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

AES Sustainability Consultants

Property Reference	Becket - Det (ASHP)	**Issued on Date**	15/12/2022
Assessment Reference	Becket - Det (ASHP)	**Prop Type Ref**	
Property	Plot, 3 Bed, K, WC, U, B, ES		

SAP Rating	87 B	**DER**	14.42	**TER**	26.24
Environmental	88 B	**% DER<TER**	45.05		
CO_2 Emissions (t/year)	1.20	**DFEE**	43.49	**TFEE**	55.13
General Requirements Compliance	Pass	**% DFEE<TFEE**	21.12		

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

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

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DWELLING AS DESIGNED

Detached House, total floor area 95 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) 26.24 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 14.42 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)55.1 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)43.5 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	0.09 (max. 0.20)	0.09 (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 East: 5.85 m², No overhang
Windows facing South: 6.78 m², No overhang
Windows facing West: 1.98 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
Roof U-value 0.09 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 0.021 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	47.6000 (1b)	x	2.3100 (2b)	=	109.9560	(1b) - (3b)
First floor	47.6000 (1c)	x	2.6100 (2c)	=	124.2360	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.2000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	234.1920	(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			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.2005	(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	0.2556	0.2506	0.2456	0.2206	0.2155	0.1905	0.1905	0.1855	0.2005	0.2155	0.2256	0.2356	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5056	0.5006	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			1.9800	1.0000	1.9800			(26)
Half Glaze			1.9800	1.3000	2.5740			(26a)
Window (Uw = 1.20)			11.4600	1.1450	13.1221			(27)
French Door (Uw = 1.40)			3.1500	1.3258	4.1761			(27)
FP McCann System			47.6000	0.1100	5.2360	75.0000	3570.0000	(28a)
100mm Knauf Supafil 34	138.7900	18.5700	120.2200	0.2500	30.0550	52.8000	6347.6160	(29a)
Plane Ceiling-500mm Loft Roll	47.6000		47.6000	0.0900	4.2840	9.0000	428.4000	(30)
Total net area of external elements Aum(A, m2)			233.9900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		61.4273			(33)
Timber GF			53.1900			9.0000	478.7100	(32c)
Timber 1F			101.6300			9.0000	914.6700	(32c)
Masonry GF			25.7200			39.0000	1003.0800	(32c)
Internal Floor			47.6000			12.6000	599.7600	(32d)
Internal Ceiling			47.6000			9.0000	428.4000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 13770.6360	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	144.6495	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	4.9781	(36)
Total fabric heat loss	(33) + (36) = 66.4054	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.0774	38.6900	38.6417	38.6417	38.6417	38.6417	38.6417	38.6417	38.6417	38.6417	38.6417	38.6417	(38)
Heat transfer coeff	105.4827	105.0953	105.0470	105.0470	105.0470	105.0470	105.0470	105.0470	105.0470	105.0470	105.0470	105.0470	(39)
Average = Sum(39)m / 12 =												105.0874	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1080	1.1039	1.1034	1.1034	1.1034	1.1034	1.1034	1.1034	1.1034	1.1034	1.1034	1.1034	(40)
HLP (average)												1.1039	(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	2.6904	(42)
Average daily hot water use (litres/day)	98.0976	(43)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	107.9074	103.9835	100.0596	96.1357	92.2118	88.2879	88.2879	92.2118	96.1357	100.0596	103.9835	107.9074	(44)
Energy conte	160.0236	139.9576	144.4237	125.9121	120.8157	104.2547	96.6073	110.8583	112.1823	130.7377	142.7104	154.9743	(45)
Energy content (annual)										Total = Sum(45)m =		1543.4579	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.0035	20.9936	21.6636	18.8868	18.1224	15.6382	14.4911	16.6288	16.8274	19.6107	21.4066	23.2461	(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													
	209.4004	184.5560	193.8005	173.6961	170.1925	152.0387	145.9841	160.2351	159.9663	180.1145	190.4944	204.3511	(62)
WWHRS	-49.7139	-43.7420	-44.6443	-36.7312	-34.1052	-28.1348	-23.8109	-28.8296	-29.6709	-36.6797	-42.4893	-48.0509	eq.(G10)
Total of WWHRS savings												-446.6025	
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													
	159.6865	140.8141	149.1563	136.9650	136.0873	123.9039	122.1733	131.4055	130.2954	143.4348	148.0052	156.3002	(64)
								Total per year (kWh/year) = Sum(64)m =				1678.2274	(64)
Heat gains from water heating, kWh/month													
	92.7093	82.2146	87.5223	80.0930	79.6727	72.8919	71.6234	76.3618	75.5278	82.9717	85.6784	91.0304	(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	134.5214	134.5214	134.5214	134.5214	134.5214	134.5214	134.5214	134.5214	134.5214	134.5214	134.5214	134.5214	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.2917	20.6875	16.8242	12.7370	9.5211	8.0381	8.6854	11.2896	15.1529	19.2401	22.4561	23.9390	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	248.3263	250.9031	244.4095	230.5855	213.1351	196.7342	185.7774	183.2005	189.6941	203.5182	220.9685	237.3695	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.4521	36.4521	36.4521	36.4521	36.4521	36.4521	36.4521	36.4521	36.4521	36.4521	36.4521	36.4521	(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)													
	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	(71)
Water heating gains (Table 5)													
	124.6092	122.3432	117.6375	111.2402	107.0869	101.2388	96.2680	102.6369	104.8998	111.5211	118.9978	122.3527	(72)
Total internal gains													
	459.5836	457.2902	442.2277	417.9191	393.0994	369.3674	354.0872	360.4834	373.1032	397.6358	425.7788	447.0176	(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	
East	2.7000	19.6403	0.4600	0.0000	0.7700	18.7828	(76)
South	6.7800	46.7521	0.4600	0.0000	0.7700	112.2740	(78)
West	1.9800	19.6403	0.4600	0.0000	0.7700	13.7740	(80)
East	3.1500	19.6403	0.4300	0.0000	0.7700	20.4841	(76)

Solar gains	165.3149	287.6351	405.1019	513.9388	581.2807	578.1301	557.0457	507.5853	443.4126	321.4464	199.2187	140.6333	(83)
Total gains	624.8985	744.9253	847.3296	931.8580	974.3801	947.4975	911.1329	868.0687	816.5158	719.0823	624.9975	587.6509	(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	36.2635	36.3972	36.4139	36.4139	36.4139	36.4139	36.4139	36.4139	36.4139	36.4139	36.4139	36.4139	
alpha	3.4176	3.4265	3.4276	3.4276	3.4276	3.4276	3.4276	3.4276	3.4276	3.4276	3.4276	3.4276	
util living area													
	0.9811	0.9654	0.9358	0.8767	0.7752	0.6282	0.4816	0.5208	0.7260	0.9033	0.9680	0.9845	(86)
Tweekday	17.7045	18.0832	18.6031	19.1818	19.6445	19.9022	19.9785	19.9702	19.8175	19.2177	18.3423	17.6217	
Tweekend	19.8889	20.0578	20.2926	20.5602	20.7853	20.9253	20.9773	20.9699	20.8721	20.5710	20.1717	19.8509	
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	19.2853	19.5425	19.9083	20.3132	20.6687	20.8853	20.9650	20.9535	20.8003	20.3378	19.7066	19.2266	(87)
Th 2	19.9943	19.9976	19.9980	19.9980	19.9980	19.9980	19.9980	19.9980	19.9980	19.9980	19.9980	19.9980	(88)
util rest of house													
	0.9774	0.9588	0.9232	0.8520	0.7293	0.5524	0.3820	0.4208	0.6581	0.8785	0.9607	0.9814	(89)
Tweekday	17.7045	18.0832	18.6031	19.1818	19.6445	19.9022	19.9785	19.9702	19.8175	19.2177	18.3423	17.6217	
Tweekend	17.7045	18.0832	18.6031	19.1818	19.6445	19.9022	19.9785	19.9702	19.8175	19.2177	18.3423	17.6217	
MIT 2	17.7045	18.0832	18.6031	19.1818	19.6445	19.9022	19.9785	19.9702	19.8175	19.2177	18.3423	17.6217	(90)
Living area fraction									fLA = Living area / (4) =			0.1957	(91)
MIT	18.0138	18.3687	18.8585	19.4032	19.8449	20.0945	20.1716	20.1627	20.0098	19.4369	18.6093	17.9358	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0138	18.3687	18.8585	19.4032	19.8449	20.0945	20.1716	20.1627	20.0098	19.4369	18.6093	17.9358	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9669	0.9442	0.9052	0.8346	0.7214	0.5602	0.4000	0.4381	0.6589	0.8613	0.9468	0.9722	(94)
Useful gains	604.2378	703.3861	767.0037	777.7221	702.9563	530.7589	364.4282	380.2791	538.0394	619.3526	591.7528	571.3193	(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	1446.5730	1415.5019	1298.2208	1103.3344	855.5957	577.1857	375.1838	395.2564	620.8112	928.2947	1209.0193	1442.9012	(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	626.6974	478.5418	395.2255	234.4409	113.5637	0.0000	0.0000	0.0000	0.0000	229.8529	444.4319	648.4569	(98)
Space heating												3171.2110	(98)
Space heating per m2											(98) / (4) =	33.3110	(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 %)	268.2210	(206)
Efficiency of secondary/supplementary heating system, %	100.0000	(208)
Space heating requirement	1182.3125	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	626.6974	478.5418	395.2255	234.4409	113.5637	0.0000	0.0000	0.0000	0.0000	229.8529	444.4319	648.4569	(98)
Space heating efficiency (main heating system 1)	268.2210	268.2210	268.2210	268.2210	268.2210	0.0000	0.0000	0.0000	0.0000	268.2210	268.2210	268.2210	(210)
Space heating fuel (main heating system)	233.6496	178.4132	147.3507	87.4058	42.3396	0.0000	0.0000	0.0000	0.0000	85.6953	165.6961	241.7621	(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	159.6865	140.8141	149.1563	136.9650	136.0873	123.9039	122.1733	131.4055	130.2954	143.4348	148.0052	156.3002	(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	93.7788	82.6956	87.5947	80.4351	79.9197	72.7648	71.7485	77.1703	76.5183	84.2347	86.9187	91.7901	(219)
Water heating fuel used												985.5693	(219)
Annual totals kWh/year													
Space heating fuel - main system												1182.3125	(211)
Space heating fuel - secondary												0.0000	(215)

Electricity for pumps and fans:
(MEVDecentralised, Database: total watage = 10.3610, total flow = 45.0000, SFP = 0.2302)

mechanical ventilation fans (SFP = 0.2302)	65.7841	(230a)
Total electricity for the above, kWh/year	65.7841	(231)
Electricity for lighting (calculated in Appendix L)	411.3386	(232)
Total delivered energy for all uses	2645.0046	(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	1182.3125	0.5190	613.6202	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	985.5693	0.5190	511.5105	(264)
Space and water heating			1125.1307	(265)
Pumps and fans	65.7841	0.5190	34.1420	(267)
Energy for lighting	411.3386	0.5190	213.4847	(268)
Total CO2, kg/year			1372.7574	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			14.4200	(273)

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

DER		14.4200	ZC1
Total Floor Area	TFA	95.2000	
Assumed number of occupants	N	2.6904	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.4572	ZC2
CO2 emissions from cooking, equation (L16)		1.9283	ZC3
Total CO2 emissions		31.8055	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		31.8055	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	47.6000 (1b)	x	2.3100 (2b)	=	109.9560	(1b) - (3b)
First floor	47.6000 (1c)	x	2.6100 (2c)	=	124.2360	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.2000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	234.1920	(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) =		0.1281	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3781	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3781	(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	0.4821	0.4726	0.4632	0.4159	0.4065	0.3592	0.3592	0.3497	0.3781	0.4065	0.4254	0.4443	(22b)
Effective ac	0.6162	0.6117	0.6073	0.5865	0.5826	0.5645	0.5645	0.5612	0.5715	0.5826	0.5905	0.5987	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			1.9800	1.0000	1.9800			(26)
TER Semi-glazed door			1.9800	1.2000	2.3760			(26a)
TER Opening Type (Uw = 1.40)			14.6100	1.3258	19.3693			(27)
FP McCann System			47.6000	0.1300	6.1880			(28a)
100mm Knauf Supafil 34	138.7900	18.5700	120.2200	0.1800	21.6396			(29a)
Plane Ceiling-500mm Loft Roll	47.6000		47.6000	0.1300	6.1880			(30)
Total net area of external elements Aum(A, m2)			233.9900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	57.7409			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9034	(36)
Total fabric heat loss					(33) + (36) =		68.6443	(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	47.6220	47.2732	46.9314	45.3260	45.0256	43.6273	43.6273	43.3683	44.1659	45.0256	45.6332	46.2685	(38)
Heat transfer coeff	116.2663	115.9176	115.5758	113.9703	113.6699	112.2716	112.2716	112.0126	112.8102	113.6699	114.2776	114.9128	(39)
Average = Sum(39)m / 12 =												113.9688	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2213	1.2176	1.2140	1.1972	1.1940	1.1793	1.1793	1.1766	1.1850	1.1940	1.2004	1.2071	(40)
HLP (average)												1.1972	(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	2.6904	(42)
Average daily hot water use (litres/day)	98.0976	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.9074	103.9835	100.0596	96.1357	92.2118	88.2879	88.2879	92.2118	96.1357	100.0596	103.9835	107.9074	(44)
Energy conte	160.0236	139.9576	144.4237	125.9121	120.8157	104.2547	96.6073	110.8583	112.1823	130.7377	142.7104	154.9743	(45)
Energy content (annual)										Total = Sum(45)m =		1543.4579	(45)
Distribution loss (46)m = 0.15 x (45)m	24.0035	20.9936	21.6636	18.8868	18.1224	15.6382	14.4911	16.6288	16.8274	19.6107	21.4066	23.2461	(46)

Water storage loss:		
Store volume	200.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):	1.6525	(48)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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  Temperature factor from Table 2b                                                                                    0.5400 (49)
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
                210.9496   185.9554   195.3498   175.1954   171.7417   153.5380   147.5334   161.7844   161.4656   181.6638   191.9937   205.9004 (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
                210.9496   185.9554   195.3498   175.1954   171.7417   153.5380   147.5334   161.7844   161.4656   181.6638   191.9937   205.9004 (64)
                                                                                                  Total per year (kWh/year) = Sum(64)m =   2143.0713 (64)
Heat gains from water heating, kWh/month
                 93.9487    83.3341    88.7618    81.2924    80.9121    74.0913    72.8628    77.6013    76.7273    84.2111    86.8779    92.2698 (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          134.5214   134.5214   134.5214   134.5214   134.5214   134.5214   134.5214   134.5214   134.5214   134.5214   134.5214   134.5214 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                 23.2917    20.6875    16.8242    12.7370     9.5211     8.0381     8.6854    11.2896    15.1529    19.2401    22.4561    23.9390 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
                248.3263   250.9031   244.4095   230.5855   213.1351   196.7342   185.7774   183.2005   189.6941   203.5182   220.9685   237.3695 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                 36.4521    36.4521    36.4521    36.4521    36.4521    36.4521    36.4521    36.4521    36.4521    36.4521    36.4521    36.4521 (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)
               -107.6171  -107.6171  -107.6171  -107.6171  -107.6171  -107.6171  -107.6171  -107.6171  -107.6171  -107.6171  -107.6171  -107.6171 (71)
Water heating gains (Table 5)
                126.2751   124.0091   119.3034   112.9061   108.7528   102.9046    97.9339   104.3028   106.5656   113.1870   120.6637   124.0186 (72)
Total internal gains
                464.2495   461.9561   446.8936   422.5850   397.7653   374.0333   358.7531   365.1493   377.7691   402.3017   430.4447   451.6835 (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
---------------------------------------------------------------------------------------------------------------------
East                                     5.8500          19.6403          0.6300          0.7000          0.7700          35.1136 (76)
South                                    6.7800          46.7521          0.6300          0.7000          0.7700          96.8729 (78)
West                                     1.9800          19.6403          0.6300          0.7000          0.7700          11.8846 (80)
---------------------------------------------------------------------------------------------------------------------

Solar gains    143.8711   250.5912   353.5050   449.2335   508.6445   506.0942   487.5535   443.9019   387.2081   280.2146   173.4286   122.3561 (83)
Total gains    608.1206   712.5473   800.3986   871.8185   906.4098   880.1275   846.3065   809.0512   764.9772   682.5163   603.8733   574.0396 (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            56.8618    57.0329    57.2015    58.0073    58.1606    58.8850    58.8850    59.0211    58.6038    58.1606    57.8513    57.5315
alpha           4.7908     4.8022     4.8134     4.8672     4.8774     4.9257     4.9257     4.9347     4.9069     4.8774     4.8568     4.8354
util living area
                0.9974     0.9939     0.9849     0.9577     0.8869     0.7375     0.5658     0.6101     0.8378     0.9698     0.9943     0.9980 (86)

MIT            19.6998    19.8715    20.1345    20.4678    20.7521    20.9319    20.9852    20.9787    20.8653    20.4908    20.0342    19.6744 (87)
Th 2           19.9030    19.9059    19.9088    19.9223    19.9248    19.9366    19.9366    19.9388    19.9320    19.9248    19.9197    19.9143 (88)
util rest of house
                0.9965     0.9918     0.9795     0.9414     0.8424     0.6443     0.4381     0.4824     0.7626     0.9550     0.9920     0.9973 (89)
MIT 2          18.1798    18.4319    18.8151    19.2984    19.6792    19.8905    19.9311    19.9300    19.8250    19.3398    18.6799    18.1507 (90)
Living area fraction                                                                                  fLA = Living area / (4) =      0.1957 (91)
MIT            18.4772    18.7136    19.0733    19.5273    19.8892    20.0943    20.1374    20.1353    20.0286    19.5650    18.9449    18.4489 (92)
Temperature adjustment                                                                                                          0.0000
adjusted MIT   18.4772    18.7136    19.0733    19.5273    19.8892    20.0943    20.1374    20.1353    20.0286    19.5650    18.9449    18.4489 (93)


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8. Space heating requirement
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                  Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation     0.9947     0.9885     0.9737     0.9338     0.8407     0.6594     0.4632     0.5073     0.7705     0.9484     0.9889     0.9959 (94)
Useful gains  604.8791   704.3734   779.3707   814.1274   762.0270   580.3724   392.0156   410.4361   589.4150   647.2682   597.1790   571.6883 (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
             1648.3313  1601.2407  1453.1676  1211.1913   930.8643   616.8524   397.1478   418.3961   668.8063  1019.0535  1353.6051  1637.3827 (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
                776.3285   602.6948   501.3048   285.8860   125.6150     0.0000     0.0000     0.0000     0.0000   276.6082   544.6268   792.8766 (98)
Space heating                                                                                                                   3905.9408 (98)
Space heating per m2                                                                                                 (98) / (4) =     41.0288 (99)


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8c. Space cooling requirement
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CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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	4177.4768	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	776.3285	602.6948	501.3048	285.8860	125.6150	0.0000	0.0000	0.0000	0.0000	276.6082	544.6268	792.8766	(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)	830.2978	644.5934	536.1549	305.7605	134.3476	0.0000	0.0000	0.0000	0.0000	295.8377	582.4885	847.9964	(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	210.9496	185.9554	195.3498	175.1954	171.7417	153.5380	147.5334	161.7844	161.4656	181.6638	191.9937	205.9004	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.9794	87.7265	87.2206	86.1127	83.9952	79.8000	79.8000	79.8000	79.8000	85.9325	87.4440	88.0657	(217)
Fuel for water heating, kWh/month	239.7716	211.9718	223.9721	203.4489	204.4661	192.4036	184.8790	202.7374	202.3379	211.4030	219.5619	233.8031	(219)
Water heating fuel used												2530.7564	(219)

Annual totals kWh/year		
Space heating fuel - main system	4177.4768	(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)	411.3386	(232)
Total delivered energy for all uses	7194.5718	(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	4177.4768	0.2160	902.3350	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2530.7564	0.2160	546.6434	(264)
Space and water heating			1448.9784	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	411.3386	0.5190	213.4847	(268)
Total CO2, kg/m2/year			1701.3881	(272)
Emissions per m2 for space and water heating			15.2204	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			2.2425	(272b)
Emissions per m2 for pumps and fans			0.4089	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.2204 * 1.55) + 2.2425 + 0.4089, rounded to 2 d.p.			26.2400	(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	47.6000 (1b)	x	2.3100 (2b)	=	109.9560	(1b) - (3b)
First floor	47.6000 (1c)	x	2.6100 (2c)	=	124.2360	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.2000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	234.1920	(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) =		0.1281	(8)
Pressure test			Yes	
Measured/design AP50			4.0100	
Infiltration rate			0.3286	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3286	(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	0.4190	0.4108	0.4025	0.3615	0.3532	0.3122	0.3122	0.3040	0.3286	0.3532	0.3697	0.3861	(22b)
Effective ac	0.5878	0.5844	0.5810	0.5653	0.5624	0.5487	0.5487	0.5462	0.5540	0.5624	0.5683	0.5745	(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			1.9800	1.0000	1.9800			(26)
Half Glaze			1.9800	1.3000	2.5740			(26a)
Window (Uw = 1.20)			11.4600	1.1450	13.1221			(27)
French Door (Uw = 1.40)			3.1500	1.3258	4.1761			(27)
FP McCann System			47.6000	0.1100	5.2360	75.0000	3570.0000	(28a)
100mm Knauf Supafil 34	138.7900	18.5700	120.2200	0.2500	30.0550	52.8000	6347.6160	(29a)
Plane Ceiling-500mm Loft Roll	47.6000		47.6000	0.0900	4.2840	9.0000	428.4000	(30)
Total net area of external elements Aum(A, m2)			233.9900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		61.4273			(33)
Timber GF			53.1900			9.0000	478.7100	(32c)
Timber 1F			101.6300			9.0000	914.6700	(32c)
Masonry GF			25.7200			39.0000	1003.0800	(32c)
Internal Floor			47.6000			12.6000	599.7600	(32d)
Internal Ceiling			47.6000			9.0000	428.4000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	13770.6360	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		144.6495	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		4.9781	(36)
Total fabric heat loss	(33) + (36) =	66.4054	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	45.4245	45.1611	44.9030	43.6903	43.4635	42.4073	42.4073	42.2117	42.8141	43.4635	43.9224	44.4023	(38)
Heat transfer coeff	111.8299	111.5665	111.3083	110.0957	109.8688	108.8127	108.8127	108.6171	109.2195	109.8688	110.3278	110.8076	(39)
Average = Sum(39)m / 12 =												110.0946	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1747	1.1719	1.1692	1.1565	1.1541	1.1430	1.1430	1.1409	1.1473	1.1541	1.1589	1.1639	(40)
HLP (average)												1.1565	(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	2.6904	(42)
Average daily hot water use (litres/day)	98.0976	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.9074	103.9835	100.0596	96.1357	92.2118	88.2879	88.2879	92.2118	96.1357	100.0596	103.9835	107.9074	(44)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy conte	160.0236	139.9576	144.4237	125.9121	120.8157	104.2547	96.6073	110.8583	112.1823	130.7377	142.7104	154.9743	(45)
Energy content (annual)										Total = Sum(45)m =		1543.4579	(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													
	34.0050	29.7410	30.6900	26.7563	25.6733	22.1541	20.5291	23.5574	23.8387	27.7818	30.3260	32.9320	(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	134.5214	134.5214	134.5214	134.5214	134.5214	134.5214	134.5214	134.5214	134.5214	134.5214	134.5214	134.5214	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.2917	20.6875	16.8242	12.7370	9.5211	8.0381	8.6854	11.2896	15.1529	19.2401	22.4561	23.9390	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	248.3263	250.9031	244.4095	230.5855	213.1351	196.7342	185.7774	183.2005	189.6941	203.5182	220.9685	237.3695	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.4521	36.4521	36.4521	36.4521	36.4521	36.4521	36.4521	36.4521	36.4521	36.4521	36.4521	36.4521	(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)													
	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	(71)
Water heating gains (Table 5)													
	45.7057	44.2574	41.2501	37.1616	34.5072	30.7696	27.5928	31.6632	33.1094	37.3411	42.1194	44.2635	(72)
Total internal gains													
	380.6800	379.2044	365.8402	343.8404	320.5197	298.8983	285.4120	289.5097	301.3128	323.4558	348.9004	368.9284	(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	
East	2.7000	19.6403	0.4600	0.0000	0.7700	18.7828	(76)
South	6.7800	46.7521	0.4600	0.0000	0.7700	112.2740	(78)
West	1.9800	19.6403	0.4600	0.0000	0.7700	13.7740	(80)
East	3.1500	19.6403	0.4300	0.0000	0.7700	20.4841	(76)

Solar gains	165.3149	287.6351	405.1019	513.9388	581.2807	578.1301	557.0457	507.5853	443.4126	321.4464	199.2187	140.6333	(83)
Total gains	545.9949	666.8395	770.9421	857.7793	901.8004	877.0284	842.4577	797.0950	744.7254	644.9022	548.1191	509.5617	(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	34.2053	34.2861	34.3656	34.7441	34.8159	35.1538	35.1538	35.2171	35.0228	34.8159	34.6710	34.5209	
alpha	3.2804	3.2857	3.2910	3.3163	3.3211	3.3436	3.3436	3.3478	3.3349	3.3211	3.3114	3.3014	
util living area													
	0.9874	0.9754	0.9521	0.9027	0.8141	0.6745	0.5277	0.5705	0.7739	0.9288	0.9784	0.9899	(86)
MIT	19.0480	19.3151	19.7050	20.1763	20.5749	20.8446	20.9493	20.9334	20.7375	20.1967	19.5283	18.9999	(87)
Th 2	19.9403	19.9425	19.9447	19.9550	19.9569	19.9659	19.9659	19.9675	19.9624	19.9569	19.9530	19.9490	(88)
util rest of house													
	0.9848	0.9704	0.9420	0.8813	0.7709	0.5969	0.4192	0.4628	0.7082	0.9086	0.9732	0.9878	(89)
MIT 2	18.1603	18.4262	18.8111	19.2739	19.6436	19.8764	19.9464	19.9399	19.7953	19.3037	18.6476	18.1189	(90)
Living area fraction									fLA = Living area / (4) =			0.1957	(91)
MIT	18.3340	18.6002	18.9861	19.4505	19.8259	20.0658	20.1427	20.1344	19.9797	19.4784	18.8199	18.2913	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3340	18.6002	18.9861	19.4505	19.8259	20.0658	20.1427	20.1344	19.9797	19.4784	18.8199	18.2913	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9794	0.9620	0.9304	0.8689	0.7647	0.6051	0.4388	0.4814	0.7094	0.8970	0.9656	0.9832	(94)
Useful gains	534.7215	641.4862	717.3032	745.3066	689.6037	530.6487	369.6442	383.6997	528.3205	578.4997	529.2406	500.9792	(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													
	1569.4225	1528.4782	1389.8031	1161.5670	892.7792	594.7537	385.4890	405.6142	642.1753	975.4618	1293.0326	1561.4279	(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													
	769.8175	596.0586	500.3399	299.7075	151.1626	0.0000	0.0000	0.0000	0.0000	295.3398	549.9302	788.9739	(98)
Space heating												3951.3299	(98)
Space heating per m2											(98) / (4) =	41.5056	(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

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1022.8391	805.2138	825.4899	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8059	0.8691	0.8481	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	824.2753	699.7938	700.1129	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1127.8759	1085.3200	1034.2439	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	218.5925	286.8314	248.5935	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												754.0174	(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	54.6481	71.7079	62.1484	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												188.5043	(107)
Space cooling per m2												1.9801	(108)
Energy for space heating												41.5056	(99)
Energy for space cooling												1.9801	(108)
Total												43.4857	(109)
Dwelling Fabric Energy Efficiency (DFEE)												43.5	(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	47.6000 (1b)	x	2.3100 (2b)	=	109.9560	(1b) - (3b)
First floor	47.6000 (1c)	x	2.6100 (2c)	=	124.2360	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.2000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	234.1920	(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) =		0.1281	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3781	(18)
Number of sides sheltered			0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3781	(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	0.4821	0.4726	0.4632	0.4159	0.4065	0.3592	0.3592	0.3497	0.3781	0.4065	0.4254	0.4443	(22b)
Effective ac	0.6162	0.6117	0.6073	0.5865	0.5826	0.5645	0.5645	0.5612	0.5715	0.5826	0.5905	0.5987	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			1.9800	1.0000	1.9800			(26)
TER Semi-glazed door			1.9800	1.2000	2.3760			(26a)
TER Opening Type (Uw = 1.40)			14.6100	1.3258	19.3693			(27)
FP McCann System			47.6000	0.1300	6.1880			(28a)
100mm Knauf Supafil 34	138.7900	18.5700	120.2200	0.1800	21.6396			(29a)
Plane Ceiling-500mm Loft Roll	47.6000		47.6000	0.1300	6.1880			(30)
Total net area of external elements Aum(A, m2)			233.9900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	57.7409			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.9034	(36)
Total fabric heat loss						(33) + (36) =	68.6443	(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	47.6220	47.2732	46.9314	45.3260	45.0256	43.6273	43.6273	43.3683	44.1659	45.0256	45.6332	46.2685	(38)
Heat transfer coeff	116.2663	115.9176	115.5758	113.9703	113.6699	112.2716	112.2716	112.0126	112.8102	113.6699	114.2776	114.9128	(39)
Average = Sum(39)m / 12 =												113.9688	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2213	1.2176	1.2140	1.1972	1.1940	1.1793	1.1793	1.1766	1.1850	1.1940	1.2004	1.2071	(40)
HLP (average)												1.1972	(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	2.6904	(42)
Average daily hot water use (litres/day)	98.0976	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.9074	103.9835	100.0596	96.1357	92.2118	88.2879	88.2879	92.2118	96.1357	100.0596	103.9835	107.9074	(44)
Energy conte	160.0236	139.9576	144.4237	125.9121	120.8157	104.2547	96.6073	110.8583	112.1823	130.7377	142.7104	154.9743	(45)
Energy content (annual)										Total = Sum(45)m =		1543.4579	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	34.0050	29.7410	30.6900	26.7563	25.6733	22.1541	20.5291	23.5574	23.8387	27.7818	30.3260	32.9320	(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	134.5214	134.5214	134.5214	134.5214	134.5214	134.5214	134.5214	134.5214	134.5214	134.5214	134.5214	134.5214	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	23.2917	20.6875	16.8242	12.7370	9.5211	8.0381	8.6854	11.2896	15.1529	19.2401	22.4561	23.9390	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	248.3263	250.9031	244.4095	230.5855	213.1351	196.7342	185.7774	183.2005	189.6941	203.5182	220.9685	237.3695	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.4521	36.4521	36.4521	36.4521	36.4521	36.4521	36.4521	36.4521	36.4521	36.4521	36.4521	36.4521	(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)	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	(71)
Water heating gains (Table 5)	45.7057	44.2574	41.2501	37.1616	34.5072	30.7696	27.5928	31.6632	33.1094	37.3411	42.1194	44.2635	(72)
Total internal gains	380.6800	379.2044	365.8402	343.8404	320.5197	298.8983	285.4120	289.5097	301.3128	323.4558	348.9004	368.9284	(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	
East	5.8500	19.6403	0.6300	0.7000	0.7700	35.1136	(76)
South	6.7800	46.7521	0.6300	0.7000	0.7700	96.8729	(78)
West	1.9800	19.6403	0.6300	0.7000	0.7700	11.8846	(80)

Solar gains	143.8711	250.5912	353.5050	449.2335	508.6445	506.0942	487.5535	443.9019	387.2081	280.2146	173.4286	122.3561	(83)
Total gains	524.5511	629.7957	719.3452	793.0739	829.1642	804.9925	772.9655	733.4116	688.5209	603.6704	522.3290	491.2845	(84)

7. Mean internal temperature (heating season)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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)													
tau	56.8618	57.0329	57.2015	58.0073	58.1606	58.8850	58.8850	59.0211	58.6038	58.1606	57.8513	57.5315	
alpha	4.7908	4.8022	4.8134	4.8672	4.8774	4.9257	4.9257	4.9347	4.9069	4.8774	4.8568	4.8354	
util living area	0.9986	0.9964	0.9902	0.9701	0.9132	0.7808	0.6117	0.6608	0.8773	0.9812	0.9970	0.9990	(86)
MIT	19.6192	19.7928	20.0604	20.4036	20.7065	20.9117	20.9793	20.9699	20.8291	20.4227	19.9563	19.5943	(87)
Th 2	19.9030	19.9059	19.9088	19.9223	19.9248	19.9366	19.9366	19.9388	19.9320	19.9248	19.9197	19.9143	(88)
util rest of house	0.9981	0.9951	0.9865	0.9579	0.8756	0.6905	0.4775	0.5282	0.8113	0.9713	0.9957	0.9987	(89)
MIT 2	18.6462	18.8216	19.0896	19.4366	19.7203	19.8941	19.9312	19.9299	19.8347	19.4613	18.9960	18.6303	(90)
Living area fraction									fLA = Living area / (4) =			0.1957	(91)
MIT	18.8366	19.0116	19.2796	19.6258	19.9133	20.0932	20.1363	20.1335	20.0293	19.6494	19.1839	18.8189	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8366	19.0116	19.2796	19.6258	19.9133	20.0932	20.1363	20.1335	20.0293	19.6494	19.1839	18.8189	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9975	0.9937	0.9837	0.9536	0.8751	0.7054	0.5041	0.5543	0.8185	0.9679	0.9944	0.9981	(94)
Useful gains	523.2189	625.8225	707.6024	756.2565	725.5781	567.8102	389.6256	406.5415	563.5306	584.2923	519.4291	490.3735	(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	1690.1184	1635.7870	1477.0088	1222.4255	933.6055	616.7336	397.0220	418.1959	668.8821	1028.6497	1380.9193	1679.9027	(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	868.1733	678.6962	572.4383	335.6417	154.7724	0.0000	0.0000	0.0000	0.0000	330.6019	620.2729	885.0097	(98)
Space heating												4445.6064	(98)
Space heating per m2											(98) / (4) =	46.6975	(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	1055.3529	830.8098	851.2961	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8266	0.8994	0.8772	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	872.3397	747.2072	746.7654	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1043.6782	1004.0953	959.8088	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	123.3637	191.1247	158.5043	0.0000	0.0000	0.0000	0.0000	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling												472.9927	(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	30.8409	47.7812	39.6261	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												118.2482	(107)
Space cooling per m2												1.2421	(108)
Energy for space heating												46.6975	(99)
Energy for space cooling												1.2421	(108)
Total												47.9396	(109)
Target Fabric Energy Efficiency (TFEE)												55.1	(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	47.6000 (1b)	x	2.3100 (2b)	=	109.9560	(1b) - (3b)
First floor	47.6000 (1c)	x	2.6100 (2c)	=	124.2360	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 95.2000						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	234.1920	(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		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2005	(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	0.2105	0.2005	0.2005	0.1855	0.1855	0.1654	0.1704	0.1604	0.1654	0.1754	0.1754	0.1905	(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			1.9800	1.0000	1.9800			(26)
Half Glaze			1.9800	1.3000	2.5740			(26a)
Window (Uw = 1.20)			11.4600	1.1450	13.1221			(27)
French Door (Uw = 1.40)			3.1500	1.3258	4.1761			(27)
FP McCann System			47.6000	0.1100	5.2360	75.0000	3570.0000	(28a)
100mm Knauf Supafil 34	138.7900	18.5700	120.2200	0.2500	30.0550	52.8000	6347.6160	(29a)
Plane Ceiling-500mm Loft Roll	47.6000		47.6000	0.0900	4.2840	9.0000	428.4000	(30)
Total net area of external elements Aum(A, m2)			233.9900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		61.4273			(33)
Timber GF			53.1900			9.0000	478.7100	(32c)
Timber 1F			101.6300			9.0000	914.6700	(32c)
Masonry GF			25.7200			39.0000	1003.0800	(32c)
Internal Floor			47.6000			12.6000	599.7600	(32d)
Internal Ceiling			47.6000			9.0000	428.4000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 13770.6360	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	144.6495	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	4.9781	(36)
Total fabric heat loss	(33) + (36) = 66.4054	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	38.6417	38.6417	38.6417	38.6417	38.6417	38.6417	38.6417	38.6417	38.6417	38.6417	38.6417	38.6417	(38)
Heat transfer coeff	105.0470	105.0470	105.0470	105.0470	105.0470	105.0470	105.0470	105.0470	105.0470	105.0470	105.0470	105.0470	(39)
Average = Sum(39)m / 12 =												105.0470	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1034	1.1034	1.1034	1.1034	1.1034	1.1034	1.1034	1.1034	1.1034	1.1034	1.1034	1.1034	(40)
HLP (average)												1.1034	(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	2.6904	(42)
Average daily hot water use (litres/day)	98.0976	(43)

CALCULATION OF HEAT DEMAND 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	107.9074	103.9835	100.0596	96.1357	92.2118	88.2879	88.2879	92.2118	96.1357	100.0596	103.9835	107.9074	(44)
Energy conte	160.0236	139.9576	144.4237	125.9121	120.8157	104.2547	96.6073	110.8583	112.1823	130.7377	142.7104	154.9743	(45)
Energy content (annual)										Total = Sum(45)m =		1543.4579	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.0035	20.9936	21.6636	18.8868	18.1224	15.6382	14.4911	16.6288	16.8274	19.6107	21.4066	23.2461	(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													
	209.4004	184.5560	193.8005	173.6961	170.1925	152.0387	145.9841	160.2351	159.9663	180.1145	190.4944	204.3511	(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													
	209.4004	184.5560	193.8005	173.6961	170.1925	152.0387	145.9841	160.2351	159.9663	180.1145	190.4944	204.3511	(64)
								Total per year (kWh/year) = Sum(64)m =				2124.8299	(64)
RHI water heating demand												2125	(64)
Heat gains from water heating, kWh/month													
	92.7093	82.2146	87.5223	80.0930	79.6727	72.8919	71.6234	76.3618	75.5278	82.9717	85.6784	91.0304	(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	161.4256	161.4256	161.4256	161.4256	161.4256	161.4256	161.4256	161.4256	161.4256	161.4256	161.4256	161.4256	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	58.2292	51.7187	42.0605	31.8425	23.8026	20.0952	21.7136	28.2241	37.8823	48.1003	56.1402	59.8476	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	370.6362	374.4823	364.7904	344.1574	318.1121	293.6331	277.2797	273.4336	283.1255	303.7584	329.8038	354.2828	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.8330	53.8330	53.8330	53.8330	53.8330	53.8330	53.8330	53.8330	53.8330	53.8330	53.8330	53.8330	(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)													
	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	(71)
Water heating gains (Table 5)													
	124.6092	122.3432	117.6375	111.2402	107.0869	101.2388	96.2680	102.6369	104.8998	111.5211	118.9978	122.3527	(72)
Total internal gains													
	661.1162	656.1857	632.1299	594.8817	556.6431	522.6086	502.9027	511.9361	533.5491	571.0214	612.5833	644.1246	(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	
East	2.7000	22.3313	0.4600	0.0000	0.7700	21.3563	(76)
South	6.7800	50.9848	0.4600	0.0000	0.7700	122.4388	(78)
West	1.9800	22.3313	0.4600	0.0000	0.7700	15.6613	(80)
East	3.1500	22.3313	0.4300	0.0000	0.7700	23.2908	(76)

Solar gains	182.7472	286.0789	398.3943	522.4897	577.8286	616.1840	586.8021	545.0447	473.1461	341.4122	225.5954	153.9818	(83)
Total gains	843.8635	942.2646	1030.5242	1117.3714	1134.4718	1138.7926	1089.7048	1056.9808	1006.6952	912.4337	838.1787	798.1064	(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	36.4139	36.4139	36.4139	36.4139	36.4139	36.4139	36.4139	36.4139	36.4139	36.4139	36.4139	36.4139	
alpha	3.4276	3.4276	3.4276	3.4276	3.4276	3.4276	3.4276	3.4276	3.4276	3.4276	3.4276	3.4276	
util living area													
	0.9499	0.9279	0.8810	0.7903	0.6474	0.4431	0.2955	0.3137	0.5573	0.8037	0.9181	0.9568	(86)
Tweekday	18.3056	18.5711	19.0382	19.5181	19.8477	19.9787	19.9964	19.9959	19.9439	19.5857	18.8894	18.2251	
Tweekend	20.1586	20.2799	20.4956	20.7260	20.8974	20.9800	20.9965	20.9956	20.9533	20.7538	20.4226	20.1218	
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	19.7014	19.8862	20.2216	20.5721	20.8416	20.9693	20.9945	20.9932	20.9270	20.6201	20.0984	19.6447	(87)
Th 2	19.9980	19.9980	19.9980	19.9980	19.9980	19.9980	19.9980	19.9980	19.9980	19.9980	19.9980	19.9980	(88)
util rest of house													
	0.9407	0.9151	0.8598	0.7536	0.5876	0.3611	0.2016	0.2175	0.4762	0.7609	0.9010	0.9487	(89)
Tweekday	18.3056	18.5711	19.0382	19.5181	19.8477	19.9787	19.9964	19.9959	19.9439	19.5857	18.8894	18.2251	
Tweekend	18.3056	18.5711	19.0382	19.5181	19.8477	19.9787	19.9964	19.9959	19.9439	19.5857	18.8894	18.2251	
MIT 2	18.3056	18.5711	19.0382	19.5181	19.8477	19.9787	19.9964	19.9959	19.9439	19.5857	18.8894	18.2251	(90)
Living area fraction									fLA = Living area / (4) =			0.1957	(91)
MIT	18.5787	18.8284	19.2698	19.7243	20.0422	20.1726	20.1917	20.1910	20.1363	19.7881	19.1260	18.5029	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5787	18.8284	19.2698	19.7243	20.0422	20.1726	20.1917	20.1910	20.1363	19.7881	19.1260	18.5029	(93)

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8. Space heating requirement

CALCULATION OF HEAT DEMAND 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9237	0.8965	0.8416	0.7425	0.5904	0.3758	0.2199	0.2363	0.4880	0.7508	0.8825	0.9327	(94)
Useful gains	779.5095	844.6972	867.2597	829.5981	669.7840	427.9473	239.6790	249.7797	491.2203	685.0321	739.7332	744.3543	(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	1415.8998	1389.6068	1246.8831	1032.0171	739.7586	438.3191	240.7407	251.1720	518.5458	860.1355	1168.7500	1407.9345	(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	473.4744	366.1792	282.4398	145.7416	52.0611	0.0000	0.0000	0.0000	0.0000	130.2769	308.8921	493.7036	(98)
Space heating												2252.7687	(98)
RHI space heating demand												2253	(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	47.6000 (1b)	x	2.3100 (2b)	=	109.9560	(1b) - (3b)
First floor	47.6000 (1c)	x	2.6100 (2c)	=	124.2360	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	95.2000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	234.1920	(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		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2005	(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	0.2556	0.2506	0.2456	0.2206	0.2155	0.1905	0.1905	0.1855	0.2005	0.2155	0.2256	0.2356	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5056	0.5006	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			1.9800	1.0000	1.9800			(26)
Half Glaze			1.9800	1.3000	2.5740			(26a)
Window (Uw = 1.20)			11.4600	1.1450	13.1221			(27)
French Door (Uw = 1.40)			3.1500	1.3258	4.1761			(27)
FP McCann System			47.6000	0.1100	5.2360	75.0000	3570.0000	(28a)
100mm Knauf Supafil 34	138.7900	18.5700	120.2200	0.2500	30.0550	52.8000	6347.6160	(29a)
Plane Ceiling-500mm Loft Roll	47.6000		47.6000	0.0900	4.2840	9.0000	428.4000	(30)
Total net area of external elements Aum(A, m2)			233.9900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	61.4273			(33)
Timber GF			53.1900			9.0000	478.7100	(32c)
Timber 1F			101.6300			9.0000	914.6700	(32c)
Masonry GF			25.7200			39.0000	1003.0800	(32c)
Internal Floor			47.6000			12.6000	599.7600	(32d)
Internal Ceiling			47.6000			9.0000	428.4000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 13770.6360	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	144.6495	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	4.9781	(36)
Total fabric heat loss	(33) + (36) = 66.4054	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.0774	38.6900	38.6417	38.6417	38.6417	38.6417	38.6417	38.6417	38.6417	38.6417	38.6417	38.6417	(38)
Heat transfer coeff	105.4827	105.0953	105.0470	105.0470	105.0470	105.0470	105.0470	105.0470	105.0470	105.0470	105.0470	105.0470	(39)
Average = Sum(39)m / 12 =												105.0874	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1080	1.1039	1.1034	1.1034	1.1034	1.1034	1.1034	1.1034	1.1034	1.1034	1.1034	1.1034	(40)
HLP (average)												1.1039	(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	2.6904	(42)
Average daily hot water use (litres/day)	98.0976	(43)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	107.9074	103.9835	100.0596	96.1357	92.2118	88.2879	88.2879	92.2118	96.1357	100.0596	103.9835	107.9074	(44)
Energy conte	160.0236	139.9576	144.4237	125.9121	120.8157	104.2547	96.6073	110.8583	112.1823	130.7377	142.7104	154.9743	(45)
Energy content (annual)										Total = Sum(45)m =		1543.4579	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.0035	20.9936	21.6636	18.8868	18.1224	15.6382	14.4911	16.6288	16.8274	19.6107	21.4066	23.2461	(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													
	209.4004	184.5560	193.8005	173.6961	170.1925	152.0387	145.9841	160.2351	159.9663	180.1145	190.4944	204.3511	(62)
WWHRS	-49.7139	-43.7420	-44.6443	-36.7312	-34.1052	-28.1348	-23.8109	-28.8296	-29.6709	-36.6797	-42.4893	-48.0509	eq.(G10)
Total of WWHRS savings												-446.6025	
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													
	159.6865	140.8141	149.1563	136.9650	136.0873	123.9039	122.1733	131.4055	130.2954	143.4348	148.0052	156.3002	(64)
									Total per year (kWh/year) = Sum(64)m =			1678.2274	(64)
Heat gains from water heating, kWh/month													
	92.7093	82.2146	87.5223	80.0930	79.6727	72.8919	71.6234	76.3618	75.5278	82.9717	85.6784	91.0304	(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	161.4256	161.4256	161.4256	161.4256	161.4256	161.4256	161.4256	161.4256	161.4256	161.4256	161.4256	161.4256	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	58.2292	51.7187	42.0605	31.8425	23.8026	20.0952	21.7136	28.2241	37.8823	48.1003	56.1402	59.8476	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	370.6362	374.4823	364.7904	344.1574	318.1121	293.6331	277.2797	273.4336	283.1255	303.7584	329.8038	354.2828	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.8330	53.8330	53.8330	53.8330	53.8330	53.8330	53.8330	53.8330	53.8330	53.8330	53.8330	53.8330	(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)													
	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	(71)
Water heating gains (Table 5)													
	124.6092	122.3432	117.6375	111.2402	107.0869	101.2388	96.2680	102.6369	104.8998	111.5211	118.9978	122.3527	(72)
Total internal gains													
	661.1162	656.1857	632.1299	594.8817	556.6431	522.6086	502.9027	511.9361	533.5491	571.0214	612.5833	644.1246	(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	
East	2.7000	19.6403	0.4600	0.0000	0.7700	18.7828	(76)
South	6.7800	46.7521	0.4600	0.0000	0.7700	112.2740	(78)
West	1.9800	19.6403	0.4600	0.0000	0.7700	13.7740	(80)
East	3.1500	19.6403	0.4300	0.0000	0.7700	20.4841	(76)

Solar gains	165.3149	287.6351	405.1019	513.9388	581.2807	578.1301	557.0457	507.5853	443.4126	321.4464	199.2187	140.6333	(83)
Total gains	826.4311	943.8208	1037.2318	1108.8205	1137.9238	1100.7387	1059.9484	1019.5214	976.9617	892.4679	811.8020	784.7579	(84)

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7. Mean internal temperature (heating season)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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)													
tau	36.2635	36.3972	36.4139	36.4139	36.4139	36.4139	36.4139	36.4139	36.4139	36.4139	36.4139	36.4139	
alpha	3.4176	3.4265	3.4276	3.4276	3.4276	3.4276	3.4276	3.4276	3.4276	3.4276	3.4276	3.4276	
util living area													
	0.9586	0.9353	0.8954	0.8238	0.7119	0.5613	0.4214	0.4539	0.6481	0.8452	0.9359	0.9645	(86)
Tweekday	18.0886	18.4297	18.8833	19.3696	19.7389	19.9324	19.9855	19.9804	19.8776	19.4209	18.6685	18.0059	
Tweekend	20.0622	20.2162	20.4242	20.6536	20.8384	20.9473	20.9849	20.9802	20.9112	20.6725	20.3215	20.0237	
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	19.5527	19.7875	20.1114	20.4591	20.7505	20.9190	20.9768	20.9695	20.8613	20.4945	19.9406	19.4932	(87)
Th 2	19.9943	19.9976	19.9980	19.9980	19.9980	19.9980	19.9980	19.9980	19.9980	19.9980	19.9980	19.9980	(88)
util rest of house													
	0.9511	0.9241	0.8773	0.7931	0.6623	0.4880	0.3314	0.3629	0.5780	0.8115	0.9227	0.9580	(89)
Tweekday	18.0886	18.4297	18.8833	19.3696	19.7389	19.9324	19.9855	19.9804	19.8776	19.4209	18.6685	18.0059	
Tweekend	18.0886	18.4297	18.8833	19.3696	19.7389	19.9324	19.9855	19.9804	19.8776	19.4209	18.6685	18.0059	
MIT 2	18.0886	18.4297	18.8833	19.3696	19.7389	19.9324	19.9855	19.9804	19.8776	19.4209	18.6685	18.0059	(90)
Living area fraction									fLA = Living area / (4) =			0.1957	(91)
MIT	18.3751	18.6954	19.1236	19.5828	19.9369	20.1255	20.1795	20.1740	20.0701	19.6310	18.9174	18.2970	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3751	18.6954	19.1236	19.5828	19.9369	20.1255	20.1795	20.1740	20.0701	19.6310	18.9174	18.2970	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9353	0.9057	0.8585	0.7788	0.6590	0.4978	0.3481	0.3794	0.5834	0.7972	0.9048	0.9433	(94)
Useful gains	772.9276	854.8414	890.4243	863.5074	749.8733	547.9274	368.9859	386.7843	569.9626	711.4547	734.4961	740.2360	(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	1484.6821	1449.8326	1326.0748	1122.1953	865.2579	580.4377	376.0112	396.4439	627.1397	948.6764	1241.3877	1480.8456	(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	529.5453	399.8341	324.1240	186.2553	85.8461	0.0000	0.0000	0.0000	0.0000	176.4930	364.9620	551.0135	(98)
Space heating												2618.0732	(98)
Space heating per m2											(98) / (4) =	27.5008	(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 %)	268.2210	(206)
Efficiency of secondary/supplementary heating system, %	100.0000	(208)
Space heating requirement	976.0879	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	529.5453	399.8341	324.1240	186.2553	85.8461	0.0000	0.0000	0.0000	0.0000	176.4930	364.9620	551.0135	(98)
Space heating efficiency (main heating system 1)	268.2210	268.2210	268.2210	268.2210	268.2210	0.0000	0.0000	0.0000	0.0000	268.2210	268.2210	268.2210	(210)
Space heating fuel (main heating system)	197.4287	149.0689	120.8421	69.4410	32.0057	0.0000	0.0000	0.0000	0.0000	65.8013	136.0676	205.4326	(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	159.6865	140.8141	149.1563	136.9650	136.0873	123.9039	122.1733	131.4055	130.2954	143.4348	148.0052	156.3002	(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	93.7788	82.6956	87.5947	80.4351	79.9197	72.7648	71.7485	77.1703	76.5183	84.2347	86.9187	91.7901	(219)
Water heating fuel used												985.5693	(219)
Annual totals kWh/year													
Space heating fuel - main system												976.0879	(211)
Space heating fuel - secondary												0.0000	(215)

Electricity for pumps and fans:
(MEVDecentralised, Database: total watage = 10.3610, total flow = 45.0000, SFP = 0.2302)

mechanical ventilation fans (SFP = 0.2302)	65.7841	(230a)
Total electricity for the above, kWh/year	65.7841	(231)
Electricity for lighting (calculated in Appendix L)	411.3386	(232)
Total delivered energy for all uses	2438.7799	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	976.0879	13.1900	128.7460	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	985.5693	13.1900	129.9966	(247)
Mechanical ventilation fans	65.7841	13.1900	8.6769	(249)
Pumps and fans for heating	0.0000	0.0000	0.0000	(249)
Energy for lighting	411.3386	13.1900	54.2556	(250)
Additional standing charges			0.0000	(251)
Total energy cost			321.6751	(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] =	0.9636	(257)
SAP value		86.5571	
SAP rating (Section 12)		87	(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	976.0879	0.5190	506.5896	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	985.5693	0.5190	511.5105	(264)
Space and water heating			1018.1001	(265)
Pumps and fans	65.7841	0.5190	34.1420	(267)
Energy for lighting	411.3386	0.5190	213.4847	(268)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Total kg/year	1265.7268	(272)
CO2 emissions per m2	13.3000	(273)
EI value	87.9025	
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) / 2.6822 = 4.918, stars = 4
Main heating environmental impact	0.519 × (1 + 0.29 × 0.00) / 2.6822 = 0.1935, stars = 5
Water heating energy efficiency	13.19 / 1.7028 = 7.746, stars = 3
Water heating environmental impact	0.519 / 1.7028 = 0.3048, stars = 5

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

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	47.6000 (1b)	x	2.3100 (2b)	=	109.9560	(1b) - (3b)
First floor	47.6000 (1c)	x	2.6100 (2c)	=	124.2360	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 95.2000						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	234.1920	(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		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2005	(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	0.2105	0.2005	0.2005	0.1855	0.1855	0.1654	0.1704	0.1604	0.1654	0.1754	0.1754	0.1905	(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			1.9800	1.0000	1.9800			(26)
Half Glaze			1.9800	1.3000	2.5740			(26a)
Window (Uw = 1.20)			11.4600	1.1450	13.1221			(27)
French Door (Uw = 1.40)			3.1500	1.3258	4.1761			(27)
FP McCann System			47.6000	0.1100	5.2360	75.0000	3570.0000	(28a)
100mm Knauf Supafil 34	138.7900	18.5700	120.2200	0.2500	30.0550	52.8000	6347.6160	(29a)
Plane Ceiling-500mm Loft Roll	47.6000		47.6000	0.0900	4.2840	9.0000	428.4000	(30)
Total net area of external elements Aum(A, m2)			233.9900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		61.4273			(33)
Timber GF			53.1900			9.0000	478.7100	(32c)
Timber 1F			101.6300			9.0000	914.6700	(32c)
Masonry GF			25.7200			39.0000	1003.0800	(32c)
Internal Floor			47.6000			12.6000	599.7600	(32d)
Internal Ceiling			47.6000			9.0000	428.4000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 13770.6360	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	144.6495	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	4.9781	(36)
Total fabric heat loss	(33) + (36) = 66.4054	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	38.6417	38.6417	38.6417	38.6417	38.6417	38.6417	38.6417	38.6417	38.6417	38.6417	38.6417	38.6417	(38)
Heat transfer coeff	105.0470	105.0470	105.0470	105.0470	105.0470	105.0470	105.0470	105.0470	105.0470	105.0470	105.0470	105.0470	(39)
Average = Sum(39)m / 12 =												105.0470	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1034	1.1034	1.1034	1.1034	1.1034	1.1034	1.1034	1.1034	1.1034	1.1034	1.1034	1.1034	(40)
HLP (average)												1.1034	(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	2.6904	(42)
Average daily hot water use (litres/day)	98.0976	(43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	107.9074	103.9835	100.0596	96.1357	92.2118	88.2879	88.2879	92.2118	96.1357	100.0596	103.9835	107.9074	(44)
Energy conte	160.0236	139.9576	144.4237	125.9121	120.8157	104.2547	96.6073	110.8583	112.1823	130.7377	142.7104	154.9743	(45)
Energy content (annual)										Total = Sum(45)m =		1543.4579	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.0035	20.9936	21.6636	18.8868	18.1224	15.6382	14.4911	16.6288	16.8274	19.6107	21.4066	23.2461	(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													
	209.4004	184.5560	193.8005	173.6961	170.1925	152.0387	145.9841	160.2351	159.9663	180.1145	190.4944	204.3511	(62)
WWHRS	-49.7139	-43.7420	-44.6443	-36.7312	-34.1052	-28.1348	-23.8109	-28.8296	-29.6709	-36.6797	-42.4893	-48.0509	eq.(G10)
Total of WWHRS savings												-446.6025	
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													
	159.6865	140.8141	149.1563	136.9650	136.0873	123.9039	122.1733	131.4055	130.2954	143.4348	148.0052	156.3002	(64)
								Total per year (kWh/year) = Sum(64)m =				1678.2274	(64)
Heat gains from water heating, kWh/month													
	92.7093	82.2146	87.5223	80.0930	79.6727	72.8919	71.6234	76.3618	75.5278	82.9717	85.6784	91.0304	(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	161.4256	161.4256	161.4256	161.4256	161.4256	161.4256	161.4256	161.4256	161.4256	161.4256	161.4256	161.4256	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	58.2292	51.7187	42.0605	31.8425	23.8026	20.0952	21.7136	28.2241	37.8823	48.1003	56.1402	59.8476	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	370.6362	374.4823	364.7904	344.1574	318.1121	293.6331	277.2797	273.4336	283.1255	303.7584	329.8038	354.2828	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.8330	53.8330	53.8330	53.8330	53.8330	53.8330	53.8330	53.8330	53.8330	53.8330	53.8330	53.8330	(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)													
	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	(71)
Water heating gains (Table 5)													
	124.6092	122.3432	117.6375	111.2402	107.0869	101.2388	96.2680	102.6369	104.8998	111.5211	118.9978	122.3527	(72)
Total internal gains													
	661.1162	656.1857	632.1299	594.8817	556.6431	522.6086	502.9027	511.9361	533.5491	571.0214	612.5833	644.1246	(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	
East	2.7000	22.3313	0.4600	0.0000	0.7700	21.3563	(76)
South	6.7800	50.9848	0.4600	0.0000	0.7700	122.4388	(78)
West	1.9800	22.3313	0.4600	0.0000	0.7700	15.6613	(80)
East	3.1500	22.3313	0.4300	0.0000	0.7700	23.2908	(76)

Solar gains	182.7472	286.0789	398.3943	522.4897	577.8286	616.1840	586.8021	545.0447	473.1461	341.4122	225.5954	153.9818	(83)
Total gains	843.8635	942.2646	1030.5242	1117.3714	1134.4718	1138.7926	1089.7048	1056.9808	1006.6952	912.4337	838.1787	798.1064	(84)

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7. Mean internal temperature (heating season)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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)													
tau	36.4139	36.4139	36.4139	36.4139	36.4139	36.4139	36.4139	36.4139	36.4139	36.4139	36.4139	36.4139	
alpha	3.4276	3.4276	3.4276	3.4276	3.4276	3.4276	3.4276	3.4276	3.4276	3.4276	3.4276	3.4276	
util living area													
	0.9499	0.9279	0.8810	0.7903	0.6474	0.4431	0.2955	0.3137	0.5573	0.8037	0.9181	0.9568	(86)
Tweekday	18.3056	18.5711	19.0382	19.5181	19.8477	19.9787	19.9964	19.9959	19.9439	19.5857	18.8894	18.2251	
Tweekend	20.1586	20.2799	20.4956	20.7260	20.8974	20.9800	20.9965	20.9956	20.9533	20.7538	20.4226	20.1218	
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	19.7014	19.8862	20.2216	20.5721	20.8416	20.9693	20.9945	20.9932	20.9270	20.6201	20.0984	19.6447	(87)
Th 2	19.9980	19.9980	19.9980	19.9980	19.9980	19.9980	19.9980	19.9980	19.9980	19.9980	19.9980	19.9980	(88)
util rest of house													
	0.9407	0.9151	0.8598	0.7536	0.5876	0.3611	0.2016	0.2175	0.4762	0.7609	0.9010	0.9487	(89)
Tweekday	18.3056	18.5711	19.0382	19.5181	19.8477	19.9787	19.9964	19.9959	19.9439	19.5857	18.8894	18.2251	
Tweekend	18.3056	18.5711	19.0382	19.5181	19.8477	19.9787	19.9964	19.9959	19.9439	19.5857	18.8894	18.2251	
MIT 2	18.3056	18.5711	19.0382	19.5181	19.8477	19.9787	19.9964	19.9959	19.9439	19.5857	18.8894	18.2251	(90)
Living area fraction									fLA = Living area / (4) =			0.1957	(91)
MIT	18.5787	18.8284	19.2698	19.7243	20.0422	20.1726	20.1917	20.1910	20.1363	19.7881	19.1260	18.5029	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5787	18.8284	19.2698	19.7243	20.0422	20.1726	20.1917	20.1910	20.1363	19.7881	19.1260	18.5029	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9237	0.8965	0.8416	0.7425	0.5904	0.3758	0.2199	0.2363	0.4880	0.7508	0.8825	0.9327	(94)
Useful gains	779.5095	844.6972	867.2597	829.5981	669.7840	427.9473	239.6790	249.7797	491.2203	685.0321	739.7332	744.3543	(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	1415.8998	1389.6068	1246.8831	1032.0171	739.7586	438.3191	240.7407	251.1720	518.5458	860.1355	1168.7500	1407.9345	(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	473.4744	366.1792	282.4398	145.7416	52.0611	0.0000	0.0000	0.0000	0.0000	130.2769	308.8921	493.7036	(98)
Space heating												2252.7687	(98)
Space heating per m2											(98) / (4) =	23.6635	(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 %)	268.2287	(206)
Efficiency of secondary/supplementary heating system, %	100.0000	(208)
Space heating requirement	839.8688	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	473.4744	366.1792	282.4398	145.7416	52.0611	0.0000	0.0000	0.0000	0.0000	130.2769	308.8921	493.7036	(98)
Space heating efficiency (main heating system 1)	268.2287	268.2287	268.2287	268.2287	268.2287	0.0000	0.0000	0.0000	0.0000	268.2287	268.2287	268.2287	(210)
Space heating fuel (main heating system)	176.5189	136.5176	105.2981	54.3349	19.4092	0.0000	0.0000	0.0000	0.0000	48.5693	115.1600	184.0607	(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	159.6865	140.8141	149.1563	136.9650	136.0873	123.9039	122.1733	131.4055	130.2954	143.4348	148.0052	156.3002	(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	93.7788	82.6956	87.5947	80.4351	79.9197	72.7648	71.7485	77.1703	76.5183	84.2347	86.9187	91.7901	(219)
Water heating fuel used												985.5693	(219)

Annual totals kWh/year

Space heating fuel - main system	839.8688	(211)
Space heating fuel - secondary	0.0000	(215)

Electricity for pumps and fans:
(MEVDecentralised, Database: total watage = 10.3610, total flow = 45.0000, SFP = 0.2302)

mechanical ventilation fans (SFP = 0.2302)	65.7841	(230a)
Total electricity for the above, kWh/year	65.7841	(231)
Electricity for lighting (calculated in Appendix L)	411.3386	(232)
Total delivered energy for all uses	2302.5608	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	839.8688	16.9600	142.4417	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	985.5693	16.9600	167.1526	(247)
Mechanical ventilation fans	65.7841	16.9600	11.1570	(249)
Pumps and fans for heating	0.0000	0.0000	0.0000	(249)
Energy for lighting	411.3386	16.9600	69.7630	(250)
Additional standing charges			0.0000	(251)
Total energy cost			390.5143	(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	839.8688	0.5190	435.8919	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	985.5693	0.5190	511.5105	(264)
Space and water heating			947.4024	(265)
Pumps and fans	65.7841	0.5190	34.1420	(267)
Energy for lighting	411.3386	0.5190	213.4847	(268)
Total kg/year			1195.0291	(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	839.8688	3.0700	2578.3972	(261)
Space heating - secondary	0.0000	3.0700	0.0000	(263)

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

Water heating (other fuel)	985.5693	3.0700	3025.6978 (264)
Space and water heating			5604.0950 (265)
Pumps and fans	65.7841	3.0700	201.9572 (267)
Energy for lighting	411.3386	3.0700	1262.8095 (268)
Primary energy kWh/year			7068.8617 (272)
Primary energy kWh/m2/year			74.2527 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 87
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	+ 2.1	-£ 67	-205 kg (17.2%)
U Solar photovoltaic panels	+ 9.5	-£ 309	-947 kg (95.6%)

Recommended measures	Typical annual savings		Energy efficiency	Environmental impact
Solar water heating	£67	2.15 kg/m²	B 89	B 90
Solar photovoltaic panels	£309	9.94 kg/m²	A 98	A 98
Total Savings	£376	12.10 kg/m²		

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

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	£391	£324	£67
Space heating	£154	£154	-£0
Water heating	£167	£100	£67
Lighting	£70	£70	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£391	£15	£376
Total cost of uses	£391	£15	£376
Delivered energy	24 kWh/m²	1 kWh/m²	23 kWh/m²
Carbon dioxide emissions	1.2 tonnes	0.0 tonnes	1.2 tonnes
CO2 emissions per m²	13 kg/m²	0 kg/m²	12 kg/m²
Primary energy	74 kWh/m²	3 kWh/m²	72 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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	47.6000 (1b)	x	2.3100 (2b)	=	109.9560	(1b) - (3b)
First floor	47.6000 (1c)	x	2.6100 (2c)	=	124.2360	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 95.2000						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	234.1920	(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		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2005	(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	0.2556	0.2506	0.2456	0.2206	0.2155	0.1905	0.1905	0.1855	0.2005	0.2155	0.2256	0.2356	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5056	0.5006	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			1.9800	1.0000	1.9800			(26)
Half Glaze			1.9800	1.3000	2.5740			(26a)
Window (Uw = 1.20)			11.4600	1.1450	13.1221			(27)
French Door (Uw = 1.40)			3.1500	1.3258	4.1761			(27)
FP McCann System			47.6000	0.1100	5.2360	75.0000	3570.0000	(28a)
100mm Knauf Supafil 34	138.7900	18.5700	120.2200	0.2500	30.0550	52.8000	6347.6160	(29a)
Plane Ceiling-500mm Loft Roll	47.6000		47.6000	0.0900	4.2840	9.0000	428.4000	(30)
Total net area of external elements Aum(A, m2)			233.9900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		61.4273			(33)
Timber GF			53.1900			9.0000	478.7100	(32c)
Timber 1F			101.6300			9.0000	914.6700	(32c)
Masonry GF			25.7200			39.0000	1003.0800	(32c)
Internal Floor			47.6000			12.6000	599.7600	(32d)
Internal Ceiling			47.6000			9.0000	428.4000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 13770.6360	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	144.6495	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	4.9781	(36)
Total fabric heat loss	(33) + (36) = 66.4054	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.0774	38.6900	38.6417	38.6417	38.6417	38.6417	38.6417	38.6417	38.6417	38.6417	38.6417	38.6417	(38)
Heat transfer coeff	105.4827	105.0953	105.0470	105.0470	105.0470	105.0470	105.0470	105.0470	105.0470	105.0470	105.0470	105.0470	(39)
Average = Sum(39)m / 12 =												105.0874	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1080	1.1039	1.1034	1.1034	1.1034	1.1034	1.1034	1.1034	1.1034	1.1034	1.1034	1.1034	(40)
HLP (average)												1.1039	(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	2.6904	(42)
Average daily hot water use (litres/day)	98.0976	(43)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	107.9074	103.9835	100.0596	96.1357	92.2118	88.2879	88.2879	92.2118	96.1357	100.0596	103.9835	107.9074	(44)
Energy conte	160.0236	139.9576	144.4237	125.9121	120.8157	104.2547	96.6073	110.8583	112.1823	130.7377	142.7104	154.9743	(45)
Energy content (annual)										Total = Sum(45)m =		1543.4579	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.0035	20.9936	21.6636	18.8868	18.1224	15.6382	14.4911	16.6288	16.8274	19.6107	21.4066	23.2461	(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													
	209.4004	184.5560	192.4048	166.9425	157.3982	139.4320	132.9572	148.1387	154.5635	178.7188	190.4944	204.3511	(62)
WWHRS	-49.7139	-43.7420	-44.6443	-36.7312	-34.1052	-28.1348	-23.8109	-28.8296	-29.6709	-36.6797	-42.4893	-48.0509	eq.(G10)
Total of WWHRS savings												-446.6025	
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												1.6535	(H8)
Utilisation factor												0.4538	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												98.0976	(H14)
Volume ratio Veff/V												0.7645	(H15)
Solar storage volume factor												0.9463	(H16)
Solar input												-684.8317	(H17)
Solar input	-19.8588	-33.1386	-56.4387	-75.6390	-93.4457	-91.8720	-90.6578	-79.2082	-62.0359	-42.3632	-23.5553	-16.6184	(63)
								Solar input (sum of months) = Sum(63)m =				-684.8317	(63)
Output from w/h													
	139.8277	107.6755	91.3218	54.5723	29.8473	19.4252	18.4885	40.1008	62.8566	99.6758	124.4498	139.6818	(64)
								Total per year (kWh/year) = Sum(64)m =				927.9234	(64)
Heat gains from water heating, kWh/month													
	92.7093	82.2146	86.4057	74.6901	69.4372	62.8065	61.2018	66.6847	71.2055	81.8551	85.6784	91.0304	(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	161.4256	161.4256	161.4256	161.4256	161.4256	161.4256	161.4256	161.4256	161.4256	161.4256	161.4256	161.4256	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	58.2292	51.7187	42.0605	31.8425	23.8026	20.0952	21.7136	28.2241	37.8823	48.1003	56.1402	59.8476	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	370.6362	374.4823	364.7904	344.1574	318.1121	293.6331	277.2797	273.4336	283.1255	303.7584	329.8038	354.2828	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.8330	53.8330	53.8330	53.8330	53.8330	53.8330	53.8330	53.8330	53.8330	53.8330	53.8330	53.8330	(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)													
	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	(71)
Water heating gains (Table 5)													
	124.6092	122.3432	116.1367	103.7362	93.3296	87.2313	82.2605	89.6299	98.8966	110.0203	118.9978	122.3527	(72)
Total internal gains													
	661.1162	656.1857	630.6291	587.3777	542.8858	508.6011	488.8953	498.9292	527.5459	569.5206	612.5833	644.1246	(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	
East	2.7000	19.6403	0.4600	0.0000	0.7700	18.7828	(76)
South	6.7800	46.7521	0.4600	0.0000	0.7700	112.2740	(78)
West	1.9800	19.6403	0.4600	0.0000	0.7700	13.7740	(80)
East	3.1500	19.6403	0.4300	0.0000	0.7700	20.4841	(76)

Solar gains	165.3149	287.6351	405.1019	513.9388	581.2807	578.1301	557.0457	507.5853	443.4126	321.4464	199.2187	140.6333	(83)
Total gains	826.4311	943.8208	1035.7310	1101.3165	1124.1665	1086.7312	1045.9410	1006.5144	970.9585	890.9671	811.8020	784.7579	(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	36.2635	36.3972	36.4139	36.4139	36.4139	36.4139	36.4139	36.4139	36.4139	36.4139	36.4139	36.4139	
alpha	3.4176	3.4265	3.4276	3.4276	3.4276	3.4276	3.4276	3.4276	3.4276	3.4276	3.4276	3.4276	
util living area													
	0.9586	0.9353	0.8958	0.8261	0.7171	0.5670	0.4265	0.4591	0.6508	0.8458	0.9359	0.9645	(86)
Tweekday	18.0886	18.4297	18.8813	19.3626	19.7322	19.9302	19.9850	19.9797	19.8758	19.4194	18.6685	18.0059	

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Tweekend	20.0622	20.2162	20.4233	20.6501	20.8345	20.9456	20.9844	20.9795	20.9100	20.6717	20.3215	20.0237	
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	19.5527	19.7875	20.1099	20.4536	20.7446	20.9165	20.9759	20.9684	20.8595	20.4933	19.9406	19.4932	(87)
Th 2	19.9943	19.9976	19.9980	19.9980	19.9980	19.9980	19.9980	19.9980	19.9980	19.9980	19.9980	19.9980	(88)
util rest of house	0.9511	0.9241	0.8777	0.7956	0.6676	0.4934	0.3356	0.3672	0.5807	0.8121	0.9227	0.9580	(89)
Tweekday	18.0886	18.4297	18.8813	19.3626	19.7322	19.9302	19.9850	19.9797	19.8758	19.4194	18.6685	18.0059	
Tweekend	18.0886	18.4297	18.8813	19.3626	19.7322	19.9302	19.9850	19.9797	19.8758	19.4194	18.6685	18.0059	
MIT 2	18.0886	18.4297	18.8813	19.3626	19.7322	19.9302	19.9850	19.9797	19.8758	19.4194	18.6685	18.0059	(90)
Living area fraction									fLA = Living area / (4) =			0.1957	(91)
MIT	18.3751	18.6954	19.1217	19.5761	19.9303	20.1232	20.1789	20.1732	20.0683	19.6295	18.9174	18.2970	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3751	18.6954	19.1217	19.5761	19.9303	20.1232	20.1789	20.1732	20.0683	19.6295	18.9174	18.2970	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9353	0.9057	0.8588	0.7811	0.6640	0.5030	0.3525	0.3839	0.5860	0.7977	0.9048	0.9433	(94)
Useful gains	772.9276	854.8414	889.5324	860.2579	746.4633	546.6438	368.6519	386.3529	568.9970	710.7554	734.4961	740.2360	(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	1484.6821	1449.8326	1325.8747	1121.4903	864.5667	580.1974	375.9508	396.3656	626.9518	948.5240	1241.3877	1480.8456	(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	529.5453	399.8341	324.6387	188.0874	87.8689	0.0000	0.0000	0.0000	0.0000	176.8998	364.9620	551.0135	(98)
Space heating												2622.8496	(98)
Space heating per m2											(98) / (4) =	27.5509	(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 %)	268.2210	(206)
Efficiency of secondary/supplementary heating system, %	100.0000	(208)
Space heating requirement	977.8687	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	529.5453	399.8341	324.6387	188.0874	87.8689	0.0000	0.0000	0.0000	0.0000	176.8998	364.9620	551.0135	(98)
Space heating efficiency (main heating system 1)	268.2210	268.2210	268.2210	268.2210	268.2210	0.0000	0.0000	0.0000	0.0000	268.2210	268.2210	268.2210	(210)
Space heating fuel (main heating system)	197.4287	149.0689	121.0340	70.1240	32.7599	0.0000	0.0000	0.0000	0.0000	65.9530	136.0676	205.4326	(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	139.8277	107.6755	91.3218	54.5723	29.8473	19.4252	18.4885	40.1008	62.8566	99.6758	124.4498	139.6818	(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	82.1164	63.2344	53.6304	32.0486	17.5284	11.4078	10.8577	23.5499	36.9137	58.5364	73.0854	82.0307	(219)
Water heating fuel used												544.9397	(219)

Annual totals kWh/year		
Space heating fuel - main system	977.8687	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
(MEVDecentralised, Database: total watage = 10.3610, total flow = 45.0000, SFP = 0.2302)		
mechanical ventilation fans (SFP = 0.2302)	65.7841	(230a)
pump for solar water heating	50.0000	(230g)
Total electricity for the above, kWh/year	115.7841	(231)
Electricity for lighting (calculated in Appendix L)	411.3386	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =	-1727.2394	(233)
Total delivered energy for all uses	322.6917	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	977.8687	13.1900	128.9809	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	544.9397	13.1900	71.8775	(247)
Mechanical ventilation fans	65.7841	13.1900	8.6769	(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	411.3386	13.1900	54.2556	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)

Total energy cost		42.5630	(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] =	0.1275	(257)
SAP value		98.2213	
SAP rating (Section 12)		98	(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	977.8687	0.5190	507.5138	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	544.9397	0.5190	282.8237	(264)
Space and water heating			790.3376	(265)
Pumps and fans	115.7841	0.5190	60.0920	(267)
Energy for lighting	411.3386	0.5190	213.4847	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			167.4770	(272)
CO2 emissions per m2			1.7600	(273)
EI value			98.3993	
EI rating			98	(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	47.6000 (1b)	x	2.3100 (2b)	=	109.9560	(1b) - (3b)
First floor	47.6000 (1c)	x	2.6100 (2c)	=	124.2360	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 95.2000						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	234.1920	(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		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2005	(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	0.2105	0.2005	0.2005	0.1855	0.1855	0.1654	0.1704	0.1604	0.1654	0.1754	0.1754	0.1905	(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			1.9800	1.0000	1.9800			(26)
Half Glaze			1.9800	1.3000	2.5740			(26a)
Window (Uw = 1.20)			11.4600	1.1450	13.1221			(27)
French Door (Uw = 1.40)			3.1500	1.3258	4.1761			(27)
FP McCann System			47.6000	0.1100	5.2360	75.0000	3570.0000	(28a)
100mm Knauf Supafil 34	138.7900	18.5700	120.2200	0.2500	30.0550	52.8000	6347.6160	(29a)
Plane Ceiling-500mm Loft Roll	47.6000		47.6000	0.0900	4.2840	9.0000	428.4000	(30)
Total net area of external elements Aum(A, m2)			233.9900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		61.4273			(33)
Timber GF			53.1900			9.0000	478.7100	(32c)
Timber 1F			101.6300			9.0000	914.6700	(32c)
Masonry GF			25.7200			39.0000	1003.0800	(32c)
Internal Floor			47.6000			12.6000	599.7600	(32d)
Internal Ceiling			47.6000			9.0000	428.4000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 13770.6360	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	144.6495	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	4.9781	(36)
Total fabric heat loss	(33) + (36) = 66.4054	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	38.6417	38.6417	38.6417	38.6417	38.6417	38.6417	38.6417	38.6417	38.6417	38.6417	38.6417	38.6417	(38)
Heat transfer coeff	105.0470	105.0470	105.0470	105.0470	105.0470	105.0470	105.0470	105.0470	105.0470	105.0470	105.0470	105.0470	(39)
Average = Sum(39)m / 12 =												105.0470	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1034	1.1034	1.1034	1.1034	1.1034	1.1034	1.1034	1.1034	1.1034	1.1034	1.1034	1.1034	(40)
HLP (average)												1.1034	(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	2.6904	(42)
Average daily hot water use (litres/day)	98.0976	(43)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	107.9074	103.9835	100.0596	96.1357	92.2118	88.2879	88.2879	92.2118	96.1357	100.0596	103.9835	107.9074	(44)
Energy conte	160.0236	139.9576	144.4237	125.9121	120.8157	104.2547	96.6073	110.8583	112.1823	130.7377	142.7104	154.9743	(45)
Energy content (annual)										Total = Sum(45)m =		1543.4579	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.0035	20.9936	21.6636	18.8868	18.1224	15.6382	14.4911	16.6288	16.8274	19.6107	21.4066	23.2461	(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													
	209.4004	184.5560	192.4048	166.9425	157.3982	139.4320	132.9572	148.1387	154.5635	178.7188	190.4944	204.3511	(62)
WWHRS	-49.7139	-43.7420	-44.6443	-36.7312	-34.1052	-28.1348	-23.8109	-28.8296	-29.6709	-36.6797	-42.4893	-48.0509	eq.(G10)
Total of WWHRS savings												-446.6025	
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												1.7462	(H8)
Utilisation factor												0.4360	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												98.0976	(H14)
Volume ratio Veff/V												0.7645	(H15)
Solar storage volume factor												0.9463	(H16)
Solar input												-694.8336	(H17)
Solar input	-21.3866	-32.1441	-54.1347	-74.8307	-90.1213	-94.8488	-92.5713	-82.6667	-64.5216	-43.8929	-25.9960	-17.7190	(63)
								Solar input (sum of months) = Sum(63)m =				-694.8336	(63)
Output from w/h													
	138.2999	108.6700	93.6258	55.3807	33.1716	16.4485	16.5751	36.6424	60.3709	98.1462	122.0092	138.5812	(64)
								Total per year (kWh/year) = Sum(64)m =				917.9214	(64)
Heat gains from water heating, kWh/month													
	92.7093	82.2146	86.4057	74.6901	69.4372	62.8065	61.2018	66.6847	71.2055	81.8551	85.6784	91.0304	(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	161.4256	161.4256	161.4256	161.4256	161.4256	161.4256	161.4256	161.4256	161.4256	161.4256	161.4256	161.4256	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	58.2292	51.7187	42.0605	31.8425	23.8026	20.0952	21.7136	28.2241	37.8823	48.1003	56.1402	59.8476	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	370.6362	374.4823	364.7904	344.1574	318.1121	293.6331	277.2797	273.4336	283.1255	303.7584	329.8038	354.2828	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.8330	53.8330	53.8330	53.8330	53.8330	53.8330	53.8330	53.8330	53.8330	53.8330	53.8330	53.8330	(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)													
	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	-107.6171	(71)
Water heating gains (Table 5)													
	124.6092	122.3432	116.1367	103.7362	93.3296	87.2313	82.2605	89.6299	98.8966	110.0203	118.9978	122.3527	(72)
Total internal gains													
	661.1162	656.1857	630.6291	587.3777	542.8858	508.6011	488.8953	498.9292	527.5459	569.5206	612.5833	644.1246	(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	
East	2.7000	22.3313	0.4600	0.0000	0.7700	21.3563	(76)
South	6.7800	50.9848	0.4600	0.0000	0.7700	122.4388	(78)
West	1.9800	22.3313	0.4600	0.0000	0.7700	15.6613	(80)
East	3.1500	22.3313	0.4300	0.0000	0.7700	23.2908	(76)

Solar gains	182.7472	286.0789	398.3943	522.4897	577.8286	616.1840	586.8021	545.0447	473.1461	341.4122	225.5954	153.9818	(83)
Total gains	843.8635	942.2646	1029.0234	1109.8674	1120.7144	1124.7851	1075.6973	1043.9739	1000.6920	910.9329	838.1787	798.1064	(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	36.4139	36.4139	36.4139	36.4139	36.4139	36.4139	36.4139	36.4139	36.4139	36.4139	36.4139	36.4139	
alpha	3.4276	3.4276	3.4276	3.4276	3.4276	3.4276	3.4276	3.4276	3.4276	3.4276	3.4276	3.4276	
util living area													
	0.9499	0.9279	0.8814	0.7929	0.6528	0.4480	0.2992	0.3175	0.5599	0.8043	0.9181	0.9568	(86)
Tweekday	18.3056	18.5711	19.0363	19.5122	19.8433	19.9780	19.9963	19.9958	19.9431	19.5845	18.8894	18.2251	

Tweekend	20.1586	20.2799	20.4947	20.7229	20.8946	20.9794	20.9963	20.9954	20.9526	20.7532	20.4226	20.1218	
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	19.7014	19.8862	20.2202	20.5673	20.8374	20.9683	20.9943	20.9929	20.9260	20.6191	20.0984	19.6447	(87)
Th 2	19.9980	19.9980	19.9980	19.9980	19.9980	19.9980	19.9980	19.9980	19.9980	19.9980	19.9980	19.9980	(88)
util rest of house	0.9407	0.9151	0.8602	0.7563	0.5930	0.3653	0.2042	0.2202	0.4786	0.7616	0.9010	0.9487	(89)
Tweekday	18.3056	18.5711	19.0363	19.5122	19.8433	19.9780	19.9963	19.9958	19.9431	19.5845	18.8894	18.2251	
Tweekend	18.3056	18.5711	19.0363	19.5122	19.8433	19.9780	19.9963	19.9958	19.9431	19.5845	18.8894	18.2251	
MIT 2	18.3056	18.5711	19.0363	19.5122	19.8433	19.9780	19.9963	19.9958	19.9431	19.5845	18.8894	18.2251	(90)
Living area fraction									fLA = Living area / (4) =			0.1957	(91)
MIT	18.5787	18.8284	19.2680	19.7187	20.0378	20.1718	20.1916	20.1909	20.1354	19.7869	19.1260	18.5029	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5787	18.8284	19.2680	19.7187	20.0378	20.1718	20.1916	20.1909	20.1354	19.7869	19.1260	18.5029	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9237	0.8965	0.8420	0.7450	0.5956	0.3801	0.2228	0.2392	0.4904	0.7514	0.8825	0.9327	(94)
Useful gains	779.5095	844.6972	866.4240	826.8256	667.4582	427.4999	239.6249	249.7126	490.7139	684.4593	739.7332	744.3543	(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	1415.8998	1389.6068	1246.6968	1031.4273	739.3040	438.2381	240.7305	251.1595	518.4512	860.0136	1168.7500	1407.9345	(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	473.4744	366.1792	282.9229	147.3133	53.4533	0.0000	0.0000	0.0000	0.0000	130.6125	308.8921	493.7036	(98)
Space heating												2256.5513	(98)
Space heating per m2											(98) / (4) =	23.7033	(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 %)	268.2287	(206)
Efficiency of secondary/supplementary heating system, %	100.0000	(208)
Space heating requirement	841.2790	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	473.4744	366.1792	282.9229	147.3133	53.4533	0.0000	0.0000	0.0000	0.0000	130.6125	308.8921	493.7036	(98)
Space heating efficiency (main heating system 1)	268.2287	268.2287	268.2287	268.2287	268.2287	0.0000	0.0000	0.0000	0.0000	268.2287	268.2287	268.2287	(210)
Space heating fuel (main heating system)	176.5189	136.5176	105.4783	54.9208	19.9283	0.0000	0.0000	0.0000	0.0000	48.6945	115.1600	184.0607	(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	138.2999	108.6700	93.6258	55.3807	33.1716	16.4485	16.5751	36.6424	60.3709	98.1462	122.0092	138.5812	(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	81.2191	63.8184	54.9835	32.5233	19.4806	9.6596	9.7340	21.5189	35.4539	57.6381	71.6521	81.3843	(219)
Water heating fuel used												539.0659	(219)

Annual totals kWh/year		
Space heating fuel - main system	841.2790	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
(MEVDecentralised, Database: total watage = 10.3610, total flow = 45.0000, SFP = 0.2302)		
mechanical ventilation fans (SFP = 0.2302)	65.7841	(230a)
pump for solar water heating	50.0000	(230g)
Total electricity for the above, kWh/year	115.7841	(231)
Electricity for lighting (calculated in Appendix L)	411.3386	(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	83.3080	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	841.2790	16.9600	142.6809	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	539.0659	16.9600	91.4256	(247)
Mechanical ventilation fans	65.7841	16.9600	11.1570	(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	411.3386	16.9600	69.7630	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	16.9600	-309.3775	(252)

Total energy cost 14.1290 (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	841.2790	0.5190	436.6238	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	539.0659	0.5190	279.7752	(264)
Space and water heating			716.3990	(265)
Pumps and fans	115.7841	0.5190	60.0920	(267)
Energy for lighting	411.3386	0.5190	213.4847	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	0.5190	-946.7389	(269)
Total kg/year			43.2368	(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	841.2790	3.0700	2582.7265	(261)
Space heating - secondary	0.0000	3.0700	0.0000	(263)
Water heating (other fuel)	539.0659	3.0700	1654.9323	(264)
Space and water heating			4237.6588	(265)
Pumps and fans	115.7841	3.0700	355.4572	(267)
Energy for lighting	411.3386	3.0700	1262.8095	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			255.7555	(272)
Primary energy kWh/m2/year			2.6865	(273)

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

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	South
Overshading	Average or unknown
Thermal mass parameter	144.6 (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	309.13	(P1)
Transmission heat loss coefficient	66.41	(37)
Summer heat loss coefficient	375.54	(P2)

Overhangs

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

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
East	1.000	0.90	1.000	0.900	(P8)
South	1.000	0.90	1.000	0.900	(P8)
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
East	2.7000	117.5071	0.4600	0.0000	0.9000	131.3494
South	6.7800	112.2060	0.4600	0.0000	0.9000	314.9533
West	1.9800	117.5071	0.4600	0.0000	0.9000	96.3229
East	3.1500	117.5071	0.4300	0.0000	0.9000	143.2470
total:						685.8725

	Jun	Jul	Aug	
Solar gains	720	686	637	(P3/P4)
Internal gains	523	503	512	
Total summer gains	1243	1189	1149	(P5)
Summer gain/loss ratio	3.31	3.17	3.06	(P6)

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

Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 144.6)	0.99	0.99	0.99	
Threshold temperature	20.30	22.05	21.85	(P7)
Likelihood of high internal temperature	Not significant	Medium	Slight	

Assessment of likelihood of high internal temperature: Medium