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

AES Sustainability Consultants

Property Reference	Atkins End/Semi (ASHP)	**Issued on Date**	15/12/2022
Assessment Reference	Atkins End/Semi (ASHP)	**Prop Type Ref**	Atkins
Property	2 Bed, WC, B, 2 Storey		

SAP Rating	86 B	**DER**	16.60	**TER**	27.11
Environmental	88 B	**% DER<TER**	38.77		
CO_2 Emissions (t/year)	1.02	**DFEE**	41.87	**TFEE**	50.85
General Requirements Compliance	Pass	**% DFEE<TFEE**	17.65		

Assessor Details	Mr. Christopher MacDougall, Chris MacDougall, Tel: 02032 902 902, chris.macdougall@aessc.co.uk	**Assessor ID**	Q920-0001
Client			

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DWELLING AS DESIGNED

Semi-Detached House, total floor area 71 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:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 27.11 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 16.60 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)50.8 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)41.9 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.11 (max. 0.25)	0.11 (max. 0.70)	OK
Roof	0.18 (max. 0.20)	0.18 (max. 0.35)	OK
Openings	1.22 (max. 2.00)	1.40 (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: 4.01 (design value)
Maximum 10.0 OK

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4 Heating efficiency
Main heating system: Heat pump with radiators or underfloor - Electric
Vaillant aroTHERM 8kW VWL 85/3 A 230v

Secondary heating system: None

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5 Cylinder insulation
Hot water storage Measured cylinder loss: 1.56 kWh/day
Permitted by DBSCG 2.24 OK
Primary pipework insulated: Yes OK

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6 Controls
Space heating controls: Time and temperature zone control OK

Hot water controls: Cylinderstat OK
Independent timer for DHW 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
Continuous extract system (decentralised)
Specific fan power: 0.1700 0.1800
Maximum 0.7 OK

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9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing North East: 3.90 m², No overhang
Windows facing South West: 6.80 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

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10 Key features
Party wall U-value 0.00 W/m²K
Floor U-value 0.11 W/m²K
Door U-value 1.00 W/m²K
Window U-value 0.90 W/m²K
Thermal bridging y-value 0.027 W/m²K

SAP 2012 WORKSHEET FOR New Build (As Designed) (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	35.4600 (1b)	x	2.3100 (2b)	=	81.9126	(1b) - (3b)
First floor	35.4600 (1c)	x	2.6100 (2c)	=	92.5506	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	70.9200					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	174.4632	(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							0 * 10	=	0.0000	(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) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		4.0100	
Infiltration rate		0.2005	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1855	(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	0.2365	0.2318	0.2272	0.2040	0.1994	0.1762	0.1762	0.1716	0.1855	0.1994	0.2086	0.2179	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(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	
Solid Door			2.1500	1.0000	2.1500			(26)
Window (Uw = 1.20)			7.3700	1.1450	8.4389			(27)
French Door (Uw = 1.40)			3.3300	1.3258	4.4148			(27)
150mm Wht + Wht Topsheet			35.4600	0.1100	3.9006	75.0000	2659.5000	(28a)
100mm Knauf Supafil 34	82.9000	12.8500	70.0500	0.2500	17.5125	52.8000	3698.6400	(29a)
FP McCann System	35.4600		35.4600	0.1800	6.3828	9.0000	319.1400	(30)
Total net area of external elements Aum(A, m2)			153.8200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	42.7996			(33)
E-WM-30			39.9000	0.0000	0.0000	45.0000	1795.5000	(32)
Timber GF			65.7000			9.0000	591.3000	(32c)
Timber 1F			69.5700			9.0000	626.1300	(32c)
Internal Floor			35.4600			12.6000	446.7960	(32d)
Internal Ceiling			35.4600			9.0000	319.1400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 10456.1460	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	147.4358	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	4.1111	(36)
Total fabric heat loss	(33) + (36) = 46.9107	(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	28.7864	28.7864	28.7864	28.7864	28.7864	28.7864	28.7864	28.7864	28.7864	28.7864	28.7864	28.7864	(38)
Heat transfer coeff	75.6972	75.6972	75.6972	75.6972	75.6972	75.6972	75.6972	75.6972	75.6972	75.6972	75.6972	75.6972	(39)
Average = Sum(39)m / 12 =												75.6972	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0674	1.0674	1.0674	1.0674	1.0674	1.0674	1.0674	1.0674	1.0674	1.0674	1.0674	1.0674	(40)
HLP (average)												1.0674	(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	2.2683	(42)
Average daily hot water use (litres/day)	88.0710	(43)

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

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Daily hot water use													
	96.8781	93.3552	89.8324	86.3096	82.7867	79.2639	79.2639	82.7867	86.3096	89.8324	93.3552	96.8781	(44)
Energy conte	143.6674	125.6524	129.6620	113.0425	108.4670	93.5987	86.7330	99.5274	100.7161	117.3749	128.1238	139.1342	(45)
Energy content (annual)										Total = Sum(45)m =		1385.6994	(45)
Distribution loss (46)m = 0.15 x (45)m													
	21.5501	18.8479	19.4493	16.9564	16.2700	14.0398	13.0100	14.9291	15.1074	17.6062	19.2186	20.8701	(46)
Water storage loss:													
Store volume												200.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5600	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8424	(55)
Total storage loss													
	26.1144	23.5872	26.1144	25.2720	26.1144	25.2720	26.1144	26.1144	25.2720	26.1144	25.2720	26.1144	(56)
If cylinder contains dedicated solar storage													
	26.1144	23.5872	26.1144	25.2720	26.1144	25.2720	26.1144	26.1144	25.2720	26.1144	25.2720	26.1144	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	193.0442	170.2508	179.0388	160.8265	157.8438	141.3827	136.1098	148.9042	148.5001	166.7517	175.9078	188.5110	(62)
WWHRS	-46.2092	-40.6549	-41.4954	-34.1633	-31.7328	-26.1861	-22.1768	-26.8460	-27.6226	-34.1312	-39.5146	-44.6584	eq.(G10)
Total of WWHRS savings												-415.3914	
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													
	146.8350	129.5959	137.5434	126.6632	126.1110	115.1967	113.9330	122.0581	120.8775	132.6205	136.3932	143.8526	(64)
								Total per year (kWh/year) = Sum(64)m =				1551.6800	(64)
Heat gains from water heating, kWh/month													
	87.2708	77.4581	82.6141	75.8138	75.5667	69.3488	68.3402	72.5943	71.7153	78.5286	80.8284	85.7636	(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	113.4126	113.4126	113.4126	113.4126	113.4126	113.4126	113.4126	113.4126	113.4126	113.4126	113.4126	113.4126	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	18.7721	16.6732	13.5596	10.2655	7.6735	6.4783	7.0001	9.0990	12.2126	15.5067	18.0986	19.2938	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	199.4347	201.5042	196.2891	185.1868	171.1721	158.0003	149.2007	147.1312	152.3463	163.4486	177.4633	190.6351	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.3413	34.3413	34.3413	34.3413	34.3413	34.3413	34.3413	34.3413	34.3413	34.3413	34.3413	34.3413	(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)													
	-90.7301	-90.7301	-90.7301	-90.7301	-90.7301	-90.7301	-90.7301	-90.7301	-90.7301	-90.7301	-90.7301	-90.7301	(71)
Water heating gains (Table 5)													
	117.2995	115.2651	111.0404	105.2970	101.5682	96.3178	91.8551	97.5730	99.6046	105.5492	112.2616	115.2736	(72)
Total internal gains													
	392.5301	390.4663	377.9128	357.7730	337.4376	317.8201	305.0796	310.8269	321.1872	341.5282	364.8473	382.2263	(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	
Northeast	3.9000	11.2829	0.4600	0.0000	0.7700	15.5860	(75)
Southwest	3.4700	36.7938	0.4600	0.0000	0.7700	45.2223	(79)
Southwest	3.3300	36.7938	0.4300	0.0000	0.7700	40.5675	(79)

Solar gains	101.3759	177.8577	257.1038	341.6132	403.6733	410.0081	391.4405	343.7261	286.1472	200.2783	122.3677	86.1466	(83)
Total gains	493.9060	568.3239	635.0167	699.3862	741.1109	727.8283	696.5201	654.5530	607.3344	541.8065	487.2150	468.3729	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	38.3698	38.3698	38.3698	38.3698	38.3698	38.3698	38.3698	38.3698	38.3698	38.3698	38.3698	38.3698	
alpha	3.5580	3.5580	3.5580	3.5580	3.5580	3.5580	3.5580	3.5580	3.5580	3.5580	3.5580	3.5580	
util living area													
	0.9782	0.9635	0.9345	0.8720	0.7601	0.6036	0.4595	0.5040	0.7184	0.8991	0.9642	0.9817	(86)
Tweekday	17.9445	18.2617	18.7396	19.2933	19.7296	19.9534	20.0132	20.0059	19.8710	19.3221	18.5223	17.8551	
Tweekend	19.9879	20.1303	20.3466	20.6034	20.8177	20.9415	20.9831	20.9763	20.8885	20.6111	20.2453	19.9479	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	19.4380	19.6547	19.9916	20.3807	20.7187	20.9102	20.9739	20.9634	20.8260	20.3998	19.8215	19.3762	(87)
Th 2	20.0276	20.0276	20.0276	20.0276	20.0276	20.0276	20.0276	20.0276	20.0276	20.0276	20.0276	20.0276	(88)
util rest of house													
	0.9740	0.9566	0.9217	0.8468	0.7136	0.5298	0.3655	0.4082	0.6510	0.8736	0.9562	0.9782	(89)
Tweekday	17.9445	18.2617	18.7396	19.2933	19.7296	19.9534	20.0132	20.0059	19.8710	19.3221	18.5223	17.8551	
Tweekend	17.9445	18.2617	18.7396	19.2933	19.7296	19.9534	20.0132	20.0059	19.8710	19.3221	18.5223	17.8551	
MIT 2	17.9445	18.2617	18.7396	19.2933	19.7296	19.9534	20.0132	20.0059	19.8710	19.3221	18.5223	17.8551	(90)
Living area fraction									fLA = Living area / (4) =			0.1638	(91)
MIT	18.1892	18.4899	18.9448	19.4715	19.8916	20.1102	20.1706	20.1628	20.0275	19.4987	18.7352	18.1043	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1892	18.4899	18.9448	19.4715	19.8916	20.1102	20.1706	20.1628	20.0275	19.4987	18.7352	18.1043	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9627	0.9419	0.9040	0.8299	0.7065	0.5364	0.3798	0.4221	0.6510	0.8567	0.9417	0.9681	(94)
Useful gains	475.5074	535.3170	574.0436	580.4257	523.5648	390.4309	264.5074	276.3060	395.3574	464.1767	458.8202	453.4195	(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	1051.3762	1028.7176	942.0337	800.2329	620.0844	417.1055	270.2836	284.8314	448.6913	673.6032	880.7480	1052.5171	(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	428.4464	331.5652	273.7847	158.2611	71.8105	0.0000	0.0000	0.0000	0.0000	155.8134	303.7879	445.7286	(98)
Space heating												2169.1979	(98)
Space heating per m2											(98) / (4) =	30.5865	(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 %)	222.0383	(206)
Efficiency of secondary/supplementary heating system, %	100.0000	(208)
Space heating requirement	976.9479	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	428.4464	331.5652	273.7847	158.2611	71.8105	0.0000	0.0000	0.0000	0.0000	155.8134	303.7879	445.7286	(98)
Space heating efficiency (main heating system 1)	222.0383	222.0383	222.0383	222.0383	222.0383	0.0000	0.0000	0.0000	0.0000	222.0383	222.0383	222.0383	(210)
Space heating fuel (main heating system)	192.9606	149.3280	123.3052	71.2765	32.3415	0.0000	0.0000	0.0000	0.0000	70.1741	136.8178	200.7441	(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		
146.8350 129.5959 137.5434 126.6632 126.1110 115.1967 113.9330 122.0581 120.8775 132.6205 136.3932	143.8526	(64)
Efficiency of water heater	170.2800	(216)
(217)m 170.2800 170.2800 170.2800 170.2800 170.2800 170.2800 170.2800 170.2800 170.2800 170.2800 170.2800	170.2800	(217)
Fuel for water heating, kWh/month		
86.2315 76.1075 80.7748 74.3852 74.0609 67.6513 66.9092 71.6808 70.9875 77.8838 80.0994	84.4800	(219)
Water heating fuel used	911.2520	(219)
Annual totals kWh/year		
Space heating fuel - main system	976.9479	(211)
Space heating fuel - secondary	0.0000	(215)

Electricity for pumps and fans:
(MEVDecentralised, Database: total watage = 6.6170, total flow = 29.0000, SFP = 0.2282)

mechanical ventilation fans (SFP = 0.2282)	48.5654	(230a)
Total electricity for the above, kWh/year	48.5654	(231)
Electricity for lighting (calculated in Appendix L)	331.5208	(232)
Total delivered energy for all uses	2268.2861	(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	976.9479	0.5190	507.0359	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	911.2520	0.5190	472.9398	(264)
Space and water heating			979.9758	(265)
Pumps and fans	48.5654	0.5190	25.2054	(267)
Energy for lighting	331.5208	0.5190	172.0593	(268)
Total CO2, kg/year			1177.2405	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			16.6000	(273)

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

DER		16.6000	ZC1
Total Floor Area	TFA	70.9200	
Assumed number of occupants	N	2.2683	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.6640	ZC2
CO2 emissions from cooking, equation (L16)		2.4455	ZC3
Total CO2 emissions		35.7095	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		35.7095	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (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	35.4600 (1b)	x	2.3100 (2b)	=	81.9126	(1b) - (3b)
First floor	35.4600 (1c)	x	2.6100 (2c)	=	92.5506	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 70.9200						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		174.4632	(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) =	0.1720	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4220	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3903	(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	0.4976	0.4879	0.4781	0.4293	0.4196	0.3708	0.3708	0.3610	0.3903	0.4196	0.4391	0.4586	(22b)
Effective ac	0.6238	0.6190	0.6143	0.5922	0.5880	0.5687	0.5687	0.5652	0.5762	0.5880	0.5964	0.6052	(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			2.1500	1.0000	2.1500			(26)
TER Opening Type (Uw = 1.40)			10.7000	1.3258	14.1856			(27)
150mm Wht + Wht Topsheet			35.4600	0.1300	4.6098			(28a)
100mm Knauf Supafil 34	82.9000	12.8500	70.0500	0.1800	12.6090			(29a)
FP McCann System	35.4600		35.4600	0.1300	4.6098			(30)
Total net area of external elements Aum(A, m2)			153.8200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	38.1642			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.4435	(36)
Total fabric heat loss					(33) + (36) =		46.6077	(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	35.9154	35.6386	35.3672	34.0927	33.8543	32.7442	32.7442	32.5387	33.1718	33.8543	34.3367	34.8410	(38)
Heat transfer coeff	82.5231	82.2463	81.9749	80.7004	80.4620	79.3519	79.3519	79.1464	79.7795	80.4620	80.9444	81.4487	(39)
Average = Sum(39)m / 12 =												80.6993	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1636	1.1597	1.1559	1.1379	1.1345	1.1189	1.1189	1.1160	1.1249	1.1345	1.1413	1.1485	(40)
HLP (average)												1.1379	(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	2.2683	(42)
Average daily hot water use (litres/day)	88.0710	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	96.8781	93.3552	89.8324	86.3096	82.7867	79.2639	79.2639	82.7867	86.3096	89.8324	93.3552	96.8781	(44)
Energy conte	143.6674	125.6524	129.6620	113.0425	108.4670	93.5987	86.7330	99.5274	100.7161	117.3749	128.1238	139.1342	(45)
Energy content (annual)										Total = Sum(45)m =		1385.6994	(45)
Distribution loss (46)m = 0.15 x (45)m	21.5501	18.8479	19.4493	16.9564	16.2700	14.0398	13.0100	14.9291	15.1074	17.6062	19.2186	20.8701	(46)

Water storage loss:		
Store volume	200.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):	1.6525	(48)
Temperature factor from Table 2b	0.5400	(49)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Enter (49) or (54) in (55)												0.8924	(55)
Total storage loss	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637	(56)
If cylinder contains dedicated solar storage	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month	194.5935	171.6502	180.5881	162.3258	159.3930	142.8820	137.6591	150.4535	149.9994	168.3009	177.4071	190.0603	(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	194.5935	171.6502	180.5881	162.3258	159.3930	142.8820	137.6591	150.4535	149.9994	168.3009	177.4071	190.0603	(64)
Total per year (kWh/year) = Sum(64)m =												1985.3128	(64)
Heat gains from water heating, kWh/month	88.5103	78.5776	83.8535	77.0133	76.8061	70.5482	69.5796	73.8337	72.9147	79.7680	82.0278	87.0030	(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	113.4126	113.4126	113.4126	113.4126	113.4126	113.4126	113.4126	113.4126	113.4126	113.4126	113.4126	113.4126	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	18.7721	16.6732	13.5596	10.2655	7.6735	6.4783	7.0001	9.0990	12.2126	15.5067	18.0986	19.2938	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	199.4347	201.5042	196.2891	185.1868	171.1721	158.0003	149.2007	147.1312	152.3463	163.4486	177.4633	190.6351	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.3413	34.3413	34.3413	34.3413	34.3413	34.3413	34.3413	34.3413	34.3413	34.3413	34.3413	34.3413	(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)	-90.7301	-90.7301	-90.7301	-90.7301	-90.7301	-90.7301	-90.7301	-90.7301	-90.7301	-90.7301	-90.7301	-90.7301	(71)
Water heating gains (Table 5)	118.9654	116.9310	112.7063	106.9629	103.2340	97.9836	93.5209	99.2389	101.2705	107.2151	113.9275	116.9395	(72)
Total internal gains	397.1959	395.1321	382.5787	362.4389	342.1035	322.4860	309.7455	315.4928	325.8531	346.1941	369.5132	386.8922	(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	
Northeast	3.9000	11.2829	0.6300	0.7000	0.7700	13.4480	(75)
Southwest	6.8000	36.7938	0.6300	0.7000	0.7700	76.4638	(79)

Solar gains	89.9118	157.6200	227.5274	301.8048	356.1988	361.6075	345.3054	303.5044	253.0580	177.4027	108.5071	76.4194	(83)
Total gains	487.1078	552.7521	610.1061	664.2437	698.3022	684.0935	655.0509	618.9971	578.9111	523.5968	478.0203	463.3116	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	59.6803	59.8811	60.0794	61.0282	61.2090	62.0653	62.0653	62.2265	61.7327	61.2090	60.8443	60.4675	
alpha	4.9787	4.9921	5.0053	5.0685	5.0806	5.1377	5.1377	5.1484	5.1155	5.0806	5.0563	5.0312	
util living area	0.9963	0.9925	0.9824	0.9498	0.8630	0.6931	0.5230	0.5718	0.8147	0.9633	0.9924	0.9972	(86)
MIT	19.8206	19.9748	20.2205	20.5414	20.8066	20.9551	20.9912	20.9865	20.8951	20.5586	20.1369	19.7994	(87)
Th 2	19.9492	19.9524	19.9555	19.9700	19.9727	19.9854	19.9854	19.9878	19.9805	19.9727	19.9672	19.9615	(88)
util rest of house	0.9951	0.9900	0.9763	0.9316	0.8149	0.6026	0.4076	0.4542	0.7379	0.9463	0.9894	0.9962	(89)
MIT 2	18.3885	18.6150	18.9724	19.4363	19.7848	19.9559	19.9822	19.9823	19.8988	19.4696	18.8626	18.3663	(90)
Living area fraction									fLA = Living area / (4) =			0.1638	(91)
MIT	18.6231	18.8378	19.1769	19.6173	19.9523	20.1196	20.1476	20.1468	20.0621	19.6480	19.0714	18.6011	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6231	18.8378	19.1769	19.6173	19.9523	20.1196	20.1476	20.1468	20.0621	19.6480	19.0714	18.6011	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9928	0.9862	0.9701	0.9238	0.8138	0.6153	0.4265	0.4734	0.7449	0.9392	0.9856	0.9943	(94)
Useful gains	483.6215	545.1517	591.8381	613.6019	568.2767	420.9447	279.4000	293.0158	431.2380	491.7561	471.1250	460.6836	(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	1181.9887	1146.3297	1039.1874	864.8933	663.9923	437.9913	281.5065	296.5493	475.6498	728.0194	969.0192	1172.9518	(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	519.5852	403.9917	332.8279	180.9298	71.2124	0.0000	0.0000	0.0000	0.0000	175.7799	358.4838	529.9276	(98)
Space heating												2572.7382	(98)
Space heating per m2											(98) / (4) =	36.2766	(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 %)	93.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2751.5917	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	519.5852	403.9917	332.8279	180.9298	71.2124	0.0000	0.0000	0.0000	0.0000	175.7799	358.4838	529.9276	(98)
Space heating efficiency (main heating system 1)													
	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)													
	555.7061	432.0766	355.9657	193.5079	76.1630	0.0000	0.0000	0.0000	0.0000	187.9999	383.4051	566.7675	(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													
	194.5935	171.6502	180.5881	162.3258	159.3930	142.8820	137.6591	150.4535	149.9994	168.3009	177.4071	190.0603	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.3102	87.0207	86.4240	85.1037	82.8240	79.8000	79.8000	79.8000	79.8000	84.9298	86.6535	87.4062	(217)
Fuel for water heating, kWh/month													
	222.8760	197.2522	208.9560	190.7389	192.4480	179.0502	172.5051	188.5382	187.9691	198.1646	204.7316	217.4448	(219)
Water heating fuel used												2360.6746	(219)
Annual totals kWh/year													
Space heating fuel - main system												2751.5917	(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)	331.5208	(232)
Total delivered energy for all uses	5518.7871	(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	2751.5917	0.2160	594.3438	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2360.6746	0.2160	509.9057	(264)
Space and water heating			1104.2495	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	331.5208	0.5190	172.0593	(268)
Total CO2, kg/m2/year			1315.2338	(272)
Emissions per m2 for space and water heating			15.5704	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			2.4261	(272b)
Emissions per m2 for pumps and fans			0.5489	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.5704 * 1.55) + 2.4261 + 0.5489, rounded to 2 d.p.			27.1100	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (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	35.4600 (1b)	x	2.3100 (2b)	=	81.9126	(1b) - (3b)
First floor	35.4600 (1c)	x	2.6100 (2c)	=	92.5506	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 70.9200						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		174.4632	(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) =		0.1720	(8)
Pressure test			Yes	
Measured/design AP50			4.0100	
Infiltration rate			0.3725	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3445	(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	0.4393	0.4307	0.4220	0.3790	0.3704	0.3273	0.3273	0.3187	0.3445	0.3704	0.3876	0.4048	(22b)
Effective ac	0.5965	0.5927	0.5891	0.5718	0.5686	0.5536	0.5536	0.5508	0.5593	0.5686	0.5751	0.5819	(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	
Solid Door			2.1500	1.0000	2.1500			(26)
Window (Uw = 1.20)			7.3700	1.1450	8.4389			(27)
French Door (Uw = 1.40)			3.3300	1.3258	4.4148			(27)
150mm Wht + Wht Topsheet			35.4600	0.1100	3.9006	75.0000	2659.5000	(28a)
100mm Knauf Supafil 34	82.9000	12.8500	70.0500	0.2500	17.5125	52.8000	3698.6400	(29a)
FP McCann System	35.4600		35.4600	0.1800	6.3828	9.0000	319.1400	(30)
Total net area of external elements Aum(A, m2)			153.8200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	42.7996			(33)
E-WM-30			39.9000	0.0000	0.0000	45.0000	1795.5000	(32)
Timber GF			65.7000			9.0000	591.3000	(32c)
Timber 1F			69.5700			9.0000	626.1300	(32c)
Internal Floor			35.4600			12.6000	446.7960	(32d)
Internal Ceiling			35.4600			9.0000	319.1400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 10456.1460	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	147.4358	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	4.1111	(36)
Total fabric heat loss	(33) + (36) = 46.9107	(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	34.3409	34.1252	33.9138	32.9208	32.7350	31.8701	31.8701	31.7099	32.2032	32.7350	33.1108	33.5038	(38)
Heat transfer coeff	81.2516	81.0359	80.8245	79.8315	79.6457	78.7808	78.7808	78.6207	79.1140	79.6457	80.0216	80.4145	(39)
Average = Sum(39)m / 12 =												79.8306	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1457	1.1426	1.1397	1.1257	1.1230	1.1108	1.1108	1.1086	1.1155	1.1230	1.1283	1.1339	(40)
HLP (average)												1.1256	(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	2.2683	(42)
Average daily hot water use (litres/day)	88.0710	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	96.8781	93.3552	89.8324	86.3096	82.7867	79.2639	79.2639	82.7867	86.3096	89.8324	93.3552	96.8781	(44)
Energy conte	143.6674	125.6524	129.6620	113.0425	108.4670	93.5987	86.7330	99.5274	100.7161	117.3749	128.1238	139.1342	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1385.6994	(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)
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													
	30.5293	26.7011	27.5532	24.0215	23.0492	19.8897	18.4308	21.1496	21.4022	24.9422	27.2263	29.5660	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	113.4126	113.4126	113.4126	113.4126	113.4126	113.4126	113.4126	113.4126	113.4126	113.4126	113.4126	113.4126	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	18.7721	16.6732	13.5596	10.2655	7.6735	6.4783	7.0001	9.0990	12.2126	15.5067	18.0986	19.2938	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	199.4347	201.5042	196.2891	185.1868	171.1721	158.0003	149.2007	147.1312	152.3463	163.4486	177.4633	190.6351	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.3413	34.3413	34.3413	34.3413	34.3413	34.3413	34.3413	34.3413	34.3413	34.3413	34.3413	34.3413	(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)													
	-90.7301	-90.7301	-90.7301	-90.7301	-90.7301	-90.7301	-90.7301	-90.7301	-90.7301	-90.7301	-90.7301	-90.7301	(71)
Water heating gains (Table 5)													
	41.0340	39.7338	37.0338	33.3632	30.9801	27.6246	24.7725	28.4268	29.7252	33.5244	37.8143	39.7393	(72)
Total internal gains													
	316.2646	314.9350	303.9063	285.8392	266.8496	249.1270	237.9971	241.6808	251.3079	269.5035	290.4000	306.6920	(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	
Northeast	3.9000	11.2829	0.4600	0.0000	0.7700	15.5860	(75)
Southwest	3.4700	36.7938	0.4600	0.0000	0.7700	45.2223	(79)
Southwest	3.3300	36.7938	0.4300	0.0000	0.7700	40.5675	(79)

Solar gains	101.3759	177.8577	257.1038	341.6132	403.6733	410.0081	391.4405	343.7261	286.1472	200.2783	122.3677	86.1466	(83)
Total gains	417.6405	492.7927	561.0101	627.4524	670.5229	659.1352	629.4376	585.4068	537.4551	469.7818	412.7677	392.8385	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.7468	35.8419	35.9357	36.3827	36.4676	36.8679	36.8679	36.9430	36.7127	36.4676	36.2963	36.1189	
alpha	3.3831	3.3895	3.3957	3.4255	3.4312	3.4579	3.4579	3.4629	3.4475	3.4312	3.4198	3.4079	
util living area													
	0.9871	0.9767	0.9555	0.9062	0.8112	0.6628	0.5169	0.5674	0.7811	0.9327	0.9785	0.9894	(86)
MIT	19.1464	19.3831	19.7502	20.2160	20.6115	20.8667	20.9578	20.9415	20.7506	20.2298	19.6035	19.1058	(87)
Th 2	19.9637	19.9662	19.9686	19.9799	19.9821	19.9920	19.9920	19.9938	19.9882	19.9821	19.9778	19.9733	(88)
util rest of house													
	0.9844	0.9719	0.9460	0.8853	0.7679	0.5861	0.4116	0.4618	0.7168	0.9134	0.9733	0.9872	(89)
MIT 2	18.2731	18.5092	18.8722	19.3307	19.6964	19.9158	19.9759	19.9696	19.8288	19.3540	18.7382	18.2399	(90)
Living area fraction										fLA = Living area / (4) =		0.1638	(91)
MIT	18.4162	18.6523	19.0161	19.4758	19.8463	20.0716	20.1368	20.1289	19.9798	19.4975	18.8800	18.3818	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4162	18.6523	19.0161	19.4758	19.8463	20.0716	20.1368	20.1289	19.9798	19.4975	18.8800	18.3818	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9789	0.9639	0.9350	0.8729	0.7614	0.5926	0.4275	0.4769	0.7162	0.9019	0.9657	0.9825	(94)
Useful gains	408.8289	475.0012	524.5244	547.7191	510.5504	390.6198	269.1034	279.1821	384.9505	423.6843	398.6263	385.9611	(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													
	1146.9650	1114.4340	1011.6041	844.2804	648.8196	431.0540	278.6305	293.1667	465.1768	708.6446	942.6536	1140.4188	(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													
	549.1733	429.6989	362.3872	213.5241	102.8723	0.0000	0.0000	0.0000	0.0000	212.0105	391.6996	561.3165	(98)
Space heating												2822.6824	(98)
Space heating per m2											(98) / (4) =	39.8009	(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	740.5398	582.9781	597.5170	0.0000	0.0000	0.0000	0.0000	(100)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8279	0.8859	0.8622	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	613.0830	516.4657	515.1546	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	855.1149	818.7310	768.7736	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	174.2629	224.8854	188.6925	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												587.8408	(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	43.5657	56.2213	47.1731	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												146.9602	(107)
Space cooling per m2												2.0722	(108)
Energy for space heating												39.8009	(99)
Energy for space cooling												2.0722	(108)
Total												41.8731	(109)
Dwelling Fabric Energy Efficiency (DFEE)												41.9	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (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	35.4600 (1b)	x	2.3100 (2b)	=	81.9126	(1b) - (3b)
First floor	35.4600 (1c)	x	2.6100 (2c)	=	92.5506	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 70.9200						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		174.4632	(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) =		0.1720	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.4220	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3903	(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	0.4976	0.4879	0.4781	0.4293	0.4196	0.3708	0.3708	0.3610	0.3903	0.4196	0.4391	0.4586	(22b)
Effective ac	0.6238	0.6190	0.6143	0.5922	0.5880	0.5687	0.5687	0.5652	0.5762	0.5880	0.5964	0.6052	(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			2.1500	1.0000	2.1500			(26)
TER Opening Type (Uw = 1.40)			10.7000	1.3258	14.1856			(27)
150mm Wht + Wht Topsheet			35.4600	0.1300	4.6098			(28a)
100mm Knauf Supafil 34	82.9000	12.8500	70.0500	0.1800	12.6090			(29a)
FP McCann System	35.4600		35.4600	0.1300	4.6098			(30)
Total net area of external elements Aum(A, m2)			153.8200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	38.1642			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.4435	(36)
Total fabric heat loss					(33) + (36) =		46.6077	(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	35.9154	35.6386	35.3672	34.0927	33.8543	32.7442	32.7442	32.5387	33.1718	33.8543	34.3367	34.8410	(38)
Heat transfer coeff	82.5231	82.2463	81.9749	80.7004	80.4620	79.3519	79.3519	79.1464	79.7795	80.4620	80.9444	81.4487	(39)
Average = Sum(39)m / 12 =												80.6993	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1636	1.1597	1.1559	1.1379	1.1345	1.1189	1.1189	1.1160	1.1249	1.1345	1.1413	1.1485	(40)
HLP (average)												1.1379	(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	2.2683	(42)
Average daily hot water use (litres/day)	88.0710	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	96.8781	93.3552	89.8324	86.3096	82.7867	79.2639	79.2639	82.7867	86.3096	89.8324	93.3552	96.8781	(44)
Energy conte	143.6674	125.6524	129.6620	113.0425	108.4670	93.5987	86.7330	99.5274	100.7161	117.3749	128.1238	139.1342	(45)
Energy content (annual)										Total = Sum(45)m =		1385.6994	(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)
If cylinder contains dedicated solar storage													

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	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													
	30.5293	26.7011	27.5532	24.0215	23.0492	19.8897	18.4308	21.1496	21.4022	24.9422	27.2263	29.5660	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	113.4126	113.4126	113.4126	113.4126	113.4126	113.4126	113.4126	113.4126	113.4126	113.4126	113.4126	113.4126	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	18.7721	16.6732	13.5596	10.2655	7.6735	6.4783	7.0001	9.0990	12.2126	15.5067	18.0986	19.2938	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	199.4347	201.5042	196.2891	185.1868	171.1721	158.0003	149.2007	147.1312	152.3463	163.4486	177.4633	190.6351	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.3413	34.3413	34.3413	34.3413	34.3413	34.3413	34.3413	34.3413	34.3413	34.3413	34.3413	34.3413	(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)													
	-90.7301	-90.7301	-90.7301	-90.7301	-90.7301	-90.7301	-90.7301	-90.7301	-90.7301	-90.7301	-90.7301	-90.7301	(71)
Water heating gains (Table 5)													
	41.0340	39.7338	37.0338	33.3632	30.9801	27.6246	24.7725	28.4268	29.7252	33.5244	37.8143	39.7393	(72)
Total internal gains													
	316.2646	314.9350	303.9063	285.8392	266.8496	249.1270	237.9971	241.6808	251.3079	269.5035	290.4000	306.6920	(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	
Northeast	3.9000	11.2829	0.6300	0.7000	0.7700	13.4480	(75)
Southwest	6.8000	36.7938	0.6300	0.7000	0.7700	76.4638	(79)

Solar gains	89.9118	157.6200	227.5274	301.8048	356.1988	361.6075	345.3054	303.5044	253.0580	177.4027	108.5071	76.4194	(83)
Total gains	406.1764	472.5550	531.4337	587.6440	623.0483	610.7345	583.3025	545.1851	504.3658	446.9062	398.9071	383.1114	(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	59.6803	59.8811	60.0794	61.0282	61.2090	62.0653	62.0653	62.2265	61.7327	61.2090	60.8443	60.4675	
alpha	4.9787	4.9921	5.0053	5.0685	5.0806	5.1377	5.1377	5.1484	5.1155	5.0806	5.0563	5.0312	
util living area													
	0.9984	0.9962	0.9901	0.9682	0.9017	0.7514	0.5806	0.6375	0.8708	0.9803	0.9966	0.9988	(86)
MIT	19.7152	19.8719	20.1237	20.4591	20.7524	20.9348	20.9860	20.9780	20.8519	20.4705	20.0350	19.6943	(87)
Th 2	19.9492	19.9524	19.9555	19.9700	19.9727	19.9854	19.9854	19.9878	19.9805	19.9727	19.9672	19.9615	(88)
util rest of house													
	0.9978	0.9949	0.9864	0.9555	0.8619	0.6619	0.4559	0.5120	0.8048	0.9702	0.9952	0.9984	(89)
MIT 2	18.7787	18.9374	19.1898	19.5296	19.8019	19.9547	19.9818	19.9814	19.8964	19.5470	19.1123	18.7676	(90)
Living area fraction									fLA = Living area / (4) =			0.1638	(91)
MIT	18.9321	19.0905	19.3428	19.6819	19.9576	20.1153	20.1463	20.1447	20.0530	19.6983	19.2635	18.9195	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9321	19.0905	19.3428	19.6819	19.9576	20.1153	20.1463	20.1447	20.0530	19.6983	19.2635	18.9195	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9971	0.9934	0.9836	0.9511	0.8612	0.6745	0.4765	0.5326	0.8103	0.9666	0.9938	0.9978	(94)
Useful gains	404.9864	469.4591	522.6953	558.8947	536.5608	411.9382	277.9268	290.3684	408.7026	431.9797	396.4345	382.2722	(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													
	1207.4876	1167.1134	1052.7894	870.1039	664.4239	437.6496	281.4095	296.3764	474.9242	732.0709	984.5660	1198.8815	(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													
	597.0609	468.8237	394.3900	224.0706	95.1301	0.0000	0.0000	0.0000	0.0000	223.2678	423.4547	607.5574	(98)
Space heating												3033.7552	(98)
Space heating per m2											(98) / (4) =	42.7771	(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	745.9081	587.2042	601.5123	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8642	0.9256	0.9033	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	644.6268	543.4881	543.3226	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	798.5427	764.8068	721.7611	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	110.8194	164.6611	132.7583	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												408.2388	(104)
Cooled fraction									fC = cooled area / (4) =			1.0000	(105)

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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	27.7049	41.1653	33.1896	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												102.0597	(107)
Space cooling per m2												1.4391	(108)
Energy for space heating												42.7771	(99)
Energy for space cooling												1.4391	(108)
Total												44.2162	(109)
Target Fabric Energy Efficiency (TFEE)												50.8	(109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (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	35.4600 (1b)	x	2.3100 (2b)	=	81.9126	(1b) - (3b)
First floor	35.4600 (1c)	x	2.6100 (2c)	=	92.5506	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 70.9200						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		174.4632	(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							0 * 10 =		0.0000	(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) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		4.0100	
Infiltration rate		0.2005	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1855	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.1947	0.1855	0.1855	0.1716	0.1716	0.1530	0.1576	0.1484	0.1530	0.1623	0.1623	0.1762	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(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	
Solid Door			2.1500	1.0000	2.1500			(26)
Window (Uw = 1.20)			7.3700	1.1450	8.4389			(27)
French Door (Uw = 1.40)			3.3300	1.3258	4.4148			(27)
150mm Wht + Wht Topsheet			35.4600	0.1100	3.9006	75.0000	2659.5000	(28a)
100mm Knauf Supafil 34	82.9000	12.8500	70.0500	0.2500	17.5125	52.8000	3698.6400	(29a)
FP McCann System	35.4600		35.4600	0.1800	6.3828	9.0000	319.1400	(30)
Total net area of external elements Aum(A, m2)			153.8200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	42.7996			(33)
E-WM-30			39.9000	0.0000	0.0000	45.0000	1795.5000	(32)
Timber GF			65.7000			9.0000	591.3000	(32c)
Timber 1F			69.5700			9.0000	626.1300	(32c)
Internal Floor			35.4600			12.6000	446.7960	(32d)
Internal Ceiling			35.4600			9.0000	319.1400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 10456.1460	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	147.4358	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	4.1111	(36)
Total fabric heat loss	(33) + (36) = 46.9107	(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	28.7864	28.7864	28.7864	28.7864	28.7864	28.7864	28.7864	28.7864	28.7864	28.7864	28.7864	28.7864	(38)
Heat transfer coeff	75.6972	75.6972	75.6972	75.6972	75.6972	75.6972	75.6972	75.6972	75.6972	75.6972	75.6972	75.6972	(39)
Average = Sum(39)m / 12 =												75.6972	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0674	1.0674	1.0674	1.0674	1.0674	1.0674	1.0674	1.0674	1.0674	1.0674	1.0674	1.0674	(40)
HLP (average)												1.0674	(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	2.2683	(42)
Average daily hot water use (litres/day)	88.0710	(43)

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

CALCULATION OF HEAT DEMAND 09 Jan 2014

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Daily hot water use
                96.8781    93.3552    89.8324    86.3096    82.7867    79.2639    79.2639    82.7867    86.3096    89.8324    93.3552    96.8781 (44)
Energy conte   143.6674   125.6524   129.6620   113.0425   108.4670    93.5987    86.7330    99.5274   100.7161   117.3749   128.1238   139.1342 (45)
Energy content (annual)                                                                                                Total = Sum(45)m =   1385.6994 (45)
Distribution loss  (46)m = 0.15 x (45)m
                21.5501    18.8479    19.4493    16.9564    16.2700    14.0398    13.0100    14.9291    15.1074    17.6062    19.2186    20.8701 (46)
Water storage loss:
Store volume                                                                                                                                 200.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                                                  1.5600 (48)
  Temperature factor from Table 2b                                                                                                             0.5400 (49)
Enter (49) or (54) in (55)                                                                                                                     0.8424 (55)
Total storage loss
                26.1144    23.5872    26.1144    25.2720    26.1144    25.2720    26.1144    26.1144    25.2720    26.1144    25.2720    26.1144 (56)
If cylinder contains dedicated solar storage
                26.1144    23.5872    26.1144    25.2720    26.1144    25.2720    26.1144    26.1144    25.2720    26.1144    25.2720    26.1144 (57)
Primary loss    23.2624    21.0112    23.2624    22.5120    23.2624    22.5120    23.2624    23.2624    22.5120    23.2624    22.5120    23.2624 (59)
Total heat required for water heating calculated for each month
               193.0442   170.2508   179.0388   160.8265   157.8438   141.3827   136.1098   148.9042   148.5001   166.7517   175.9078   188.5110 (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
               193.0442   170.2508   179.0388   160.8265   157.8438   141.3827   136.1098   148.9042   148.5001   166.7517   175.9078   188.5110 (64)
                                                                                                 Total per year (kWh/year) = Sum(64)m =   1967.0714 (64)
RHI water heating demand                                                                                                                        1967 (64)
Heat gains from water heating, kWh/month
                87.2708    77.4581    82.6141    75.8138    75.5667    69.3488    68.3402    72.5943    71.7153    78.5286    80.8284    85.7636 (65)


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5. Internal gains (see Table 5 and 5a)
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Metabolic gains (Table 5), Watts
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m          136.0951   136.0951   136.0951   136.0951   136.0951   136.0951   136.0951   136.0951   136.0951   136.0951   136.0951   136.0951 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                46.9302    41.6830    33.8989    25.6636    19.1839    16.1958    17.5002    22.7474    30.5315    38.7667    45.2465    48.2345 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               297.6637   300.7525   292.9688   276.3982   255.4807   235.8213   222.6876   219.5988   227.3825   243.9531   264.8706   284.5300 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                50.8778    50.8778    50.8778    50.8778    50.8778    50.8778    50.8778    50.8778    50.8778    50.8778    50.8778    50.8778 (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)
               -90.7301   -90.7301   -90.7301   -90.7301   -90.7301   -90.7301   -90.7301   -90.7301   -90.7301   -90.7301   -90.7301   -90.7301 (71)
Water heating gains (Table 5)
               117.2995   115.2651   111.0404   105.2970   101.5682    96.3178    91.8551    97.5730    99.6046   105.5492   112.2616   115.2736 (72)
Total internal gains
               558.1362   553.9434   534.1509   503.6016   472.4756   444.5777   428.2856   436.1619   453.7613   484.5118   518.6215   544.2809 (73)


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6. Solar gains
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[Jan]                                      Area        Solar flux              g              FF          Access            Gains
                                            m2          Table 6a     Specific data     Specific data      factor              W
                                                           W/m2       or Table 6b       or Table 6c     Table 6d
---------------------------------------------------------------------------------------------------------------------------------------------
Northeast                                 3.9000          12.9236          0.4600            0.0000        0.7700          17.8523 (75)
Southwest                                 3.4700          40.4699          0.4600            0.0000        0.7700          49.7405 (79)
Southwest                                 3.3300          40.4699          0.4300            0.0000        0.7700          44.6206 (79)
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Solar gains    112.2135   177.4647   254.4583   350.4173   405.0526   440.9333   416.1583   372.5546   307.6640   213.6472   138.8213    94.4046 (83)
Total gains    670.3497   731.4081   788.6092   854.0189   877.5282   885.5110   844.4439   808.7165   761.4253   698.1591   657.4428   638.6856 (84)


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7. Mean internal temperature (heating season)
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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            38.3698    38.3698    38.3698    38.3698    38.3698    38.3698    38.3698    38.3698    38.3698    38.3698    38.3698    38.3698
alpha           3.5580     3.5580     3.5580     3.5580     3.5580     3.5580     3.5580     3.5580     3.5580     3.5580     3.5580     3.5580
util living area
                0.9407     0.9194     0.8711     0.7742     0.6200     0.4153     0.2758     0.2966     0.5391     0.7880     0.9060     0.9479 (86)

Tweekday       18.5405    18.7655    19.1865    19.6239    19.9122    20.0143    20.0265    20.0261    19.9851    19.6799    19.0670    18.4695
Tweekend       20.2575    20.3608    20.5562    20.7680    20.9203    20.9861    20.9977    20.9970    20.9630    20.7908    20.4967    20.2248
24 / 16            0          0          0          0          0          0          0          0          0          0          0          0
24 / 9             0          0          0          0          0          0          0          0          0          0          0          0
16 / 9             0          0          0          0          0          0          0          0          0          0          0          0
MIT            19.8540    20.0112    20.3150    20.6377    20.8770    20.9786    20.9964    20.9953    20.9423    20.6771    20.2141    19.8036 (87)
Th 2           20.0276    20.0276    20.0276    20.0276    20.0276    20.0276    20.0276    20.0276    20.0276    20.0276    20.0276    20.0276 (88)
util rest of house
                0.9301     0.9055     0.8488     0.7367     0.5614     0.3392     0.1903     0.2079     0.4609     0.7441     0.8872     0.9383 (89)
Tweekday       18.5405    18.7655    19.1865    19.6239    19.9122    20.0143    20.0265    20.0261    19.9851    19.6799    19.0670    18.4695
Tweekend       18.5405    18.7655    19.1865    19.6239    19.9122    20.0143    20.0265    20.0261    19.9851    19.6799    19.0670    18.4695
MIT 2          18.5405    18.7655    19.1865    19.6239    19.9122    20.0143    20.0265    20.0261    19.9851    19.6799    19.0670    18.4695 (90)
Living area fraction                                                                                   fLA = Living area / (4) =          0.1638 (91)
MIT            18.7557    18.9696    19.3714    19.7900    20.0703    20.1723    20.1854    20.1849    20.1420    19.8433    19.2549    18.6881 (92)
Temperature adjustment                                                                                                                  0.0000
adjusted MIT   18.7557    18.9696    19.3714    19.7900    20.0703    20.1723    20.1854    20.1849    20.1420    19.8433    19.2549    18.6881 (93)


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8. Space heating requirement
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CALCULATION OF HEAT DEMAND 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9126	0.8869	0.8314	0.7266	0.5641	0.3508	0.2043	0.2224	0.4706	0.7348	0.8690	0.9215	(94)
Useful gains	611.7436	648.7214	655.6203	620.5393	495.0365	310.5950	172.5126	179.8539	358.2930	513.0421	571.3270	588.5427	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1033.6986	1012.0438	906.2008	748.6478	535.1980	315.8286	173.0013	180.5302	374.0920	623.9946	851.9642	1028.5802	(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	313.9345	244.1527	186.4318	92.2381	29.8801	0.0000	0.0000	0.0000	0.0000	82.5486	202.0588	327.3879	(98)
Space heating												1478.6326	(98)
RHI space heating demand												1479	(98)

SAP 2012 WORKSHEET FOR New Build (As Designed) (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	35.4600 (1b)	x	2.3100 (2b)	=	81.9126	(1b) - (3b)
First floor	35.4600 (1c)	x	2.6100 (2c)	=	92.5506	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 70.9200						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		174.4632	(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							0 * 10 =		0.0000	(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) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		4.0100	
Infiltration rate		0.2005	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1855	(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	0.2365	0.2318	0.2272	0.2040	0.1994	0.1762	0.1762	0.1716	0.1855	0.1994	0.2086	0.2179	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(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	
Solid Door			2.1500	1.0000	2.1500			(26)
Window (Uw = 1.20)			7.3700	1.1450	8.4389			(27)
French Door (Uw = 1.40)			3.3300	1.3258	4.4148			(27)
150mm Wht + Wht Topsheet			35.4600	0.1100	3.9006	75.0000	2659.5000	(28a)
100mm Knauf Supafil 34	82.9000	12.8500	70.0500	0.2500	17.5125	52.8000	3698.6400	(29a)
FP McCann System	35.4600		35.4600	0.1800	6.3828	9.0000	319.1400	(30)
Total net area of external elements Aum(A, m2)			153.8200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	42.7996			(33)
E-WM-30			39.9000	0.0000	0.0000	45.0000	1795.5000	(32)
Timber GF			65.7000			9.0000	591.3000	(32c)
Timber 1F			69.5700			9.0000	626.1300	(32c)
Internal Floor			35.4600			12.6000	446.7960	(32d)
Internal Ceiling			35.4600			9.0000	319.1400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 10456.1460	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	147.4358	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	4.1111	(36)
Total fabric heat loss	(33) + (36) = 46.9107	(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	28.7864	28.7864	28.7864	28.7864	28.7864	28.7864	28.7864	28.7864	28.7864	28.7864	28.7864	28.7864	(38)
Heat transfer coeff	75.6972	75.6972	75.6972	75.6972	75.6972	75.6972	75.6972	75.6972	75.6972	75.6972	75.6972	75.6972	(39)
Average = Sum(39)m / 12 =												75.6972	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0674	1.0674	1.0674	1.0674	1.0674	1.0674	1.0674	1.0674	1.0674	1.0674	1.0674	1.0674	(40)
HLP (average)												1.0674	(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	2.2683	(42)
Average daily hot water use (litres/day)	88.0710	(43)

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

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Daily hot water use													
	96.8781	93.3552	89.8324	86.3096	82.7867	79.2639	79.2639	82.7867	86.3096	89.8324	93.3552	96.8781	(44)
Energy conte	143.6674	125.6524	129.6620	113.0425	108.4670	93.5987	86.7330	99.5274	100.7161	117.3749	128.1238	139.1342	(45)
Energy content (annual)										Total = Sum(45)m =		1385.6994	(45)
Distribution loss (46)m = 0.15 x (45)m													
	21.5501	18.8479	19.4493	16.9564	16.2700	14.0398	13.0100	14.9291	15.1074	17.6062	19.2186	20.8701	(46)
Water storage loss:													
Store volume												200.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5600	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.8424	(55)
Total storage loss													
	26.1144	23.5872	26.1144	25.2720	26.1144	25.2720	26.1144	26.1144	25.2720	26.1144	25.2720	26.1144	(56)
If cylinder contains dedicated solar storage													
	26.1144	23.5872	26.1144	25.2720	26.1144	25.2720	26.1144	26.1144	25.2720	26.1144	25.2720	26.1144	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	193.0442	170.2508	179.0388	160.8265	157.8438	141.3827	136.1098	148.9042	148.5001	166.7517	175.9078	188.5110	(62)
WWHRS	-46.2092	-40.6549	-41.4954	-34.1633	-31.7328	-26.1861	-22.1768	-26.8460	-27.6226	-34.1312	-39.5146	-44.6584	eq.(G10)
Total of WWHRS savings												-415.3914	
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													
	146.8350	129.5959	137.5434	126.6632	126.1110	115.1967	113.9330	122.0581	120.8775	132.6205	136.3932	143.8526	(64)
								Total per year (kWh/year) = Sum(64)m =				1551.6800	(64)
Heat gains from water heating, kWh/month													
	87.2708	77.4581	82.6141	75.8138	75.5667	69.3488	68.3402	72.5943	71.7153	78.5286	80.8284	85.7636	(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	136.0951	136.0951	136.0951	136.0951	136.0951	136.0951	136.0951	136.0951	136.0951	136.0951	136.0951	136.0951	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	46.9302	41.6830	33.8989	25.6636	19.1839	16.1958	17.5002	22.7474	30.5315	38.7667	45.2465	48.2345	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	297.6637	300.7525	292.9688	276.3982	255.4807	235.8213	222.6876	219.5988	227.3825	243.9531	264.8706	284.5300	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	50.8778	50.8778	50.8778	50.8778	50.8778	50.8778	50.8778	50.8778	50.8778	50.8778	50.8778	50.8778	(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)													
	-90.7301	-90.7301	-90.7301	-90.7301	-90.7301	-90.7301	-90.7301	-90.7301	-90.7301	-90.7301	-90.7301	-90.7301	(71)
Water heating gains (Table 5)													
	117.2995	115.2651	111.0404	105.2970	101.5682	96.3178	91.8551	97.5730	99.6046	105.5492	112.2616	115.2736	(72)
Total internal gains													
	558.1362	553.9434	534.1509	503.6016	472.4756	444.5777	428.2856	436.1619	453.7613	484.5118	518.6215	544.2809	(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	
Northeast	3.9000	11.2829	0.4600	0.0000	0.7700	15.5860	(75)
Southwest	3.4700	36.7938	0.4600	0.0000	0.7700	45.2223	(79)
Southwest	3.3300	36.7938	0.4300	0.0000	0.7700	40.5675	(79)

Solar gains	101.3759	177.8577	257.1038	341.6132	403.6733	410.0081	391.4405	343.7261	286.1472	200.2783	122.3677	86.1466	(83)
Total gains	659.5121	731.8011	791.2547	845.2148	876.1489	854.5858	819.7261	779.8880	739.9086	684.7901	640.9892	630.4275	(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	38.3698	38.3698	38.3698	38.3698	38.3698	38.3698	38.3698	38.3698	38.3698	38.3698	38.3698	38.3698	
alpha	3.5580	3.5580	3.5580	3.5580	3.5580	3.5580	3.5580	3.5580	3.5580	3.5580	3.5580	3.5580	
util living area													
	0.9502	0.9279	0.8876	0.8108	0.6886	0.5317	0.3964	0.4321	0.6303	0.8315	0.9252	0.9567	(86)
Tweekday	18.3553	18.6329	19.0391	19.4883	19.8205	19.9796	20.0188	20.0147	19.9301	19.5336	18.8678	18.2666	
Tweekend	20.1739	20.3006	20.4878	20.7012	20.8696	20.9610	20.9894	20.9855	20.9275	20.7177	20.4050	20.1336	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	19.7251	19.9181	20.2094	20.5334	20.7987	20.9401	20.9837	20.9776	20.8868	20.5643	20.0709	19.6629	(87)
Th 2	20.0276	20.0276	20.0276	20.0276	20.0276	20.0276	20.0276	20.0276	20.0276	20.0276	20.0276	20.0276	(88)
util rest of house													
	0.9415	0.9157	0.8686	0.7793	0.6390	0.4616	0.3129	0.3465	0.5616	0.7964	0.9104	0.9490	(89)
Tweekday	18.3553	18.6329	19.0391	19.4883	19.8205	19.9796	20.0188	20.0147	19.9301	19.5336	18.8678	18.2666	
Tweekend	18.3553	18.6329	19.0391	19.4883	19.8205	19.9796	20.0188	20.0147	19.9301	19.5336	18.8678	18.2666	
MIT 2	18.3553	18.6329	19.0391	19.4883	19.8205	19.9796	20.0188	20.0147	19.9301	19.5336	18.8678	18.2666	(90)
Living area fraction									fLA = Living area / (4) =			0.1638	(91)
MIT	18.5797	18.8435	19.2308	19.6595	19.9808	20.1370	20.1769	20.1725	20.0869	19.7025	19.0649	18.4953	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5797	18.8435	19.2308	19.6595	19.9808	20.1370	20.1769	20.1725	20.0869	19.7025	19.0649	18.4953	(93)

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8. Space heating requirement

CALCULATION OF ENERGY RATINGS 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9249	0.8973	0.8503	0.7659	0.6364	0.4698	0.3260	0.3596	0.5660	0.7830	0.8923	0.9333	(94)
Useful gains	609.9728	656.6775	672.8375	647.3659	557.5957	401.5182	267.2186	280.4412	418.8151	536.1960	571.9486	588.3510	(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	1080.9321	1055.4827	963.6872	814.4665	626.8304	419.1343	270.7633	285.5666	453.1906	689.0303	905.7124	1082.1166	(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	350.3938	267.9971	216.3922	120.3124	51.5106	0.0000	0.0000	0.0000	0.0000	113.7087	240.3100	367.3616	(98)
Space heating												1727.9863	(98)
Space heating per m2											(98) / (4) =	24.3653	(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 %)	222.0383	(206)
Efficiency of secondary/supplementary heating system, %	100.0000	(208)
Space heating requirement	778.2381	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	350.3938	267.9971	216.3922	120.3124	51.5106	0.0000	0.0000	0.0000	0.0000	113.7087	240.3100	367.3616	(98)
Space heating efficiency (main heating system 1)	222.0383	222.0383	222.0383	222.0383	222.0383	0.0000	0.0000	0.0000	0.0000	222.0383	222.0383	222.0383	(210)
Space heating fuel (main heating system)	157.8078	120.6986	97.4572	54.1855	23.1990	0.0000	0.0000	0.0000	0.0000	51.2113	108.2291	165.4497	(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	146.8350	129.5959	137.5434	126.6632	126.1110	115.1967	113.9330	122.0581	120.8775	132.6205	136.3932	143.8526	(64)
Efficiency of water heater												170.2800	(216)
(217)m	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	(217)
Fuel for water heating, kWh/month	86.2315	76.1075	80.7748	74.3852	74.0609	67.6513	66.9092	71.6808	70.9875	77.8838	80.0994	84.4800	(219)
Water heating fuel used												911.2520	(219)
Annual totals kWh/year													
Space heating fuel - main system												778.2381	(211)
Space heating fuel - secondary												0.0000	(215)

Electricity for pumps and fans:
(MEVDecentralised, Database: total watage = 6.6170, total flow = 29.0000, SFP = 0.2282)
mechanical ventilation fans (SFP = 0.2282)

mechanical ventilation fans (SFP = 0.2282)	48.5654	(230a)
Total electricity for the above, kWh/year	48.5654	(231)
Electricity for lighting (calculated in Appendix L)	331.5208	(232)
Total delivered energy for all uses	2069.5764	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	778.2381	13.1900	102.6496	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	911.2520	13.1900	120.1941	(247)
Mechanical ventilation fans	48.5654	13.1900	6.4058	(249)
Pumps and fans for heating	0.0000	0.0000	0.0000	(249)
Energy for lighting	331.5208	13.1900	43.7276	(250)
Additional standing charges			0.0000	(251)
Total energy cost			272.9771	(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] =	0.9890	(257)
SAP value	86.2028	
SAP rating (Section 12)	86	(258)
SAP band	B	

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	778.2381	0.5190	403.9056	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	911.2520	0.5190	472.9398	(264)
Space and water heating			876.8454	(265)
Pumps and fans	48.5654	0.5190	25.2054	(267)
Energy for lighting	331.5208	0.5190	172.0593	(268)
Total kg/year			1074.1101	(272)
CO2 emissions per m2			15.1500	(273)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

EI value	87.5836
EI rating	88 (274)
EI band	B

Calculation of stars for heating and DHW

Main heating energy efficiency	13.19 × (1 + 0.29 × 0.00) / 2.2204 = 5.940, stars = 3
Main heating environmental impact	0.519 × (1 + 0.29 × 0.00) / 2.2204 = 0.2337, stars = 4
Water heating energy efficiency	13.19 / 1.7028 = 7.746, stars = 3
Water heating environmental impact	0.519 / 1.7028 = 0.3048, stars = 5

SAP 2012 WORKSHEET FOR New Build (As Designed) (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	35.4600 (1b)	x	2.3100 (2b)	=	81.9126	(1b) - (3b)
First floor	35.4600 (1c)	x	2.6100 (2c)	=	92.5506	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 70.9200						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	174.4632	(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							0 * 10	=	0.0000	(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) =	0.0000 / (5) =		0.0000	(8)
Pressure test			Yes	
Measured/design AP50			4.0100	
Infiltration rate			0.2005	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.1855	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.1947	0.1855	0.1855	0.1716	0.1716	0.1530	0.1576	0.1484	0.1530	0.1623	0.1623	0.1762	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(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	
Solid Door			2.1500	1.0000	2.1500			(26)
Window (Uw = 1.20)			7.3700	1.1450	8.4389			(27)
French Door (Uw = 1.40)			3.3300	1.3258	4.4148			(27)
150mm Wht + Wht Topsheet			35.4600	0.1100	3.9006	75.0000	2659.5000	(28a)
100mm Knauf Supafil 34	82.9000	12.8500	70.0500	0.2500	17.5125	52.8000	3698.6400	(29a)
FP McCann System	35.4600		35.4600	0.1800	6.3828	9.0000	319.1400	(30)
Total net area of external elements Aum(A, m2)			153.8200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	42.7996			(33)
E-WM-30			39.9000	0.0000	0.0000	45.0000	1795.5000	(32)
Timber GF			65.7000			9.0000	591.3000	(32c)
Timber 1F			69.5700			9.0000	626.1300	(32c)
Internal Floor			35.4600			12.6000	446.7960	(32d)
Internal Ceiling			35.4600			9.0000	319.1400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 10456.1460	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	147.4358	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	4.1111	(36)
Total fabric heat loss	(33) + (36) = 46.9107	(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	28.7864	28.7864	28.7864	28.7864	28.7864	28.7864	28.7864	28.7864	28.7864	28.7864	28.7864	28.7864	(38)
Heat transfer coeff	75.6972	75.6972	75.6972	75.6972	75.6972	75.6972	75.6972	75.6972	75.6972	75.6972	75.6972	75.6972	(39)
Average = Sum(39)m / 12 =												75.6972	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0674	1.0674	1.0674	1.0674	1.0674	1.0674	1.0674	1.0674	1.0674	1.0674	1.0674	1.0674	(40)
HLP (average)												1.0674	(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	2.2683	(42)
Average daily hot water use (litres/day)	88.0710	(43)

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

```
Daily hot water use
                96.8781    93.3552    89.8324    86.3096    82.7867    79.2639    79.2639    82.7867    86.3096    89.8324    93.3552    96.8781 (44)
Energy conte   143.6674   125.6524   129.6620   113.0425   108.4670    93.5987    86.7330    99.5274   100.7161   117.3749   128.1238   139.1342 (45)
Energy content (annual)                                                                                                Total = Sum(45)m =   1385.6994 (45)
Distribution loss  (46)m = 0.15 x (45)m
                21.5501    18.8479    19.4493    16.9564    16.2700    14.0398    13.0100    14.9291    15.1074    17.6062    19.2186    20.8701 (46)
Water storage loss:
Store volume                                                                                                                                200.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                                                  1.5600 (48)
  Temperature factor from Table 2b                                                                                                              0.5400 (49)
Enter (49) or (54) in (55)                                                                                                                      0.8424 (55)
Total storage loss
                26.1144    23.5872    26.1144    25.2720    26.1144    25.2720    26.1144    26.1144    25.2720    26.1144    25.2720    26.1144 (56)
If cylinder contains dedicated solar storage
                26.1144    23.5872    26.1144    25.2720    26.1144    25.2720    26.1144    26.1144    25.2720    26.1144    25.2720    26.1144 (57)
Primary loss    23.2624    21.0112    23.2624    22.5120    23.2624    22.5120    23.2624    23.2624    22.5120    23.2624    22.5120    23.2624 (59)
Total heat required for water heating calculated for each month
               193.0442   170.2508   179.0388   160.8265   157.8438   141.3827   136.1098   148.9042   148.5001   166.7517   175.9078   188.5110 (62)
WWHRS          -46.2092   -40.6549   -41.4954   -34.1633   -31.7328   -26.1861   -22.1768   -26.8460   -27.6226   -34.1312   -39.5146   -44.6584 eq.(G10)
Total of WWHRS savings                                                                                                                     -415.3914
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
               146.8350   129.5959   137.5434   126.6632   126.1110   115.1967   113.9330   122.0581   120.8775   132.6205   136.3932   143.8526 (64)
                                                                                                     Total per year (kWh/year) = Sum(64)m =   1551.6800 (64)
Heat gains from water heating, kWh/month
                87.2708    77.4581    82.6141    75.8138    75.5667    69.3488    68.3402    72.5943    71.7153    78.5286    80.8284    85.7636 (65)


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5. Internal gains (see Table 5 and 5a)
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Metabolic gains (Table 5), Watts
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m          136.0951   136.0951   136.0951   136.0951   136.0951   136.0951   136.0951   136.0951   136.0951   136.0951   136.0951   136.0951 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                46.9302    41.6830    33.8989    25.6636    19.1839    16.1958    17.5002    22.7474    30.5315    38.7667    45.2465    48.2345 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               297.6637   300.7525   292.9688   276.3982   255.4807   235.8213   222.6876   219.5988   227.3825   243.9531   264.8706   284.5300 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                50.8778    50.8778    50.8778    50.8778    50.8778    50.8778    50.8778    50.8778    50.8778    50.8778    50.8778    50.8778 (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)
               -90.7301   -90.7301   -90.7301   -90.7301   -90.7301   -90.7301   -90.7301   -90.7301   -90.7301   -90.7301   -90.7301   -90.7301 (71)
Water heating gains (Table 5)
               117.2995   115.2651   111.0404   105.2970   101.5682    96.3178    91.8551    97.5730    99.6046   105.5492   112.2616   115.2736 (72)
Total internal gains
               558.1362   553.9434   534.1509   503.6016   472.4756   444.5777   428.2856   436.1619   453.7613   484.5118   518.6215   544.2809 (73)


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6. Solar gains
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[Jan]                                      Area        Solar flux              g              FF          Access          Gains
                                            m2          Table 6a     Specific data     Specific data      factor            W
                                                          W/m2       or Table 6b       or Table 6c     Table 6d
-----------------------------------------------------------------------------------------------------------------------------------------
Northeast                                 3.9000          12.9236          0.4600            0.0000       0.7700        17.8523 (75)
Southwest                                 3.4700          40.4699          0.4600            0.0000       0.7700        49.7405 (79)
Southwest                                 3.3300          40.4699          0.4300            0.0000       0.7700        44.6206 (79)
-----------------------------------------------------------------------------------------------------------------------------------------

Solar gains    112.2135   177.4647   254.4583   350.4173   405.0526   440.9333   416.1583   372.5546   307.6640   213.6472   138.8213    94.4046 (83)
Total gains    670.3497   731.4081   788.6092   854.0189   877.5282   885.5110   844.4439   808.7165   761.4253   698.1591   657.4428   638.6856 (84)


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7. Mean internal temperature (heating season)
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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            38.3698    38.3698    38.3698    38.3698    38.3698    38.3698    38.3698    38.3698    38.3698    38.3698    38.3698    38.3698
alpha           3.5580     3.5580     3.5580     3.5580     3.5580     3.5580     3.5580     3.5580     3.5580     3.5580     3.5580     3.5580
util living area
                0.9407     0.9194     0.8711     0.7742     0.6200     0.4153     0.2758     0.2966     0.5391     0.7880     0.9060     0.9479 (86)

Tweekday       18.5405    18.7655    19.1865    19.6239    19.9122    20.0143    20.0265    20.0261    19.9851    19.6799    19.0670    18.4695
Tweekend       20.2575    20.3608    20.5562    20.7680    20.9203    20.9861    20.9977    20.9970    20.9630    20.7908    20.4967    20.2248
24 / 16            0          0          0          0          0          0          0          0          0          0          0          0
24 / 9             0          0          0          0          0          0          0          0          0          0          0          0
16 / 9             0          0          0          0          0          0          0          0          0          0          0          0
MIT            19.8540    20.0112    20.3150    20.6377    20.8770    20.9786    20.9964    20.9953    20.9423    20.6771    20.2141    19.8036 (87)
Th 2           20.0276    20.0276    20.0276    20.0276    20.0276    20.0276    20.0276    20.0276    20.0276    20.0276    20.0276    20.0276 (88)
util rest of house
                0.9301     0.9055     0.8488     0.7367     0.5614     0.3392     0.1903     0.2079     0.4609     0.7441     0.8872     0.9383 (89)
Tweekday       18.5405    18.7655    19.1865    19.6239    19.9122    20.0143    20.0265    20.0261    19.9851    19.6799    19.0670    18.4695
Tweekend       18.5405    18.7655    19.1865    19.6239    19.9122    20.0143    20.0265    20.0261    19.9851    19.6799    19.0670    18.4695
MIT 2          18.5405    18.7655    19.1865    19.6239    19.9122    20.0143    20.0265    20.0261    19.9851    19.6799    19.0670    18.4695 (90)
Living area fraction                                                                                   fLA = Living area / (4) =      0.1638 (91)
MIT            18.7557    18.9696    19.3714    19.7900    20.0703    20.1723    20.1854    20.1849    20.1420    19.8433    19.2549    18.6881 (92)
Temperature adjustment                                                                                                                  0.0000
adjusted MIT   18.7557    18.9696    19.3714    19.7900    20.0703    20.1723    20.1854    20.1849    20.1420    19.8433    19.2549    18.6881 (93)


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8. Space heating requirement
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CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9126	0.8869	0.8314	0.7266	0.5641	0.3508	0.2043	0.2224	0.4706	0.7348	0.8690	0.9215	(94)
Useful gains	611.7436	648.7214	655.6203	620.5393	495.0365	310.5950	172.5126	179.8539	358.2930	513.0421	571.3270	588.5427	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1033.6986	1012.0438	906.2008	748.6478	535.1980	315.8286	173.0013	180.5302	374.0920	623.9946	851.9642	1028.5802	(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	313.9345	244.1527	186.4318	92.2381	29.8801	0.0000	0.0000	0.0000	0.0000	82.5486	202.0588	327.3879	(98)

Space heating 1478.6326 (98)

Space heating per m2 (98) / (4) = 20.8493 (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 %)	222.0383	(206)
Efficiency of secondary/supplementary heating system, %	100.0000	(208)
Space heating requirement	665.9360	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	313.9345	244.1527	186.4318	92.2381	29.8801	0.0000	0.0000	0.0000	0.0000	82.5486	202.0588	327.3879	(98)
Space heating efficiency (main heating system 1)	222.0383	222.0383	222.0383	222.0383	222.0383	0.0000	0.0000	0.0000	0.0000	222.0383	222.0383	222.0383	(210)
Space heating fuel (main heating system)	141.3876	109.9597	83.9638	41.5415	13.4572	0.0000	0.0000	0.0000	0.0000	37.1777	91.0018	147.4466	(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	143.8526	(64)
Efficiency of water heater	170.2800	(216)
(217)m	170.2800	(217)
Fuel for water heating, kWh/month	84.4800	(219)
Water heating fuel used	911.2520	(219)
Annual totals kWh/year		
Space heating fuel - main system	665.9360	(211)
Space heating fuel - secondary	0.0000	(215)

Water heating requirement	146.8350	129.5959	137.5434	126.6632	126.1110	115.1967	113.9330	122.0581	120.8775	132.6205	136.3932	143.8526	(64)
Efficiency of water heater												170.2800	(216)
(217)m	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	(217)
Fuel for water heating, kWh/month	86.2315	76.1075	80.7748	74.3852	74.0609	67.6513	66.9092	71.6808	70.9875	77.8838	80.0994	84.4800	(219)

Water heating fuel used	911.2520	(219)
Annual totals kWh/year		
Space heating fuel - main system	665.9360	(211)
Space heating fuel - secondary	0.0000	(215)

Electricity for pumps and fans:
(MEVDecentralised, Database: total watage = 6.6170, total flow = 29.0000, SFP = 0.2282)
mechanical ventilation fans (SFP = 0.2282)

mechanical ventilation fans (SFP = 0.2282)	48.5654	(230a)
Total electricity for the above, kWh/year	48.5654	(231)
Electricity for lighting (calculated in Appendix L)	331.5208	(232)
Total delivered energy for all uses	1957.2742	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	665.9360	16.9600	112.9427	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	911.2520	16.9600	154.5483	(247)
Mechanical ventilation fans	48.5654	16.9600	8.2367	(249)
Pumps and fans for heating	0.0000	0.0000	0.0000	(249)
Energy for lighting	331.5208	16.9600	56.2259	(250)
Additional standing charges			0.0000	(251)
Total energy cost			331.9537	(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	665.9360	0.5190	345.6208	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	911.2520	0.5190	472.9398	(264)
Space and water heating			818.5606	(265)
Pumps and fans	48.5654	0.5190	25.2054	(267)
Energy for lighting	331.5208	0.5190	172.0593	(268)
Total kg/year			1015.8253	(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	665.9360	3.0700	2044.4235	(261)
Space heating - secondary	0.0000	3.0700	0.0000	(263)
Water heating (other fuel)	911.2520	3.0700	2797.5438	(264)
Space and water heating			4841.9673	(265)

Pumps and fans	48.5654	3.0700	149.0957 (267)
Energy for lighting	331.5208	3.0700	1017.7689 (268)
Primary energy kWh/year			6008.8319 (272)
Primary energy kWh/m2/year			84.7269 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 86
Current environmental impact rating: B 88

(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	Recommended
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	+ 2.4	-£ 62	-191 kg (18.8%)
U Solar photovoltaic panels	+ 11.5	-£ 309	-947 kg (114.7%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£62	2.69 kg/m²	B 89	B 90
Solar photovoltaic panels	£309	13.35 kg/m²	A 100	A 100
Total Savings	£372	16.04 kg/m²		

Potential energy efficiency rating: A 100
Potential environmental impact rating: A 100

Fuel prices for cost data on this page from database revision number 440 TEST (26 Feb 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£332	£270	£62
Space heating	£121	£121	-£0
Water heating	£155	£92	£63
Lighting	£56	£56	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£332	-£39	£371
Total cost of uses	£332	-£40	£372
Delivered energy	28 kWh/m²	-3 kWh/m²	31 kWh/m²
Carbon dioxide emissions	1.0 tonnes	-0.1 tonnes	1.1 tonnes
CO2 emissions per m²	14 kg/m²	-2 kg/m²	16 kg/m²
Primary energy	85 kWh/m²	-10 kWh/m²	95 kWh/m²

SAP 2012 WORKSHEET FOR New Build (As Designed) (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	35.4600 (1b)	x	2.3100 (2b)	=	81.9126	(1b) - (3b)
First floor	35.4600 (1c)	x	2.6100 (2c)	=	92.5506	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 70.9200						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	174.4632	(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							0 * 10	=	0.0000	(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) =	0.0000 / (5) =		0.0000	(8)
Pressure test			Yes	
Measured/design AP50			4.0100	
Infiltration rate			0.2005	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.1855	(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	0.2365	0.2318	0.2272	0.2040	0.1994	0.1762	0.1762	0.1716	0.1855	0.1994	0.2086	0.2179	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(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	
Solid Door			2.1500	1.0000	2.1500			(26)
Window (Uw = 1.20)			7.3700	1.1450	8.4389			(27)
French Door (Uw = 1.40)			3.3300	1.3258	4.4148			(27)
150mm Wht + Wht Topsheet			35.4600	0.1100	3.9006	75.0000	2659.5000	(28a)
100mm Knauf Supafil 34	82.9000	12.8500	70.0500	0.2500	17.5125	52.8000	3698.6400	(29a)
FP McCann System	35.4600		35.4600	0.1800	6.3828	9.0000	319.1400	(30)
Total net area of external elements Aum(A, m2)			153.8200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	42.7996			(33)
E-WM-30			39.9000	0.0000	0.0000	45.0000	1795.5000	(32)
Timber GF			65.7000			9.0000	591.3000	(32c)
Timber 1F			69.5700			9.0000	626.1300	(32c)
Internal Floor			35.4600			12.6000	446.7960	(32d)
Internal Ceiling			35.4600			9.0000	319.1400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 10456.1460	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	147.4358	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	4.1111	(36)
Total fabric heat loss	(33) + (36) = 46.9107	(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	28.7864	28.7864	28.7864	28.7864	28.7864	28.7864	28.7864	28.7864	28.7864	28.7864	28.7864	28.7864	(38)
Heat transfer coeff	75.6972	75.6972	75.6972	75.6972	75.6972	75.6972	75.6972	75.6972	75.6972	75.6972	75.6972	75.6972	(39)
Average = Sum(39)m / 12 =												75.6972	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0674	1.0674	1.0674	1.0674	1.0674	1.0674	1.0674	1.0674	1.0674	1.0674	1.0674	1.0674	(40)
HLP (average)												1.0674	(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	2.2683	(42)
Average daily hot water use (litres/day)	88.0710	(43)

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

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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Daily hot water use
                96.8781    93.3552    89.8324    86.3096    82.7867    79.2639    79.2639    82.7867    86.3096    89.8324    93.3552    96.8781 (44)
Energy conte   143.6674   125.6524   129.6620   113.0425   108.4670    93.5987    86.7330    99.5274   100.7161   117.3749   128.1238   139.1342 (45)
Energy content (annual)                                                                                                Total = Sum(45)m =   1385.6994 (45)
Distribution loss  (46)m = 0.15 x (45)m
                21.5501    18.8479    19.4493    16.9564    16.2700    14.0398    13.0100    14.9291    15.1074    17.6062    19.2186    20.8701 (46)
Water storage loss:
Store volume                                                                                                                                200.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                                                 1.5600 (48)
  Temperature factor from Table 2b                                                                                                            0.5400 (49)
Enter (49) or (54) in (55)                                                                                                                    0.8424 (55)
Total storage loss
                26.1144    23.5872    26.1144    25.2720    26.1144    25.2720    26.1144    26.1144    25.2720    26.1144    25.2720    26.1144 (56)
If cylinder contains dedicated solar storage
                26.1144    23.5872    26.1144    25.2720    26.1144    25.2720    26.1144    26.1144    25.2720    26.1144    25.2720    26.1144 (57)
Primary loss    23.2624    21.0112    21.8667    15.7584    10.4681     9.9053    10.2355    11.1660    17.1091    21.8667    22.5120    23.2624 (59)
Total heat required for water heating calculated for each month
               193.0442   170.2508   177.6431   154.0729   145.0495   128.7760   123.0829   136.8077   143.0972   165.3559   175.9078   188.5110 (62)
WWHRS          -46.2092   -40.6549   -41.4954   -34.1633   -31.7328   -26.1861   -22.1768   -26.8460   -27.6226   -34.1312   -39.5146   -44.6584 eq.(G10)
Total of WWHRS savings                                                                                                                     -415.3914
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                                                                                                                           1.8691 (H8)
Utilisation factor                                                                                                                            0.4143 (H9)
Collector performance factor                                                                                                                  0.8793 (H10)
Dedicated solar storage volume                                                                                                               75.0000 (H11)
Effective solar volume                                                                                                                       75.0000 (H13)
Daily hot water demand                                                                                                                       88.0710 (H14)
Volume ratio Veff/V                                                                                                                           0.8516 (H15)
Solar storage volume factor                                                                                                                   0.9679 (H16)
Solar input                                                                                                                               -639.5139 (H17)
Solar input    -18.5446   -30.9457   -52.7040   -70.6337   -87.2620   -85.7925   -84.6587   -73.9667   -57.9308   -39.5599   -21.9966   -15.5187 (63)
                                                                                              Solar input (sum of months) = Sum(63)m =   -639.5139 (63)
Output from w/h
               128.2903    98.6502    83.4437    49.2758    26.0546    16.7975    16.2474    35.9950    57.5438    91.6648   114.3966   128.3339 (64)
                                                                                               Total per year (kWh/year) = Sum(64)m =    846.6937 (64)
Heat gains from water heating, kWh/month
                87.2708    77.4581    81.4975    70.4110    65.3313    59.2634    57.9186    62.9171    67.3930    77.4120    80.8284    85.7636 (65)


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5. Internal gains (see Table 5 and 5a)
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Metabolic gains (Table 5), Watts
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m          136.0951   136.0951   136.0951   136.0951   136.0951   136.0951   136.0951   136.0951   136.0951   136.0951   136.0951   136.0951 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                46.9302    41.6830    33.8989    25.6636    19.1839    16.1958    17.5002    22.7474    30.5315    38.7667    45.2465    48.2345 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               297.6637   300.7525   292.9688   276.3982   255.4807   235.8213   222.6876   219.5988   227.3825   243.9531   264.8706   284.5300 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                50.8778    50.8778    50.8778    50.8778    50.8778    50.8778    50.8778    50.8778    50.8778    50.8778    50.8778    50.8778 (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)
               -90.7301   -90.7301   -90.7301   -90.7301   -90.7301   -90.7301   -90.7301   -90.7301   -90.7301   -90.7301   -90.7301   -90.7301 (71)
Water heating gains (Table 5)
               117.2995   115.2651   109.5396    97.7930    87.8108    82.3103    77.8476    84.5660    93.6014   104.0484   112.2616   115.2736 (72)
Total internal gains
               558.1362   553.9434   532.6501   496.0976   458.7182   430.5702   414.2782   423.1550   447.7581   483.0110   518.6215   544.2809 (73)


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6. Solar gains
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[Jan]                                     Area        Solar flux              g              FF          Access            Gains
                                           m2          Table 6a     Specific data     Specific data      factor              W
                                                          W/m2       or Table 6b       or Table 6c     Table 6d
-----------------------------------------------------------------------------------------------------
Northeast                                3.9000          11.2829            0.4600            0.0000          0.7700          15.5860 (75)
Southwest                                3.4700          36.7938            0.4600            0.0000          0.7700          45.2223 (79)
Southwest                                3.3300          36.7938            0.4300            0.0000          0.7700          40.5675 (79)
-----------------------------------------------------------------------------------------------------

Solar gains    101.3759   177.8577   257.1038   341.6132   403.6733   410.0081   391.4405   343.7261   286.1472   200.2783   122.3677    86.1466 (83)
Total gains    659.5121   731.8011   789.7539   837.7108   862.3916   840.5784   805.7187   766.8811   733.9054   683.2893   640.9892   630.4275 (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            38.3698    38.3698    38.3698    38.3698    38.3698    38.3698    38.3698    38.3698    38.3698    38.3698    38.3698    38.3698
alpha           3.5580     3.5580     3.5580     3.5580     3.5580     3.5580     3.5580     3.5580     3.5580     3.5580     3.5580     3.5580
util living area
                0.9502     0.9279     0.8881     0.8140     0.6956     0.5389     0.4027     0.4387     0.6340     0.8323     0.9252     0.9567 (86)

Tweekday       18.3553    18.6329    19.0365    19.4797    19.8128    19.9774    20.0184    20.0141    19.9281    19.5317    18.8678    18.2666
Tweekend       20.1739    20.3006    20.4865    20.6968    20.8651    20.9593    20.9889    20.9847    20.9261    20.7167    20.4050    20.1336
24 / 16            0          0          0          0          0          0          0          0          0          0          0          0
```

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

24 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	19.7251	19.9181	20.2075	20.5265	20.7918	20.9374	20.9828	20.9764	20.8847	20.5628	20.0709	19.6629	(87)
Th 2	20.0276	20.0276	20.0276	20.0276	20.0276	20.0276	20.0276	20.0276	20.0276	20.0276	20.0276	20.0276	(88)
util rest of house	0.9415	0.9157	0.8692	0.7827	0.6461	0.4684	0.3181	0.3521	0.5652	0.7972	0.9104	0.9490	(89)
Tweekday	18.3553	18.6329	19.0365	19.4797	19.8128	19.9774	20.0184	20.0141	19.9281	19.5317	18.8678	18.2666	
Tweekend	18.3553	18.6329	19.0365	19.4797	19.8128	19.9774	20.0184	20.0141	19.9281	19.5317	18.8678	18.2666	
MIT 2	18.3553	18.6329	19.0365	19.4797	19.8128	19.9774	20.0184	20.0141	19.9281	19.5317	18.8678	18.2666	(90)
Living area fraction									fLA = Living area / (4) =			0.1638	(91)
MIT	18.5797	18.8435	19.2284	19.6512	19.9733	20.1347	20.1764	20.1717	20.0848	19.7007	19.0649	18.4953	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5797	18.8435	19.2284	19.6512	19.9733	20.1347	20.1764	20.1717	20.0848	19.7007	19.0649	18.4953	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9249	0.8973	0.8509	0.7692	0.6432	0.4765	0.3314	0.3653	0.5695	0.7838	0.8923	0.9333	(94)
Useful gains	609.9728	656.6775	671.9842	644.3532	554.6765	400.5456	266.9860	280.1218	417.9894	535.5501	571.9486	588.3510	(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	1080.9321	1055.4827	963.5017	813.8360	626.2615	418.9583	270.7223	285.5101	453.0353	688.8944	905.7124	1082.1166	(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	350.3938	267.9971	216.8890	122.0276	53.2592	0.0000	0.0000	0.0000	0.0000	114.0882	240.3100	367.3616	(98)
Space heating												1732.3264	(98)
Space heating per m2											(98) / (4) =	24.4265	(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 %)	222.0383	(206)
Efficiency of secondary/supplementary heating system, %	100.0000	(208)
Space heating requirement	780.1928	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	350.3938	267.9971	216.8890	122.0276	53.2592	0.0000	0.0000	0.0000	0.0000	114.0882	240.3100	367.3616	(98)
Space heating efficiency (main heating system 1)	222.0383	222.0383	222.0383	222.0383	222.0383	0.0000	0.0000	0.0000	0.0000	222.0383	222.0383	222.0383	(210)
Space heating fuel (main heating system)	157.8078	120.6986	97.6809	54.9579	23.9865	0.0000	0.0000	0.0000	0.0000	51.3822	108.2291	165.4497	(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	128.2903	98.6502	83.4437	49.2758	26.0546	16.7975	16.2474	35.9950	57.5438	91.6648	114.3966	128.3339	(64)
Efficiency of water heater												170.2800	(216)
(217)m	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	(217)
Fuel for water heating, kWh/month	75.3408	57.9341	49.0038	28.9381	15.3010	9.8646	9.5416	21.1387	33.7936	53.8318	67.1815	75.3664	(219)
Water heating fuel used												497.2362	(219)

Annual totals kWh/year		
Space heating fuel - main system	780.1928	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
(MEVDecentralised, Database: total watage = 6.6170, total flow = 29.0000, SFP = 0.2282)		
mechanical ventilation fans (SFP = 0.2282)	48.5654	(230a)
pump for solar water heating	50.0000	(230g)
Total electricity for the above, kWh/year	98.5654	(231)
Electricity for lighting (calculated in Appendix L)	331.5208	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) = -1727.2394	-1727.2394	(233)
Total delivered energy for all uses	-19.7242	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	780.1928	13.1900	102.9074	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	497.2362	13.1900	65.5854	(247)
Mechanical ventilation fans	48.5654	13.1900	6.4058	(249)
Pumps and fans for heating	0.0000	0.0000	0.0000	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	331.5208	13.1900	43.7276	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			-2.6016	(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] =	-0.0094	(257)
SAP value		100.1315	
SAP rating (Section 12)		100	(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	780.1928	0.5190	404.9201	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	497.2362	0.5190	258.0656	(264)
Space and water heating			662.9856	(265)
Pumps and fans	98.5654	0.5190	51.1554	(267)
Energy for lighting	331.5208	0.5190	172.0593	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			-10.2369	(272)
CO2 emissions per m2			-0.1400	(273)
EI value			100.1183	
EI rating			100	(274)
EI band			A	

SAP 2012 WORKSHEET FOR New Build (As Designed) (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	35.4600 (1b)	x	2.3100 (2b)	=	81.9126	(1b) - (3b)
First floor	35.4600 (1c)	x	2.6100 (2c)	=	92.5506	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 70.9200						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	174.4632	(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							0 * 10	=	0.0000	(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) =	0.0000 / (5) =		0.0000	(8)
Pressure test			Yes	
Measured/design AP50			4.0100	
Infiltration rate			0.2005	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.1855	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.1947	0.1855	0.1855	0.1716	0.1716	0.1530	0.1576	0.1484	0.1530	0.1623	0.1623	0.1762	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(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	
Solid Door			2.1500	1.0000	2.1500			(26)
Window (Uw = 1.20)			7.3700	1.1450	8.4389			(27)
French Door (Uw = 1.40)			3.3300	1.3258	4.4148			(27)
150mm Wht + Wht Topsheet			35.4600	0.1100	3.9006	75.0000	2659.5000	(28a)
100mm Knauf Supafil 34	82.9000	12.8500	70.0500	0.2500	17.5125	52.8000	3698.6400	(29a)
FP McCann System	35.4600		35.4600	0.1800	6.3828	9.0000	319.1400	(30)
Total net area of external elements Aum(A, m2)			153.8200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	42.7996			(33)
E-WM-30			39.9000	0.0000	0.0000	45.0000	1795.5000	(32)
Timber GF			65.7000			9.0000	591.3000	(32c)
Timber 1F			69.5700			9.0000	626.1300	(32c)
Internal Floor			35.4600			12.6000	446.7960	(32d)
Internal Ceiling			35.4600			9.0000	319.1400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 10456.1460	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	147.4358	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	4.1111	(36)
Total fabric heat loss	(33) + (36) = 46.9107	(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	28.7864	28.7864	28.7864	28.7864	28.7864	28.7864	28.7864	28.7864	28.7864	28.7864	28.7864	28.7864	(38)
Heat transfer coeff	75.6972	75.6972	75.6972	75.6972	75.6972	75.6972	75.6972	75.6972	75.6972	75.6972	75.6972	75.6972	(39)
Average = Sum(39)m / 12 =												75.6972	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0674	1.0674	1.0674	1.0674	1.0674	1.0674	1.0674	1.0674	1.0674	1.0674	1.0674	1.0674	(40)
HLP (average)												1.0674	(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	2.2683	(42)
Average daily hot water use (litres/day)	88.0710	(43)

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

```
Daily hot water use
                96.8781    93.3552    89.8324    86.3096    82.7867    79.2639    79.2639    82.7867    86.3096    89.8324    93.3552    96.8781 (44)
Energy conte   143.6674   125.6524   129.6620   113.0425   108.4670    93.5987    86.7330    99.5274   100.7161   117.3749   128.1238   139.1342 (45)
Energy content (annual)                                                                                                Total = Sum(45)m =   1385.6994 (45)
Distribution loss  (46)m = 0.15 x (45)m
                21.5501    18.8479    19.4493    16.9564    16.2700    14.0398    13.0100    14.9291    15.1074    17.6062    19.2186    20.8701 (46)
Water storage loss:
Store volume                                                                                                                                 200.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                                                  1.5600 (48)
  Temperature factor from Table 2b                                                                                                             0.5400 (49)
Enter (49) or (54) in (55)                                                                                                                     0.8424 (55)
Total storage loss
                26.1144    23.5872    26.1144    25.2720    26.1144    25.2720    26.1144    26.1144    25.2720    26.1144    25.2720    26.1144 (56)
If cylinder contains dedicated solar storage
                26.1144    23.5872    26.1144    25.2720    26.1144    25.2720    26.1144    26.1144    25.2720    26.1144    25.2720    26.1144 (57)
Primary loss    23.2624    21.0112    21.8667    15.7584    10.4681     9.9053    10.2355    11.1660    17.1091    21.8667    22.5120    23.2624 (59)
Total heat required for water heating calculated for each month
               193.0442   170.2508   177.6431   154.0729   145.0495   128.7760   123.0829   136.8077   143.0972   165.3559   175.9078   188.5110 (62)
WWHRS          -46.2092   -40.6549   -41.4954   -34.1633   -31.7328   -26.1861   -22.1768   -26.8460   -27.6226   -34.1312   -39.5146   -44.6584 eq.(G10)
Total of WWHRS savings                                                                                                                      -415.3914
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                                                                                                               1140.0998 (H5)
Overshading factor                                                                                                                             0.8000 (H6)
Solar energy available                                                                                                                      1915.3676 (H7)
Adjustment factor for showers                                                                                                                  1.0000 (H7a)
Solar-to-load ratio                                                                                                                            1.9740 (H8)
Utilisation factor                                                                                                                             0.3975 (H9)
Collector performance factor                                                                                                                   0.8793 (H10)
Dedicated solar storage volume                                                                                                                75.0000 (H11)
Effective solar volume                                                                                                                        75.0000 (H13)
Daily hot water demand                                                                                                                        88.0710 (H14)
Volume ratio Veff/V                                                                                                                            0.8516 (H15)
Solar storage volume factor                                                                                                                    0.9679 (H16)
Solar input                                                                                                                                 -647.8721 (H17)
Solar input    -19.9412   -29.9716   -50.4759   -69.7731   -84.0303   -88.4382   -86.3147   -77.0795   -60.1608   -40.9263   -24.2390   -16.5214 (63)
                                                                                                Solar input (sum of months) = Sum(63)m =   -647.8721 (63)
Output from w/h
               126.8938    99.6243    85.6718    50.1364    29.2863    14.1517    14.5914    32.8822    55.3137    90.2984   112.1542   127.3312 (64)
                                                                                                 Total per year (kWh/year) = Sum(64)m =    838.3355 (64)
Heat gains from water heating, kWh/month
                87.2708    77.4581    81.4975    70.4110    65.3313    59.2634    57.9186    62.9171    67.3930    77.4120    80.8284    85.7636 (65)


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5. Internal gains (see Table 5 and 5a)
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Metabolic gains (Table 5), Watts
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m          136.0951   136.0951   136.0951   136.0951   136.0951   136.0951   136.0951   136.0951   136.0951   136.0951   136.0951   136.0951 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                46.9302    41.6830    33.8989    25.6636    19.1839    16.1958    17.5002    22.7474    30.5315    38.7667    45.2465    48.2345 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               297.6637   300.7525   292.9688   276.3982   255.4807   235.8213   222.6876   219.5988   227.3825   243.9531   264.8706   284.5300 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                50.8778    50.8778    50.8778    50.8778    50.8778    50.8778    50.8778    50.8778    50.8778    50.8778    50.8778    50.8778 (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)
               -90.7301   -90.7301   -90.7301   -90.7301   -90.7301   -90.7301   -90.7301   -90.7301   -90.7301   -90.7301   -90.7301   -90.7301 (71)
Water heating gains (Table 5)
               117.2995   115.2651   109.5396    97.7930    87.8108    82.3103    77.8476    84.5660    93.6014   104.0484   112.2616   115.2736 (72)
Total internal gains
               558.1362   553.9434   532.6501   496.0976   458.7182   430.5702   414.2782   423.1550   447.7581   483.0110   518.6215   544.2809 (73)


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6. Solar gains
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[Jan]                                      Area        Solar flux              g              FF           Access            Gains
                                            m2          Table 6a     Specific data     Specific data       factor              W
                                                          W/m2       or Table 6b       or Table 6c       Table 6d
-----------------------------------------------------------------------------------------------------------
Northeast                                 3.9000          12.9236          0.4600            0.0000          0.7700          17.8523 (75)
Southwest                                 3.4700          40.4699          0.4600            0.0000          0.7700          49.7405 (79)
Southwest                                 3.3300          40.4699          0.4300            0.0000          0.7700          44.6206 (79)
-----------------------------------------------------------------------------------------------------------

Solar gains    112.2135   177.4647   254.4583   350.4173   405.0526   440.9333   416.1583   372.5546   307.6640   213.6472   138.8213    94.4046 (83)
Total gains    670.3497   731.4081   787.1084   846.5149   863.7708   871.5035   830.4364   795.7096   755.4221   696.6583   657.4428   638.6856 (84)


-----------------------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
-----------------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                                  21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                 Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau            38.3698    38.3698    38.3698    38.3698    38.3698    38.3698    38.3698    38.3698    38.3698    38.3698    38.3698    38.3698
alpha           3.5580     3.5580     3.5580     3.5580     3.5580     3.5580     3.5580     3.5580     3.5580     3.5580     3.5580     3.5580
util living area
                0.9407     0.9194     0.8717     0.7777     0.6272     0.4214     0.2803     0.3013     0.5426     0.7888     0.9060     0.9479 (86)

Tweekday       18.5405    18.7655    19.1841    19.6169    19.9075    20.0136    20.0265    20.0260    19.9842    19.6785    19.0670    18.4695
Tweekend       20.2575    20.3608    20.5550    20.7643    20.9173    20.9854    20.9976    20.9968    20.9623    20.7900    20.4967    20.2248
24 / 16              0          0          0          0          0          0          0          0          0          0          0          0
```

24 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
MIT	19.8540	20.0112	20.3132	20.6319	20.8724	20.9776	20.9962	20.9951	20.9411	20.6759	20.2141	19.8036	(87)
Th 2	20.0276	20.0276	20.0276	20.0276	20.0276	20.0276	20.0276	20.0276	20.0276	20.0276	20.0276	20.0276	(88)
util rest of house	0.9301	0.9055	0.8494	0.7404	0.5685	0.3444	0.1935	0.2112	0.4642	0.7450	0.8872	0.9383	(89)
Tweekday	18.5405	18.7655	19.1841	19.6169	19.9075	20.0136	20.0265	20.0260	19.9842	19.6785	19.0670	18.4695	
Tweekend	18.5405	18.7655	19.1841	19.6169	19.9075	20.0136	20.0265	20.0260	19.9842	19.6785	19.0670	18.4695	
MIT 2	18.5405	18.7655	19.1841	19.6169	19.9075	20.0136	20.0265	20.0260	19.9842	19.6785	19.0670	18.4695	(90)
Living area fraction									fLA = Living area / (4) =			0.1638	(91)
MIT	18.7557	18.9696	19.3691	19.7832	20.0656	20.1715	20.1854	20.1848	20.1410	19.8419	19.2549	18.6881	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7557	18.9696	19.3691	19.7832	20.0656	20.1715	20.1854	20.1848	20.1410	19.8419	19.2549	18.6881	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9126	0.8869	0.8319	0.7301	0.5709	0.3560	0.2077	0.2260	0.4737	0.7357	0.8690	0.9215	(94)
Useful gains	611.7436	648.7214	654.8293	618.0244	493.1476	310.2841	172.4787	179.8090	357.8794	512.5226	571.3270	588.5427	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	1033.6986	1012.0438	906.0301	748.1327	534.8427	315.7738	172.9951	180.5221	374.0170	623.8881	851.9642	1028.5802	(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	313.9345	244.1527	186.8934	93.6779	31.0212	0.0000	0.0000	0.0000	0.0000	82.8559	202.0588	327.3879	(98)
Space heating												1481.9823	(98)
Space heating per m2											(98) / (4) =	20.8965	(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 %)	222.0383	(206)
Efficiency of secondary/supplementary heating system, %	100.0000	(208)
Space heating requirement	667.4446	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	313.9345	244.1527	186.8934	93.6779	31.0212	0.0000	0.0000	0.0000	0.0000	82.8559	202.0588	327.3879	(98)
Space heating efficiency (main heating system 1)	222.0383	222.0383	222.0383	222.0383	222.0383	0.0000	0.0000	0.0000	0.0000	222.0383	222.0383	222.0383	(210)
Space heating fuel (main heating system)	141.3876	109.9597	84.1717	42.1900	13.9711	0.0000	0.0000	0.0000	0.0000	37.3161	91.0018	147.4466	(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	126.8938	99.6243	85.6718	50.1364	29.2863	14.1517	14.5914	32.8822	55.3137	90.2984	112.1542	127.3312	(64)
Efficiency of water heater												170.2800	(216)
(217)m	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	(217)
Fuel for water heating, kWh/month	74.5207	58.5062	50.3123	29.4435	17.1989	8.3108	8.5691	19.3107	32.4840	53.0294	65.8646	74.7776	(219)
Water heating fuel used												492.3276	(219)

Annual totals kWh/year		
Space heating fuel - main system	667.4446	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
(MEVDecentralised, Database: total watage = 6.6170, total flow = 29.0000, SFP = 0.2282)		
mechanical ventilation fans (SFP = 0.2282)	48.5654	(230a)
pump for solar water heating	50.0000	(230g)
Total electricity for the above, kWh/year	98.5654	(231)
Electricity for lighting (calculated in Appendix L)	331.5208	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 2.50 * 1140 * 0.80) = -1824.1596	-1824.1596	(233)
Total delivered energy for all uses	-234.3012	(238)

10a. Fuel costs - using BEDF prices (440)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	667.4446	16.9600	113.1986	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	492.3276	16.9600	83.4988	(247)
Mechanical ventilation fans	48.5654	16.9600	8.2367	(249)
Pumps and fans for heating	0.0000	0.0000	0.0000	(249)
Pump for solar water heating	50.0000	16.9600	8.4800	(249)
Energy for lighting	331.5208	16.9600	56.2259	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	16.9600	-309.3775	(252)
Total energy cost			-39.7375	(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	667.4446	0.5190	346.4038	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	492.3276	0.5190	255.5180	(264)
Space and water heating			601.9218	(265)
Pumps and fans	98.5654	0.5190	51.1554	(267)
Energy for lighting	331.5208	0.5190	172.0593	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	0.5190	-946.7389	(269)
Total kg/year			-121.6023	(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	667.4446	3.0700	2049.0550	(261)
Space heating - secondary	0.0000	3.0700	0.0000	(263)
Water heating (other fuel)	492.3276	3.0700	1511.4459	(264)
Space and water heating			3560.5008	(265)
Pumps and fans	98.5654	3.0700	302.5957	(267)
Energy for lighting	331.5208	3.0700	1017.7689	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			-719.3046	(272)
Primary energy kWh/m2/year			-10.1425	(273)

SAP 2012 OVERHEATING ASSESSMENT FOR New Build (As Designed) 9.92

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	North East
Overshading	Average or unknown
Thermal mass parameter	147.4 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	230.29	(P1)
Transmission heat loss coefficient	46.91	(37)
Summer heat loss coefficient	277.20	(P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North East	0.000	1.000	None
South West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North East	1.000	0.90	1.000	0.900	(P8)
South West	1.000	0.90	1.000	0.900	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	3.9000	98.8453	0.4600	0.0000	0.9000	159.5956
South West	3.4700	119.9223	0.4600	0.0000	0.9000	172.2780
South West	3.3300	119.9223	0.4300	0.0000	0.9000	154.5451
total:						486.4187

	Jun	Jul	Aug	
Solar gains	515	486	435	(P3/P4)
Internal gains	445	428	436	
Total summer gains	960	915	872	(P5)
Summer gain/loss ratio	3.46	3.30	3.14	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 147.4)	0.97	0.97	0.97	
Threshold temperature	20.43	22.17	21.91	(P7)
Likelihood of high internal temperature	Not significant	Medium	Slight	

Assessment of likelihood of high internal temperature: Medium

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