9090	0.7971	0.6205	0.4656	0.5150	0.7513	0.9318	0.9819	0.9923	(86)
MIT	19.6889	19.8829	20.1688	20.5297	20.8075	20.9537	20.9897	20.9841	20.8911	20.5360	20.0551	19.6626	(87)
Th 2	19.7625	19.7667	19.7707	19.7899	19.7935	19.8102	19.8102	19.8133	19.8038	19.7935	19.7862	19.7786	(88)
util rest of house													
	0.9872	0.9755	0.9492	0.8789	0.7343	0.5210	0.3444	0.3896	0.6589	0.9024	0.9749	0.9897	(89)
MIT 2	18.6046	18.7988	19.0803	19.4350	19.6745	19.7912	19.8080	19.8094	19.7507	19.4522	18.9860	18.5913	(90)
Living area fraction										fLA = Living area / (4) =		0.1387	(91)
MIT	18.7550	18.9492	19.2313	19.5868	19.8316	19.9525	19.9719	19.9724	19.9089	19.6025	19.1343	18.7399	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.6050	18.7992	19.0813	19.4368	19.6816	19.8025	19.8219	19.8224	19.7589	19.4525	18.9843	18.5899	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9830	0.9691	0.9400	0.8682	0.7277	0.5203	0.3456	0.3906	0.6549	0.8917	0.9685	0.9862	(94)
Useful gains	729.7538	828.6436	891.8922	903.2779	803.1325	564.8082	358.4208	378.1960	589.7967	721.5227	707.4014	693.3517	(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													
	1674.7022	1620.9268	1461.6769	1202.2792	907.6276	582.1891	360.5474	381.8389	637.2033	1006.6616	1360.7525	1659.4579	(97)
Month fracti	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													
	703.0416	532.4143	423.9198	215.2809	77.7444	0.0000	0.0000	0.0000	0.0000	212.1433	470.4128	718.7831	(98)
Space heating												3353.7403	(98)
Space heating per m2											(98) / (4) =	40.1357	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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 %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3705.7904	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	703.0416	532.4143	423.9198	215.2809	77.7444	0.0000	0.0000	0.0000	0.0000	212.1433	470.4128	718.7831	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	776.8416	588.3031	468.4197	237.8795	85.9054	0.0000	0.0000	0.0000	0.0000	234.4125	519.7932	794.2354	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	200.0927	176.3190	185.0594	165.7418	162.3093	144.8748	138.9989	152.7249	152.5250	171.8834	181.9383	195.2312	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7710	89.6822	89.5030	89.0796	88.3113	87.3000	87.3000	87.3000	87.3000	89.0392	89.5842	89.7969	(217)
Fuel for water heating, kWh/month													
	222.8925	196.6042	206.7632	186.0603	183.7923	165.9505	159.2199	174.9427	174.7137	193.0424	203.0920	217.4141	(219)
Water heating fuel used												2284.4876	(219)
Annual totals kWh/year													
Space heating fuel - main system												3705.7904	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.8903	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.00 * 1080 * 1.00) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												4694.9289	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3705.7904	3.4800	128.9615	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2284.4876	3.4800	79.5002	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	356.8903	13.1900	47.0738	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			157.6051	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	0.5149	(257)
SAP value		92.8173	
SAP rating (Section 12)		93	(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	3705.7904	0.2160	800.4507	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2284.4876	0.2160	493.4493	(264)
Space and water heating			1293.9001	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.8903	0.5190	185.2261	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			621.6139	(272)
CO2 emissions per m2			7.4400	(273)
EI value			93.5208	
EI rating			94	(274)
EI band			A	

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8866 = 3.925, stars = 4

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Water heating environmental impact 0.216 / 0.8866 = 0.2436, stars = 4

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	46.6100	(1b)	x 2.4000	(2b) =	111.8640	(1b) - (3b)
First floor	36.9500	(1c)	x 2.6000	(2c) =	96.0700	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	83.5600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.9340	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent 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)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1443	(8)
Pressure test			Yes	
Measured/design AP50			7.8500	
Infiltration rate			0.5368	(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) =		0.4563	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	3.9000	3.7000	3.8000	3.7000	3.7000	3.3000	3.4000	3.1000	3.1000	3.3000	3.2000	3.5000	(22)
Wind factor	0.9750	0.9250	0.9500	0.9250	0.9250	0.8250	0.8500	0.7750	0.7750	0.8250	0.8000	0.8750	(22a)
Adj infilt rate	0.4449	0.4220	0.4334	0.4220	0.4220	0.3764	0.3878	0.3536	0.3536	0.3764	0.3650	0.3992	(22b)
Effective ac	0.5989	0.5891	0.5939	0.5891	0.5891	0.5708	0.5752	0.5625	0.5625	0.5708	0.5666	0.5797	(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	
Door			1.9400	1.8000	3.4920			(26)
Windows (Uw = 1.40)			10.8800	1.3258	14.4242			(27)
Bi fold doors (Uw = 1.40)			8.0000	1.3258	10.6061			(27)
Heat Loss Floor 1			46.6100	0.1000	4.6610			(28a)
External Wall 1	106.7500	20.8200	85.9300	0.2200	18.9046			(29a)
External Roof 1	9.6600		9.6600	0.1500	1.4490			(30)
External Roof 2	36.9500		36.9500	0.1300	4.8035			(30)
Total net area of external elements Aum(A, m2)			199.9700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		58.3404			(33)
Party Wall 1			36.4000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	12.8111	(36)
Total fabric heat loss (33) + (36) =	71.1515	(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	41.0987	40.4202	40.7550	40.4202	40.4202	39.1703	39.4694	38.5989	38.5989	39.1703	38.8801	39.7774	(38)
Heat transfer coeff	112.2502	111.5717	111.9065	111.5717	111.5717	110.3218	110.6209	109.7504	109.7504	110.3218	110.0316	110.9289	(39)
Average = Sum(39)m / 12 =												110.8831	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3433	1.3352	1.3392	1.3352	1.3352	1.3203	1.3238	1.3134	1.3134	1.3203	1.3168	1.3275	(40)
HLP (average)												1.3270	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.5269 (42)
Average daily hot water use (litres/day)	94.2150 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	103.6365	99.8679	96.0993	92.3307	88.5621	84.7935	84.7935	88.5621	92.3307	96.0993	99.8679	103.6365	(44)
Energy conte	153.6899	134.4182	138.7075	120.9286	116.0339	100.1284	92.7837	106.4706	107.7422	125.5632	137.0620	148.8405	(45)
Energy content (annual)										Total = Sum(45)m =		1482.3688	(45)
Distribution loss (46)m = 0.15 x (45)m	23.0535	20.1627	20.8061	18.1393	17.4051	15.0193	13.9176	15.9706	16.1613	18.8345	20.5593	22.3261	(46)
Water storage loss:													

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

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)
Combi loss	46.4028	41.9008	46.3518	44.8132	46.2755	44.7464	46.2153	46.2543	44.7828	46.3202	44.8763	46.3907	(61)

Total heat required for water heating calculated for each month

	200.0927	176.3190	185.0594	165.7418	162.3093	144.8748	138.9989	152.7249	152.5250	171.8834	181.9383	195.2312	(62)
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) = Sum(63)m =				0.0000	(63)

Output from w/h

	200.0927	176.3190	185.0594	165.7418	162.3093	144.8748	138.9989	152.7249	152.5250	171.8834	181.9383	195.2312	(64)
								Total per year (kWh/year) = Sum(64)m =				2027.6988	(64)

Heat gains from water heating, kWh/month

	62.7026	55.1692	57.7082	51.4121	50.1501	44.4793	42.4044	46.9651	47.0200	53.3298	56.7922	61.0871	(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	151.6168	151.6168	151.6168	151.6168	151.6168	151.6168	151.6168	151.6168	151.6168	151.6168	151.6168	151.6168	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	50.5215	44.8728	36.4930	27.6275	20.6519	17.4352	18.8394	24.4881	32.8679	41.7333	48.7090	51.9257	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	338.3877	341.8991	333.0505	314.2128	290.4336	268.0845	253.1540	249.6426	258.4912	277.3289	301.1081	323.4571	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	52.6886	52.6886	52.6886	52.6886	52.6886	52.6886	52.6886	52.6886	52.6886	52.6886	52.6886	52.6886	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)

Losses e.g. evaporation (negative values) (Table 5)

	-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	(71)

Water heating gains (Table 5)

	84.2777	82.0971	77.5648	71.4056	67.4061	61.7768	56.9951	63.1251	65.3055	71.6799	78.8781	82.1064	(72)

Total internal gains

	579.4145	575.0965	553.3358	519.4736	484.7192	453.5241	435.2160	443.4833	462.8922	496.9696	534.9227	563.7167	(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	4.2000	12.7650	0.7600	0.7000	0.7700	19.7659	(74)
South	6.6800	54.2217	0.7600	0.7000	0.7700	133.5348	(78)
North	8.0000	12.7650	0.7600	0.7000	0.7700	37.6493	(74)

Solar gains	190.9500	287.3313	405.6324	564.6535	634.9037	715.8410	657.0563	578.9922	483.9766	340.0426	225.7469	157.8653	(83)
Total gains	770.3645	862.4278	958.9682	1084.1270	1119.6229	1169.3651	1092.2723	1022.4755	946.8688	837.0122	760.6696	721.5821	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	51.6950	52.0094	51.8538	52.0094	52.0094	52.5987	52.4564	52.8725	52.8725	52.5987	52.7374	52.3108	
alpha	4.4463	4.4673	4.4569	4.4673	4.4673	4.5066	4.4971	4.5248	4.5248	4.5066	4.5158	4.4874	
util living area	0.9856	0.9748	0.9462	0.8639	0.7205	0.4717	0.3425	0.3832	0.6481	0.8940	0.9705	0.9887	(86)
MIT	19.9110	20.0824	20.3566	20.6839	20.8945	20.9880	20.9978	20.9964	20.9511	20.6852	20.2690	19.8806	(87)
Th 2	19.8070	19.8133	19.8102	19.8133	19.8133	19.8250	19.8222	19.8303	19.8303	19.8250	19.8277	19.8193	(88)
util rest of house	0.9808	0.9665	0.9280	0.8211	0.6423	0.3676	0.2248	0.2604	0.5413	0.8498	0.9589	0.9848	(89)
MIT 2	18.8594	19.0318	19.2926	19.5908	19.7566	19.8216	19.8219	19.8298	19.8111	19.6112	19.2278	18.8395	(90)
Living area fraction									fLA = Living area / (4) =			0.1387	(91)
MIT	19.0052	19.1775	19.4402	19.7424	19.9144	19.9834	19.9850	19.9916	19.9692	19.7602	19.3722	18.9839	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.8552	19.0275	19.2902	19.5924	19.7644	19.8334	19.8350	19.8416	19.8192	19.6102	19.2222	18.8339	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9755	0.9592	0.9181	0.8118	0.6387	0.3684	0.2261	0.2616	0.5402	0.8399	0.9509	0.9803	(94)
Useful gains	751.4570	827.1989	880.3966	880.0814	715.1441	430.7922	247.0015	267.5087	511.4679	702.9911	723.3207	707.3319	(95)
Ext temp.	5.3000	5.9000	7.6000	10.0000	12.9000	15.9000	17.6000	17.4000	15.0000	11.6000	8.2000	5.3000	(96)
Heat loss rate W	1521.5777	1464.6596	1308.2047	1070.2396	765.8732	433.9377	247.2415	267.9710	528.9108	883.6981	1212.7899	1501.2965	(97)
Month fracti	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	572.9698	428.3736	318.2892	136.9139	37.7425	0.0000	0.0000	0.0000	0.0000	134.4460	352.4178	590.7097	(98)
Space heating												2571.8626	(98)
Space heating per m2											(98) / (4) =	30.7786	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

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 %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2841.8371	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	572.9698	428.3736	318.2892	136.9139	37.7425	0.0000	0.0000	0.0000	0.0000	134.4460	352.4178	590.7097	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	633.1158	473.3410	351.7008	151.2861	41.7044	0.0000	0.0000	0.0000	0.0000	148.5592	389.4119	652.7178	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	200.0927	176.3190	185.0594	165.7418	162.3093	144.8748	138.9989	152.7249	152.5250	171.8834	181.9383	195.2312	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.6494	89.5430	89.2966	88.7191	87.8863	87.3000	87.3000	87.3000	87.3000	88.6762	89.3844	89.6834	(217)
Fuel for water heating, kWh/month													
	223.1946	196.9099	207.2412	186.8164	184.6811	165.9505	159.2199	174.9427	174.7137	193.8327	203.5459	217.6893	(219)
Water heating fuel used												2288.7377	(219)
Annual totals kWh/year													
Space heating fuel - main system												2841.8371	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.8903	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.00 * 1179 * 1.00) =										-1885.7641		-1885.7641	(233)
Total delivered energy for all uses												3676.7010	(238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2841.8371	10.2300	290.7199	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2288.7377	10.2300	234.1379	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Energy for lighting	356.8903	36.7200	131.0501	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1885.7641	36.7200	-692.4526	(252)
Total energy cost			93.9953	(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	2841.8371	0.2160	613.8368	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2288.7377	0.2160	494.3673	(264)
Space and water heating			1108.2042	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	356.8903	0.5190	185.2261	(268)
Energy saving/generation technologies				
PV Unit	-1885.7641	0.5190	-978.7116	(269)
Total kg/year			353.6437	(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	2841.8371	1.2200	3467.0413	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2288.7377	1.2200	2792.2600	(264)
Space and water heating			6259.3013	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	356.8903	3.0700	1095.6532	(268)
Energy saving/generation technologies				
PV Unit	-1885.7641	3.0700	-5789.2958	(269)
Primary energy kWh/year			1795.9087	(272)
Primary energy kWh/m2/year			21.4924	(273)

SAP 2012 EPC IMPROVEMENTS

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

Current energy efficiency rating: A 93
Current environmental impact rating: A 94

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Already installed
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 84	-189 kg (53.6%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£84	2.27 kg/m²	A 94	A 95
Total Savings	£84	2.27 kg/m²		

Potential energy efficiency rating: A 94
Potential environmental impact rating: A 95

Fuel prices for cost data on this page from database revision number 531 TEST (31 Oct 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£159	£177	-£18
Mains gas	£628	£526	£102
Space heating	£421	£421	£0
Water heating	£234	£150	£84
Lighting	£131	£131	£0
Generated (PV)	-£692	-£692	£0
Total cost of fuels	£95	£11	£84
Total cost of uses	£94	£10	£84
Delivered energy	44 kWh/m²	33 kWh/m²	11 kWh/m²
Carbon dioxide emissions	0.4 tonnes	0.2 tonnes	0.2 tonnes
CO2 emissions per m²	4 kg/m²	2 kg/m²	2 kg/m²
Primary energy	21 kWh/m²	9 kWh/m²	13 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	46.6100	(1b)	x 2.4000	(2b) =	111.8640	(1b) - (3b)
First floor	36.9500	(1c)	x 2.6000	(2c) =	96.0700	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	83.5600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		207.9340	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent 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)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1443	(8)
Pressure test		Yes	
Measured/design AP50		7.8500	
Infiltration rate		0.5368	(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) =	0.4563	(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	0.5817	0.5703	0.5589	0.5019	0.4905	0.4334	0.4334	0.4220	0.4563	0.4905	0.5133	0.5361	(22b)
Effective ac	0.6692	0.6626	0.6562	0.6259	0.6203	0.5939	0.5939	0.5891	0.6041	0.6203	0.6317	0.6437	(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	
Door			1.9400	1.8000	3.4920			(26)
Windows (Uw = 1.40)			10.8800	1.3258	14.4242			(27)
Bi fold doors (Uw = 1.40)			8.0000	1.3258	10.6061			(27)
Heat Loss Floor 1			46.6100	0.1000	4.6610			(28a)
External Wall 1	106.7500	20.8200	85.9300	0.2200	18.9046			(29a)
External Roof 1	9.6600		9.6600	0.1500	1.4490			(30)
External Roof 2	36.9500		36.9500	0.1300	4.8035			(30)
Total net area of external elements Aum(A, m2)			199.9700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		58.3404			(33)
Party Wall 1			36.4000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	12.8111	(36)
Total fabric heat loss (33) + (36) =	71.1515	(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	45.9197	45.4689	45.0269	42.9512	42.5629	40.7550	40.7550	40.4202	41.4513	42.5629	43.3485	44.1699	(38)
Heat transfer coeff	117.0712	116.6204	116.1784	114.1027	113.7144	111.9065	111.9065	111.5717	112.6029	113.7144	114.5000	115.3214	(39)
Average = Sum(39)m / 12 =												114.1009	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.4010	1.3956	1.3904	1.3655	1.3609	1.3392	1.3392	1.3352	1.3476	1.3609	1.3703	1.3801	(40)
HLP (average)												1.3655	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.5269 (42)
Average daily hot water use (litres/day)	94.2150 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	103.6365	99.8679	96.0993	92.3307	88.5621	84.7935	84.7935	88.5621	92.3307	96.0993	99.8679	103.6365	(44)
Energy conte	153.6899	134.4182	138.7075	120.9286	116.0339	100.1284	92.7837	106.4706	107.7422	125.5632	137.0620	148.8405	(45)
Energy content (annual)										Total = Sum(45)m =		1482.3688	(45)
Distribution loss (46)m = 0.15 x (45)m	23.0535	20.1627	20.8061	18.1393	17.4051	15.0193	13.9176	15.9706	16.1613	18.8345	20.5593	22.3261	(46)
Water storage loss:													

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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)
Combi loss	46.4028	41.9008	46.3518	44.8132	46.2755	44.7464	46.2153	46.2543	44.7828	46.3202	44.8763	46.3907	(61)
Total heat required for water heating calculated for each month	200.0927	176.3190	185.0594	165.7418	162.3093	144.8748	138.9989	152.7249	152.5250	171.8834	181.9383	195.2312	(62)

Aperture area of solar collector	3.0000	(H1)
Zero-loss collector efficiency	0.7000	(H2)
Collector heat loss coefficient	1.8000	(H3)
Collector 2nd order heat loss coefficient	0.0050	(H3a)
Collector effective heat loss coefficient	1.8063	(H3b)
Collector performance ratio	2.5804	(H4)
Annual solar radiation per m2	1079.5246	(H5)
Overshading factor	0.8000	(H6)
Solar energy available	1813.6014	(H7)
Adjustment factor for showers	1.0000	(H7a)
Solar-to-load ratio	1.2234	(H8)
Utilisation factor	0.5584	(H9)
Collector performance factor	0.8793	(H10)
Dedicated solar storage volume	75.0000	(H11)
Effective solar volume	75.0000	(H13)
Daily hot water demand	94.2150	(H14)
Volume ratio Veff/V	0.7961	(H15)
Solar storage volume factor	0.9544	(H16)
Solar input	-849.8593	(H17)

Solar input	-24.6442	-41.1241	-70.0391	-93.8662	-115.9638	-114.0109	-112.5042	-98.2955	-76.9851	-52.5717	-29.2316	-20.6230	(63)

Solar input (sum of months) = Sum(63)m = -849.8593 (63)

Output from w/h	175.4485	135.1948	115.0203	71.8756	46.3456	30.8639	26.4948	54.4295	75.5400	119.3117	152.7067	174.6082	(64)

Total per year (kWh/year) = Sum(64)m = 1177.8395 (64)

Heat gains from water heating, kWh/month	62.7026	55.1692	57.7082	51.4121	50.1501	44.4793	42.4044	46.9651	47.0200	53.3298	56.7922	61.0871	(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	151.6168	151.6168	151.6168	151.6168	151.6168	151.6168	151.6168	151.6168	151.6168	151.6168	151.6168	151.6168	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	50.5215	44.8728	36.4930	27.6275	20.6519	17.4352	18.8394	24.4881	32.8679	41.7333	48.7090	51.9257	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	338.3877	341.8991	333.0505	314.2128	290.4336	268.0845	253.1540	249.6426	258.4912	277.3289	301.1081	323.4571	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	52.6886	52.6886	52.6886	52.6886	52.6886	52.6886	52.6886	52.6886	52.6886	52.6886	52.6886	52.6886	(69)
Pumps, fans	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	3.0000	(70)
Losses e.g. evaporation (negative values) (Table 5)	-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	-101.0779	(71)
Water heating gains (Table 5)	84.2777	82.0971	77.5648	71.4056	67.4061	61.7768	56.9951	63.1251	65.3055	71.6799	78.8781	82.1064	(72)
Total internal gains	579.4145	575.0965	553.3358	519.4736	484.7192	453.5241	435.2160	443.4833	462.8922	496.9696	534.9227	563.7167	(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	4.2000	10.6334	0.7600	0.7000	0.7700	16.4652	(74)
South	6.6800	46.7521	0.7600	0.7000	0.7700	115.1389	(78)
North	8.0000	10.6334	0.7600	0.7000	0.7700	31.3622	(74)

Solar gains	162.9663	279.9684	395.5139	520.9511	618.9593	632.0143	601.8908	524.8106	437.6546	312.1886	195.4801	139.3619	(83)
Total gains	742.3808	855.0650	948.8497	1040.4247	1103.6785	1085.5383	1037.1069	968.2939	900.5468	809.1582	730.4028	703.0786	(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	49.5662	49.7578	49.9471	50.8557	51.0294	51.8538	51.8538	52.0094	51.5331	51.0294	50.6793	50.3183	
alpha	4.3044	4.3172	4.3298	4.3904	4.4020	4.4569	4.4569	4.4673	4.4355	4.4020	4.3786	4.3546	
util living area	0.9903	0.9815	0.9618	0.9090	0.7971	0.6205	0.4656	0.5150	0.7513	0.9318	0.9819	0.9923	(86)
MIT	19.6889	19.8829	20.1688	20.5297	20.8075	20.9537	20.9897	20.9841	20.8911	20.5360	20.0551	19.6626	(87)
Th 2	19.7625	19.7667	19.7707	19.7899	19.7935	19.8102	19.8102	19.8133	19.8038	19.7935	19.7862	19.7786	(88)
util rest of house	0.9872	0.9755	0.9492	0.8789	0.7343	0.5210	0.3444	0.3896	0.6589	0.9024	0.9749	0.9897	(89)
MIT 2	18.6046	18.7988	19.0803	19.4350	19.6745	19.7912	19.8080	19.8094	19.7507	19.4522	18.9860	18.5913	(90)

Living area fraction fLA = Living area / (4) = 0.1387 (91)

MIT	18.7550	18.9492	19.2313	19.5868	19.8316	19.9525	19.9719	19.9724	19.9089	19.6025	19.1343	18.7399	(92)

Temperature adjustment -0.1500

adjusted MIT	18.6050	18.7992	19.0813	19.4368	19.6816	19.8025	19.8219	19.8224	19.7589	19.4525	18.9843	18.5899	(93)

8. Space heating requirement

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9830	0.9691	0.9400	0.8682	0.7277	0.5203	0.3456	0.3906	0.6549	0.8917	0.9685	0.9862	(94)
Useful gains	729.7538	828.6436	891.8922	903.2779	803.1325	564.8082	358.4208	378.1960	589.7967	721.5227	707.4014	693.3517	(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													
	1674.7022	1620.9268	1461.6769	1202.2792	907.6276	582.1891	360.5474	381.8389	637.2033	1006.6616	1360.7525	1659.4579	(97)
Month fracti	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													
	703.0416	532.4143	423.9198	215.2809	77.7444	0.0000	0.0000	0.0000	0.0000	212.1433	470.4128	718.7831	(98)
Space heating												3353.7403	(98)
Space heating per m2											(98) / (4) =	40.1357	(99)

8c. Space cooling requirement

Not applicable

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 %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3705.7904	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	703.0416	532.4143	423.9198	215.2809	77.7444	0.0000	0.0000	0.0000	0.0000	212.1433	470.4128	718.7831	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	776.8416	588.3031	468.4197	237.8795	85.9054	0.0000	0.0000	0.0000	0.0000	234.4125	519.7932	794.2354	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	175.4485	135.1948	115.0203	71.8756	46.3456	30.8639	26.4948	54.4295	75.5400	119.3117	152.7067	174.6082	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8423	89.8332	89.7975	89.6772	89.2778	87.3000	87.3000	87.3000	87.3000	89.3214	89.6943	89.8563	(217)
Fuel for water heating, kWh/month													
	195.2850	150.4954	128.0885	80.1493	51.9116	35.3538	30.3491	62.3476	86.5292	133.5756	170.2525	194.3194	(219)
Water heating fuel used												1318.6570	(219)
Annual totals kWh/year													
Space heating fuel - main system												3705.7904	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.8903	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.00 * 1080 * 1.00) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												3779.0983	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3705.7904	3.4800	128.9615	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1318.6570	3.4800	45.8893	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	356.8903	13.1900	47.0738	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			130.5892	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):	0.4200	(256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] =	0.4266	(257)
SAP value	94.0485	
SAP rating (Section 12)	94	(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	3705.7904	0.2160	800.4507	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Water heating (other fuel)	1318.6570	0.2160	284.8299 (264)
Space and water heating			1085.2806 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	356.8903	0.5190	185.2261 (268)
Energy saving/generation technologies			
PV Unit	-1727.2394	0.5190	-896.4372 (269)
Total kg/year			438.9445 (272)
CO2 emissions per m2			5.2500 (273)
EI value			95.4248
EI rating			95 (274)
EI band			A

CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	46.6100 (1b)	x	2.4000 (2b)	=	111.8640	(1b) - (3b)
First floor	36.9500 (1c)	x	2.6000 (2c)	=	96.0700	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	83.5600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	207.9340	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent 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)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1443	(8)
Pressure test		Yes	
Measured/design AP50		7.8500	
Infiltration rate		0.5368	(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) =	0.4563	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	3.9000	3.7000	3.8000	3.7000	3.7000	3.3000	3.4000	3.1000	3.1000	3.3000	3.2000	3.5000	(22)
Wind factor	0.9750	0.9250	0.9500	0.9250	0.9250	0.8250	0.8500	0.7750	0.7750	0.8250	0.8000	0.8750	(22a)
Adj infilt rate	0.4449	0.4220	0.4334	0.4220	0.4220	0.3764	0.3878	0.3536	0.3536	0.3764	0.3650	0.3992	(22b)
Effective ac	0.5989	0.5891	0.5939	0.5891	0.5891	0.5708	0.5752	0.5625	0.5625	0.5708	0.5666	0.5797	(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	
Door			1.9400	1.8000	3.4920			(26)
Windows (Uw = 1.40)			10.8800	1.3258	14.4242			(27)
Bi fold doors (Uw = 1.40)			8.0000	1.3258	10.6061			(27)
Heat Loss Floor 1			46.6100	0.1000	4.6610			(28a)
External Wall 1	106.7500	20.8200	85.9300	0.2200	18.9046			(29a)
External Roof 1	9.6600		9.6600	0.1500	1.4490			(30)
External Roof 2	36.9500		36.9500	0.1300	4.8035			(30)
Total net area of external elements Aum(A, m2)			199.9700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		58.3404			(33)
Party Wall 1			36.4000	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	12.8111	(36)
Total fabric heat loss (33) + (36) =	71.1515	(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	41.0987	40.4202	40.7550	40.4202	40.4202	39.1703	39.4694	38.5989	38.5989	39.1703	38.8801	39.7774	(38)
Heat transfer coeff	112.2502	111.5717	111.9065	111.5717	111.5717	110.3218	110.6209	109.7504	109.7504	110.3218	110.0316	110.9289	(39)
Average = Sum(39)m / 12 =												110.8831	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3433	1.3352	1.3392	1.3352	1.3352	1.3203	1.3238	1.3134	1.3134	1.3203	1.3168	1.3275	(40)
HLP (average)												1.3270	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.5269 (42)
Average daily hot water use (litres/day)	94.2150 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	103.6365	99.8679	96.0993	92.3307	88.5621	84.7935	84.7935	88.5621	92.3307	96.0993	99.8679	103.6365	(44)
Energy conte	153.6899	134.4182	138.7075	120.9286	116.0339	100.1284	92.7837	106.4706	107.7422	125.5632	137.0620	148.8405	(45)
Energy content (annual)										Total = Sum(45)m =		1482.3688	(45)
Distribution loss (46)m = 0.15 x (45)m	23.0535	20.1627	20.8061	18.1393	17.4051	15.0193	13.9176	15.9706	16.1613	18.8345	20.5593	22.3261	(46)

Water storage loss:

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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)
Combi loss 46.4028 41.9008 46.3518 44.8132 46.2755 44.7464 46.2153 46.2543 44.7828 46.3202 44.8763 46.3907 (61)
Total heat required for water heating calculated for each month
200.0927 176.3190 185.0594 165.7418 162.3093 144.8748 138.9989 152.7249 152.5250 171.8834 181.9383 195.2312 (62)

Aperture area of solar collector	3.0000 (H1)
Zero-loss collector efficiency	0.7000 (H2)
Collector heat loss coefficient	1.8000 (H3)
Collector 2nd order heat loss coefficient	0.0050 (H3a)
Collector effective heat loss coefficient	1.8063 (H3b)
Collector performance ratio	2.5804 (H4)
Annual solar radiation per m2	1178.6026 (H5)
Overshading factor	0.8000 (H6)
Solar energy available	1980.0523 (H7)
Adjustment factor for showers	1.0000 (H7a)
Solar-to-load ratio	1.3357 (H8)
Utilisation factor	0.5270 (H9)
Collector performance factor	0.8793 (H10)
Dedicated solar storage volume	75.0000 (H11)
Effective solar volume	75.0000 (H13)
Daily hot water demand	94.2150 (H14)
Volume ratio Veff/V	0.7961 (H15)
Solar storage volume factor	0.9544 (H16)
Solar input	-875.6688 (H17)

Solar input -27.7684 -40.5296 -68.6100 -96.3747 -112.0536 -121.4318 -115.5711 -102.4516 -81.0523 -54.9034 -32.4559 -22.4665 (63)
Solar input (sum of months) = Sum(63)m = -875.6688 (63)
Output from w/h
172.3244 135.7894 116.4493 69.3671 50.2557 23.4430 23.4278 50.2734 71.4728 116.9800 149.4824 172.7647 (64)
Total per year (kWh/year) = Sum(64)m = 1152.0300 (64)
Heat gains from water heating, kWh/month
62.7026 55.1692 57.7082 51.4121 50.1501 44.4793 42.4044 46.9651 47.0200 53.3298 56.7922 61.0871 (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	151.6168	151.6168	151.6168	151.6168	151.6168	151.6168	151.6168	151.6168	151.6168	151.6168	151.6168	151.6168	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
50.5215 44.8728 36.4930 27.6275 20.6519 17.4352 18.8394 24.4881 32.8679 41.7333 48.7090 51.9257 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
338.3877 341.8991 333.0505 314.2128 290.4336 268.0845 253.1540 249.6426 258.4912 277.3289 301.1081 323.4571 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
52.6886 52.6886 52.6886 52.6886 52.6886 52.6886 52.6886 52.6886 52.6886 52.6886 52.6886 52.6886 (69)
Pumps, fans 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 3.0000 (70)
Losses e.g. evaporation (negative values) (Table 5)
-101.0779 -101.0779 -101.0779 -101.0779 -101.0779 -101.0779 -101.0779 -101.0779 -101.0779 -101.0779 -101.0779 -101.0779 (71)
Water heating gains (Table 5)
84.2777 82.0971 77.5648 71.4056 67.4061 61.7768 56.9951 63.1251 65.3055 71.6799 78.8781 82.1064 (72)
Total internal gains
579.4145 575.0965 553.3358 519.4736 484.7192 453.5241 435.2160 443.4833 462.8922 496.9696 534.9227 563.7167 (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	4.2000	12.7650	0.7600	0.7000	0.7700	19.7659	(74)
South	6.6800	54.2217	0.7600	0.7000	0.7700	133.5348	(78)
North	8.0000	12.7650	0.7600	0.7000	0.7700	37.6493	(74)

Solar gains 190.9500 287.3313 405.6324 564.6535 634.9037 715.8410 657.0563 578.9922 483.9766 340.0426 225.7469 157.8653 (83)
Total gains 770.3645 862.4278 958.9682 1084.1270 1119.6229 1169.3651 1092.2723 1022.4755 946.8688 837.0122 760.6696 721.5821 (84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	51.6950	52.0094	51.8538	52.0094	52.0094	52.5987	52.4564	52.8725	52.8725	52.5987	52.7374	52.3108	
alpha	4.4463	4.4673	4.4569	4.4673	4.4673	4.5066	4.4971	4.5248	4.5248	4.5066	4.5158	4.4874	

util living area
0.9856 0.9748 0.9462 0.8639 0.7205 0.4717 0.3425 0.3832 0.6481 0.8940 0.9705 0.9887 (86)

MIT	19.9110	20.0824	20.3566	20.6839	20.8945	20.9880	20.9978	20.9964	20.9511	20.6852	20.2690	19.8806	(87)
Th 2	19.8070	19.8133	19.8102	19.8133	19.8133	19.8250	19.8222	19.8303	19.8303	19.8250	19.8277	19.8193	(88)

util rest of house
0.9808 0.9665 0.9280 0.8211 0.6423 0.3676 0.2248 0.2604 0.5413 0.8498 0.9589 0.9848 (89)

MIT 2	18.8594	19.0318	19.2926	19.5908	19.7566	19.8216	19.8219	19.8298	19.8111	19.6112	19.2278	18.8395	(90)
Living area fraction									fLA = Living area / (4) =			0.1387	(91)
MIT	19.0052	19.1775	19.4402	19.7424	19.9144	19.9834	19.9850	19.9916	19.9692	19.7602	19.3722	18.9839	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.8552	19.0275	19.2902	19.5924	19.7644	19.8334	19.8350	19.8416	19.8192	19.6102	19.2222	18.8339	(93)

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8. Space heating requirement

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9755	0.9592	0.9181	0.8118	0.6387	0.3684	0.2261	0.2616	0.5402	0.8399	0.9509	0.9803	(94)
Useful gains	751.4570	827.1989	880.3966	880.0814	715.1441	430.7922	247.0015	267.5087	511.4679	702.9911	723.3207	707.3319	(95)
Ext temp.	5.3000	5.9000	7.6000	10.0000	12.9000	15.9000	17.6000	17.4000	15.0000	11.6000	8.2000	5.3000	(96)
Heat loss rate W													
	1521.5777	1464.6596	1308.2047	1070.2396	765.8732	433.9377	247.2415	267.9710	528.9108	883.6981	1212.7899	1501.2965	(97)
Month fracti	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													
	572.9698	428.3736	318.2892	136.9139	37.7425	0.0000	0.0000	0.0000	0.0000	134.4460	352.4178	590.7097	(98)
Space heating												2571.8626	(98)
Space heating per m2											(98) / (4) =	30.7786	(99)

8c. Space cooling requirement

Not applicable

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 %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2841.8371	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	572.9698	428.3736	318.2892	136.9139	37.7425	0.0000	0.0000	0.0000	0.0000	134.4460	352.4178	590.7097	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	633.1158	473.3410	351.7008	151.2861	41.7044	0.0000	0.0000	0.0000	0.0000	148.5592	389.4119	652.7178	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	172.3244	135.7894	116.4493	69.3671	50.2557	23.4430	23.4278	50.2734	71.4728	116.9800	149.4824	172.7647	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7394	89.7085	89.6201	89.3981	88.6443	87.3000	87.3000	87.3000	87.3000	88.9825	89.5227	89.7555	(217)
Fuel for water heating, kWh/month													
	192.0275	151.3673	129.9367	77.5935	56.6937	26.8534	26.8360	57.5869	81.8703	131.4641	166.9772	192.4836	(219)
Water heating fuel used												1291.6901	(219)
Annual totals kWh/year													
Space heating fuel - main system												2841.8371	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												356.8903	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.00 * 1179 * 1.00) =										-1885.7641		-1885.7641	(233)
Total delivered energy for all uses												2729.6534	(238)

10a. Fuel costs - using BEDF prices (531)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2841.8371	10.2300	290.7199	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1291.6901	10.2300	132.1399	(247)
Pumps and fans for heating	75.0000	36.7200	27.5400	(249)
Pump for solar water heating	50.0000	36.7200	18.3600	(249)
Energy for lighting	356.8903	36.7200	131.0501	(250)
Additional standing charges			103.0000	(251)
Energy saving/generation technologies				
PV Unit	-1885.7641	36.7200	-692.4526	(252)
Total energy cost			10.3574	(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	2841.8371	0.2160	613.8368	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1291.6901	0.2160	279.0051	(264)
Space and water heating			892.8419	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	356.8903	0.5190	185.2261	(268)
Energy saving/generation technologies				
PV Unit	-1885.7641	0.5190	-978.7116	(269)
Total kg/year			164.2314	(272)

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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	2841.8371	1.2200	3467.0413	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1291.6901	1.2200	1575.8619	(264)
Space and water heating			5042.9033	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	356.8903	3.0700	1095.6532	(268)
Energy saving/generation technologies				
PV Unit	-1885.7641	3.0700	-5789.2958	(269)
Primary energy kWh/year			733.0106	(272)
Primary energy kWh/m2/year			8.7723	(273)