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

AES Sustainability Consultants

Property Reference	Mylne - Semi (ASHP)	**Issued on Date**	15/12/2022
Assessment Reference	Mylne - Semi (ASHP)	**Prop Type Ref**	
Property	Plot, 4 Bed, K, WC, B, ES		

SAP Rating	87 B	**DER**	13.23	**TER**	24.12
Environmental	89 B	**% DER<TER**	45.14		
CO_2 Emissions (t/year)	1.20	**DFEE**	38.61	**TFEE**	49.96
General Requirements Compliance	Pass	**% DFEE<TFEE**	22.71		

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

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DWELLING AS DESIGNED

Semi-Detached House, total floor area 106 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) 24.12 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 13.23 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)50.0 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)38.6 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): Slight OK
Based on:
Overshading: Average
Windows facing North East: 5.44 m², No overhang
Windows facing South West: 7.29 m², No overhang
Windows facing North West: 0.66 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 0.025 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	52.7900 (1b)	x	2.3900 (2b)	=	126.1681	(1b) - (3b)
First floor	52.7900 (1c)	x	2.6100 (2c)	=	137.7819	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	105.5800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	263.9500	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							0 * 10	=	0.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =		0.0000	(8)
Pressure test			Yes	
Measured/design AP50			4.0100	
Infiltration rate			0.2005	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.1855	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.2365	0.2318	0.2272	0.2040	0.1994	0.1762	0.1762	0.1716	0.1855	0.1994	0.2086	0.2179	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			1.9800	1.0000	1.9800			(26)
Window (Uw = 1.20)			10.2400	1.1450	11.7252			(27)
French Door (Uw = 1.40)			3.1500	1.3258	4.1761			(27)
FP McCann System			52.7900	0.1100	5.8069	75.0000	3959.2500	(28a)
100mm Knauf Supafil 34	104.1000	15.3700	88.7300	0.2500	22.1825	52.8000	4684.9440	(29a)
Plane Ceiling-500mm Loft Roll	52.7900		52.7900	0.0900	4.7511	9.0000	475.1100	(30)
Total net area of external elements Aum(A, m2)			209.6800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.6218			(33)
E-WM-30			43.7000	0.0000	0.0000	45.0000	1966.5000	(32)
Timber GF			41.1600			9.0000	370.4400	(32c)
Timber FF			130.1500			9.0000	1171.3500	(32c)
Masonry GF			31.8300			39.0000	1241.3700	(32c)
Internal Floor			52.7900			12.6000	665.1540	(32d)
Internal Ceiling			52.7900			9.0000	475.1100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 15009.2280	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	142.1598	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	5.1972	(36)
Total fabric heat loss	(33) + (36) = 55.8190	(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	43.5518	43.5518	43.5518	43.5518	43.5518	43.5518	43.5518	43.5518	43.5518	43.5518	43.5518	43.5518	(38)
Heat transfer coeff	99.3708	99.3708	99.3708	99.3708	99.3708	99.3708	99.3708	99.3708	99.3708	99.3708	99.3708	99.3708	(39)
Average = Sum(39)m / 12 =												99.3708	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9412	0.9412	0.9412	0.9412	0.9412	0.9412	0.9412	0.9412	0.9412	0.9412	0.9412	0.9412	(40)
HLP (average)												0.9412	(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	2.7855	(42)
Average daily hot water use (litres/day)	100.3563	(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													
	110.3919	106.3776	102.3634	98.3491	94.3349	90.3206	90.3206	94.3349	98.3491	102.3634	106.3776	110.3919	(44)
Energy conte	163.7080	143.1800	147.7490	128.8111	123.5973	106.6551	98.8316	113.4107	114.7652	133.7478	145.9962	158.5424	(45)
Energy content (annual)										Total = Sum(45)m =		1578.9946	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.5562	21.4770	22.1623	19.3217	18.5396	15.9983	14.8247	17.0116	17.2148	20.0622	21.8994	23.7814	(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													
	213.0848	187.7784	197.1258	176.5951	172.9741	154.4391	148.2084	162.7875	162.5492	183.1246	193.7802	207.9192	(62)
WWHRS	-51.2286	-45.0754	-46.0049	-37.8458	-35.1377	-28.9848	-24.5270	-29.6978	-30.5659	-37.7895	-43.7795	-49.5160	eq.(G10)
Total of WWHRS savings												-460.1529	
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													
	161.8562	142.7030	151.1209	138.7493	137.8365	125.4543	123.6814	133.0897	131.9834	145.3351	150.0007	158.4032	(64)
								Total per year (kWh/year) = Sum(64)m =				1700.2137	(64)
Heat gains from water heating, kWh/month													
	93.9343	83.2861	88.6280	81.0569	80.5976	73.6900	72.3630	77.2105	76.3866	83.9726	86.7709	92.2168	(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	139.2763	139.2763	139.2763	139.2763	139.2763	139.2763	139.2763	139.2763	139.2763	139.2763	139.2763	139.2763	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	25.9077	23.0110	18.7138	14.1675	10.5904	8.9409	9.6609	12.5576	16.8548	21.4011	24.9782	26.6278	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	265.0459	267.7963	260.8655	246.1107	227.4854	209.9802	198.2857	195.5353	202.4661	217.2209	235.8462	253.3514	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.9276	36.9276	36.9276	36.9276	36.9276	36.9276	36.9276	36.9276	36.9276	36.9276	36.9276	36.9276	(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)													
	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	(71)
Water heating gains (Table 5)													
	126.2558	123.9376	119.1236	112.5790	108.3300	102.3473	97.2620	103.7776	106.0926	112.8664	120.5152	123.9473	(72)
Total internal gains													
	481.9924	479.5278	463.4858	437.6401	411.1887	386.0512	369.9915	376.6534	390.1964	416.2713	446.1225	468.7094	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	5.4400	11.2829	0.4600	0.0000	0.7700	21.7405	(75)
Southwest	4.1400	36.7938	0.4600	0.0000	0.7700	53.9540	(79)
Northwest	0.6600	11.2829	0.4600	0.0000	0.7700	2.6376	(81)
Southwest	3.1500	36.7938	0.4300	0.0000	0.7700	38.3747	(79)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	116.7069	206.8924	304.5874	413.4497	496.0039	506.8912	482.6737	418.8718	341.9383	234.4593	141.2625	98.9226	(83)
Total gains	598.6992	686.4202	768.0733	851.0898	907.1926	892.9424	852.6652	795.5252	732.1347	650.7306	587.3851	567.6319	(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	41.9563	41.9563	41.9563	41.9563	41.9563	41.9563	41.9563	41.9563	41.9563	41.9563	41.9563	41.9563	
alpha	3.7971	3.7971	3.7971	3.7971	3.7971	3.7971	3.7971	3.7971	3.7971	3.7971	3.7971	3.7971	
util living area													
	0.9866	0.9766	0.9550	0.9028	0.7988	0.6419	0.4922	0.5425	0.7648	0.9283	0.9773	0.9890	(86)
Tweekday	18.0678	18.3570	18.8153	19.3683	19.8192	20.0547	20.1175	20.1091	19.9597	19.3874	18.6136	17.9861	
Tweekend	20.0102	20.1392	20.3449	20.5981	20.8153	20.9419	20.9837	20.9764	20.8836	20.6023	20.2525	19.9739	
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	19.4724	19.6685	19.9890	20.3724	20.7149	20.9107	20.9749	20.9635	20.8182	20.3863	19.8328	19.4163	(87)
Th 2	20.1326	20.1326	20.1326	20.1326	20.1326	20.1326	20.1326	20.1326	20.1326	20.1326	20.1326	20.1326	(88)
util rest of house													
	0.9840	0.9722	0.9463	0.8834	0.7590	0.5741	0.4032	0.4522	0.7062	0.9099	0.9722	0.9869	(89)
Tweekday	18.0678	18.3570	18.8153	19.3683	19.8192	20.0547	20.1175	20.1091	19.9597	19.3874	18.6136	17.9861	
Tweekend	18.0678	18.3570	18.8153	19.3683	19.8192	20.0547	20.1175	20.1091	19.9597	19.3874	18.6136	17.9861	
MIT 2	18.0678	18.3570	18.8153	19.3683	19.8192	20.0547	20.1175	20.1091	19.9597	19.3874	18.6136	17.9861	(90)
Living area fraction									fLA = Living area / (4) =			0.1555	(91)
MIT	18.2862	18.5609	18.9978	19.5244	19.9585	20.1879	20.2509	20.2420	20.0932	19.5428	18.8032	18.2085	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2862	18.5609	18.9978	19.5244	19.9585	20.1879	20.2509	20.2420	20.0932	19.5428	18.8032	18.2085	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9763	0.9614	0.9316	0.8673	0.7501	0.5787	0.4158	0.4641	0.7032	0.8943	0.9616	0.9801	(94)
Useful gains	584.5276	659.9397	715.5722	738.1137	680.5266	516.7506	354.5270	369.1850	514.8523	581.9379	564.8010	556.3292	(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	1389.8215	1357.4990	1241.9153	1055.7578	820.6558	555.2698	362.7879	381.7817	595.5475	888.6513	1162.9582	1392.0406	(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	599.1386	468.7599	391.5993	228.7038	104.2561	0.0000	0.0000	0.0000	0.0000	228.1947	430.6732	621.7693	(98)
Space heating												3073.0949	(98)
Space heating per m2											(98) / (4) =	29.1068	(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 %)	264.8045	(206)
Efficiency of secondary/supplementary heating system, %	100.0000	(208)
Space heating requirement	1160.5146	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	599.1386	468.7599	391.5993	228.7038	104.2561	0.0000	0.0000	0.0000	0.0000	228.1947	430.6732	621.7693	(98)
Space heating efficiency (main heating system 1)	264.8045	264.8045	264.8045	264.8045	264.8045	0.0000	0.0000	0.0000	0.0000	264.8045	264.8045	264.8045	(210)
Space heating fuel (main heating system)	226.2570	177.0211	147.8824	86.3670	39.3710	0.0000	0.0000	0.0000	0.0000	86.1748	162.6382	234.8031	(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	161.8562	142.7030	151.1209	138.7493	137.8365	125.4543	123.6814	133.0897	131.9834	145.3351	150.0007	158.4032	(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	95.0529	83.8049	88.7485	81.4830	80.9470	73.6753	72.6341	78.1593	77.5096	85.3507	88.0906	93.0251	(219)
Water heating fuel used												998.4811	(219)
Annual totals kWh/year													
Space heating fuel - main system												1160.5146	(211)
Space heating fuel - secondary												0.0000	(215)

Electricity for pumps and fans:
(MEVDecentralised, Database: total watage = 8.4890, total flow = 37.0000, SFP = 0.2294)

mechanical ventilation fans (SFP = 0.2294)	73.8816	(230a)
Total electricity for the above, kWh/year	73.8816	(231)
Electricity for lighting (calculated in Appendix L)	457.5382	(232)
Total delivered energy for all uses	2690.4155	(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	1160.5146	0.5190	602.3071	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	998.4811	0.5190	518.2117	(264)
Space and water heating			1120.5188	(265)
Pumps and fans	73.8816	0.5190	38.3446	(267)
Energy for lighting	457.5382	0.5190	237.4623	(268)
Total CO2, kg/year			1396.3257	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			13.2300	(273)

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

DER		13.2300	ZC1
Total Floor Area	TFA	105.5800	
Assumed number of occupants	N	2.7855	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		14.8760	ZC2
CO2 emissions from cooking, equation (L16)		1.7603	ZC3
Total CO2 emissions		29.8663	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		29.8663	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	52.7900 (1b)	x	2.3900 (2b)	=	126.1681	(1b) - (3b)
First floor	52.7900 (1c)	x	2.6100 (2c)	=	137.7819	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	105.5800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	263.9500	(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							4 * 10	=	40.0000	(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) =	40.0000 / (5) =		0.1515	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.4015	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3714	(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	0.4736	0.4643	0.4550	0.4086	0.3993	0.3529	0.3529	0.3436	0.3714	0.3993	0.4179	0.4364	(22b)
Effective ac	0.6121	0.6078	0.6035	0.5835	0.5797	0.5623	0.5623	0.5590	0.5690	0.5797	0.5873	0.5952	(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 Opening Type (Uw = 1.40)			13.3900	1.3258	17.7519			(27)
FP McCann System			52.7900	0.1300	6.8627			(28a)
100mm Knauf Supafil 34	104.1000	15.3700	88.7300	0.1800	15.9714			(29a)
Plane Ceiling-500mm Loft Roll	52.7900		52.7900	0.1300	6.8627			(30)
Total net area of external elements Aum(A, m2)			209.6800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.4287			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.1594	(36)
Total fabric heat loss					(33) + (36) =		59.5881	(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	53.3191	52.9398	52.5680	50.8219	50.4951	48.9743	48.9743	48.6926	49.5601	50.4951	51.1561	51.8470	(38)
Heat transfer coeff	112.9072	112.5279	112.1561	110.4099	110.0832	108.5624	108.5624	108.2807	109.1482	110.0832	110.7442	111.4351	(39)
Average = Sum(39)m / 12 =												110.4084	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0694	1.0658	1.0623	1.0457	1.0427	1.0282	1.0282	1.0256	1.0338	1.0427	1.0489	1.0555	(40)
HLP (average)												1.0457	(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	2.7855	(42)
Average daily hot water use (litres/day)	100.3563	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.3919	106.3776	102.3634	98.3491	94.3349	90.3206	90.3206	94.3349	98.3491	102.3634	106.3776	110.3919	(44)
Energy conte	163.7080	143.1800	147.7490	128.8111	123.5973	106.6551	98.8316	113.4107	114.7652	133.7478	145.9962	158.5424	(45)
Energy content (annual)										Total = Sum(45)m =		1578.9946	(45)
Distribution loss (46)m = 0.15 x (45)m	24.5562	21.4770	22.1623	19.3217	18.5396	15.9983	14.8247	17.0116	17.2148	20.0622	21.8994	23.7814	(46)

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

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Enter (49) or (54) in (55)												0.8924	(55)
Total storage loss	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637	(56)
If cylinder contains dedicated solar storage	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month	214.6340	189.1778	198.6750	178.0944	174.5234	155.9384	149.7577	164.3368	164.0485	184.6739	195.2795	209.4685	(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	214.6340	189.1778	198.6750	178.0944	174.5234	155.9384	149.7577	164.3368	164.0485	184.6739	195.2795	209.4685	(64)
Total per year (kWh/year) = Sum(64)m =												2178.6080	(64)
Heat gains from water heating, kWh/month	95.1738	84.4056	89.8674	82.2563	81.8370	74.8895	73.6024	78.4499	77.5861	85.2120	87.9704	93.4562	(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	139.2763	139.2763	139.2763	139.2763	139.2763	139.2763	139.2763	139.2763	139.2763	139.2763	139.2763	139.2763	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	25.9077	23.0110	18.7138	14.1675	10.5904	8.9409	9.6609	12.5576	16.8548	21.4011	24.9782	26.6278	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	265.0459	267.7963	260.8655	246.1107	227.4854	209.9802	198.2857	195.5353	202.4661	217.2209	235.8462	253.3514	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.9276	36.9276	36.9276	36.9276	36.9276	36.9276	36.9276	36.9276	36.9276	36.9276	36.9276	36.9276	(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)	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	(71)
Water heating gains (Table 5)	127.9217	125.6035	120.7895	114.2449	109.9959	104.0131	98.9279	105.4435	107.7584	114.5323	122.1811	125.6132	(72)
Total internal gains	486.6583	484.1937	468.1517	442.3060	415.8546	390.7171	374.6574	381.3193	394.8623	420.9372	450.7884	473.3753	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	5.4400	11.2829	0.6300	0.7000	0.7700	18.7583	(75)
Southwest	7.2900	36.7938	0.6300	0.7000	0.7700	81.9737	(79)
Northwest	0.6600	11.2829	0.6300	0.7000	0.7700	2.2758	(81)

Solar gains	103.0078	182.4470	268.1898	363.4060	435.4370	444.7768	423.6151	367.9675	300.8629	206.6465	124.6519	87.3299	(83)
Total gains	589.6660	666.6407	736.3415	805.7121	851.2916	835.4939	798.2725	749.2868	695.7251	627.5837	575.4403	560.7051	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	64.9378	65.1567	65.3727	66.4066	66.6036	67.5367	67.5367	67.7124	67.1742	66.6036	66.2062	65.7956	
alpha	5.3292	5.3438	5.3582	5.4271	5.4402	5.5024	5.5024	5.5142	5.4783	5.4402	5.4137	5.3864	
util living area	0.9986	0.9970	0.9921	0.9735	0.9112	0.7589	0.5836	0.6395	0.8771	0.9825	0.9970	0.9989	(86)
MIT	19.8294	19.9638	20.1903	20.4998	20.7749	20.9448	20.9893	20.9828	20.8701	20.5207	20.1249	19.8125	(87)
Th 2	20.0259	20.0289	20.0318	20.0454	20.0479	20.0599	20.0599	20.0621	20.0553	20.0479	20.0428	20.0374	(88)
util rest of house	0.9981	0.9959	0.9892	0.9629	0.8751	0.6745	0.4666	0.5216	0.8155	0.9736	0.9957	0.9986	(89)
MIT 2	18.4564	18.6548	18.9868	19.4415	19.8168	20.0210	20.0556	20.0545	19.9453	19.4778	18.9008	18.4400	(90)
Living area fraction									fLA = Living area / (4) =			0.1555	(91)
MIT	18.6699	18.8584	19.1739	19.6060	19.9658	20.1647	20.2008	20.1989	20.0891	19.6400	19.0912	18.6535	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6699	18.8584	19.1739	19.6060	19.9658	20.1647	20.2008	20.1989	20.0891	19.6400	19.0912	18.6535	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9971	0.9941	0.9856	0.9565	0.8714	0.6848	0.4847	0.5397	0.8181	0.9683	0.9938	0.9978	(94)
Useful gains	587.9575	662.6877	725.7197	770.6861	741.8333	572.1349	386.9536	404.4090	569.1868	607.6870	571.8988	559.4605	(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	1622.4655	1570.7059	1421.4594	1182.0543	909.9230	604.1117	390.9162	411.3450	653.7004	995.1520	1327.9554	1610.6259	(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	769.6739	610.1882	517.6304	296.1851	125.0588	0.0000	0.0000	0.0000	0.0000	288.2740	544.3608	782.0671	(98)
Space heating												3933.4383	(98)
Space heating per m2											(98) / (4) =	37.2555	(99)

8c. Space cooling requirement

Not applicable

9a. Energy requirements - Individual heating systems, including micro-CHP

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	93.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4206.8858	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	769.6739	610.1882	517.6304	296.1851	125.0588	0.0000	0.0000	0.0000	0.0000	288.2740	544.3608	782.0671	(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)	823.1807	652.6077	553.6154	316.7755	133.7527	0.0000	0.0000	0.0000	0.0000	308.3145	582.2040	836.4354	(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	214.6340	189.1778	198.6750	178.0944	174.5234	155.9384	149.7577	164.3368	164.0485	184.6739	195.2795	209.4685	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.9291	87.7165	87.2550	86.1618	83.9430	79.8000	79.8000	79.8000	79.8000	85.9974	87.4057	88.0071	(217)
Fuel for water heating, kWh/month	244.0989	215.6695	227.6948	206.6977	207.9070	195.4115	187.6663	205.9359	205.5746	214.7434	223.4172	238.0132	(219)

Water heating fuel used	2572.8301	(219)
Annual totals kWh/year		
Space heating fuel - main system	4206.8858	(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)	457.5382	(232)
Total delivered energy for all uses	7312.2541	(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	4206.8858	0.2160	908.6873	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2572.8301	0.2160	555.7313	(264)
Space and water heating			1464.4186	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	457.5382	0.5190	237.4623	(268)
Total CO2, kg/m2/year			1740.8060	(272)
Emissions per m2 for space and water heating			13.8702	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			2.2491	(272b)
Emissions per m2 for pumps and fans			0.3687	(272c)
Target Carbon Dioxide Emission Rate (TER) = (13.8702 * 1.55) + 2.2491 + 0.3687, rounded to 2 d.p.			24.1200	(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	52.7900 (1b)	x	2.3900 (2b)	=	126.1681	(1b) - (3b)
First floor	52.7900 (1c)	x	2.6100 (2c)	=	137.7819	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 105.5800						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	263.9500	(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							4 * 10	=	40.0000	(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) =	40.0000 / (5) =		0.1515	(8)
Pressure test			Yes	
Measured/design AP50			4.0100	
Infiltration rate			0.3520	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3256	(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	0.4152	0.4071	0.3989	0.3582	0.3501	0.3094	0.3094	0.3012	0.3256	0.3501	0.3663	0.3826	(22b)
Effective ac	0.5862	0.5828	0.5796	0.5642	0.5613	0.5479	0.5479	0.5454	0.5530	0.5613	0.5671	0.5732	(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)
Window (Uw = 1.20)			10.2400	1.1450	11.7252			(27)
French Door (Uw = 1.40)			3.1500	1.3258	4.1761			(27)
FP McCann System			52.7900	0.1100	5.8069	75.0000	3959.2500	(28a)
100mm Knauf Supafil 34	104.1000	15.3700	88.7300	0.2500	22.1825	52.8000	4684.9440	(29a)
Plane Ceiling-500mm Loft Roll	52.7900		52.7900	0.0900	4.7511	9.0000	475.1100	(30)
Total net area of external elements Aum(A, m2)			209.6800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.6218			(33)
E-WM-30			43.7000	0.0000	0.0000	45.0000	1966.5000	(32)
Timber GF			41.1600			9.0000	370.4400	(32c)
Timber FF			130.1500			9.0000	1171.3500	(32c)
Masonry GF			31.8300			39.0000	1241.3700	(32c)
Internal Floor			52.7900			12.6000	665.1540	(32d)
Internal Ceiling			52.7900			9.0000	475.1100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 15009.2280	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	142.1598	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	5.1972	(36)
Total fabric heat loss	(33) + (36) = 55.8190	(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	51.0594	50.7679	50.4821	49.1399	48.8888	47.7198	47.7198	47.5033	48.1701	48.8888	49.3968	49.9279	(38)
Heat transfer coeff	106.8784	106.5869	106.3011	104.9589	104.7078	103.5388	103.5388	103.3223	103.9891	104.7078	105.2158	105.7469	(39)
Average = Sum(39)m / 12 =												104.9577	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0123	1.0095	1.0068	0.9941	0.9917	0.9807	0.9807	0.9786	0.9849	0.9917	0.9966	1.0016	(40)
HLP (average)												0.9941	(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	2.7855	(42)
Average daily hot water use (litres/day)	100.3563	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.3919	106.3776	102.3634	98.3491	94.3349	90.3206	90.3206	94.3349	98.3491	102.3634	106.3776	110.3919	(44)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy conte	163.7080	143.1800	147.7490	128.8111	123.5973	106.6551	98.8316	113.4107	114.7652	133.7478	145.9962	158.5424	(45)
Energy content (annual)										Total = Sum(45)m =		1578.9946	(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													
	34.7879	30.4258	31.3967	27.3724	26.2644	22.6642	21.0017	24.0998	24.3876	28.4214	31.0242	33.6903	(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	139.2763	139.2763	139.2763	139.2763	139.2763	139.2763	139.2763	139.2763	139.2763	139.2763	139.2763	139.2763	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	25.9077	23.0110	18.7138	14.1675	10.5904	8.9409	9.6609	12.5576	16.8548	21.4011	24.9782	26.6278	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	265.0459	267.7963	260.8655	246.1107	227.4854	209.9802	198.2857	195.5353	202.4661	217.2209	235.8462	253.3514	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.9276	36.9276	36.9276	36.9276	36.9276	36.9276	36.9276	36.9276	36.9276	36.9276	36.9276	36.9276	(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)													
	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	(71)
Water heating gains (Table 5)													
	46.7580	45.2764	42.1998	38.0172	35.3017	31.4781	28.2281	32.3922	33.8717	38.2008	43.0892	45.2826	(72)
Total internal gains													
	402.4945	400.8666	386.5620	363.0783	338.1603	315.1820	300.9576	305.2680	317.9755	341.6057	368.6965	390.0447	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	5.4400	11.2829	0.4600	0.0000	0.7700	21.7405	(75)
Southwest	4.1400	36.7938	0.4600	0.0000	0.7700	53.9540	(79)
Northwest	0.6600	11.2829	0.4600	0.0000	0.7700	2.6376	(81)
Southwest	3.1500	36.7938	0.4300	0.0000	0.7700	38.3747	(79)

Solar gains	116.7069	206.8924	304.5874	413.4497	496.0039	506.8912	482.6737	418.8718	341.9383	234.4593	141.2625	98.9226	(83)
Total gains	519.2014	607.7590	691.1494	776.5280	834.1642	822.0732	783.6313	724.1398	659.9138	576.0651	509.9590	488.9672	(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	39.0091	39.1158	39.2209	39.7225	39.8178	40.2673	40.2673	40.3517	40.0930	39.8178	39.6255	39.4265	
alpha	3.6006	3.6077	3.6147	3.6482	3.6545	3.6845	3.6845	3.6901	3.6729	3.6545	3.6417	3.6284	
util living area													
	0.9917	0.9846	0.9689	0.9281	0.8414	0.6950	0.5455	0.6010	0.8176	0.9515	0.9858	0.9933	(86)
MIT	19.2179	19.4304	19.7748	20.2252	20.6161	20.8706	20.9603	20.9432	20.7483	20.2366	19.6471	19.1830	(87)
Th 2	20.0731	20.0754	20.0776	20.0882	20.0902	20.0995	20.0995	20.1012	20.0959	20.0902	20.0862	20.0820	(88)
util rest of house													
	0.9900	0.9815	0.9623	0.9123	0.8050	0.6256	0.4475	0.5032	0.7632	0.9378	0.9825	0.9919	(89)
MIT 2	18.4288	18.6416	18.9839	19.4310	19.7980	20.0215	20.0829	20.0757	19.9263	19.4501	18.8665	18.4007	(90)
Living area fraction									fLA = Living area / (4) =			0.1555	(91)
MIT	18.5515	18.7643	19.1069	19.5545	19.9252	20.1535	20.2194	20.2106	20.0542	19.5724	18.9879	18.5224	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5515	18.7643	19.1069	19.5545	19.9252	20.1535	20.2194	20.2106	20.0542	19.5724	18.9879	18.5224	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9862	0.9757	0.9536	0.9011	0.7975	0.6301	0.4612	0.5159	0.7603	0.9278	0.9771	0.9887	(94)
Useful gains	512.0496	593.0074	659.0796	699.6970	665.2606	518.0244	361.4198	373.6021	501.7150	534.4991	498.2672	483.4627	(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													
	1523.1793	1477.7511	1340.1322	1118.2878	861.2479	575.0054	374.7472	393.7190	619.1686	939.4825	1250.7912	1514.5495	(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													
	752.2805	594.5478	506.7032	301.3854	145.8146	0.0000	0.0000	0.0000	0.0000	301.3076	541.8173	767.1285	(98)
Space heating												3910.9849	(98)
Space heating per m2											(98) / (4) =	37.0429	(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	973.2648	766.1872	785.2497	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8221	0.8833	0.8564	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	800.1121	676.7511	672.4965	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1069.9130	1022.7025	955.4296	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	194.2566	257.3878	210.5022	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												662.1466	(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	48.5641	64.3470	52.6256	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												165.5367	(107)
Space cooling per m2												1.5679	(108)
Energy for space heating												37.0429	(99)
Energy for space cooling												1.5679	(108)
Total												38.6107	(109)
Dwelling Fabric Energy Efficiency (DFEE)												38.6	(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	52.7900 (1b)	x	2.3900 (2b)	=	126.1681	(1b) - (3b)
First floor	52.7900 (1c)	x	2.6100 (2c)	=	137.7819	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	105.5800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	263.9500	(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							4 * 10	=	40.0000	(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) =	40.0000 / (5) =		0.1515	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.4015	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3714	(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	0.4736	0.4643	0.4550	0.4086	0.3993	0.3529	0.3529	0.3436	0.3714	0.3993	0.4179	0.4364	(22b)
Effective ac	0.6121	0.6078	0.6035	0.5835	0.5797	0.5623	0.5623	0.5590	0.5690	0.5797	0.5873	0.5952	(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 Opening Type (Uw = 1.40)			13.3900	1.3258	17.7519			(27)
FP McCann System			52.7900	0.1300	6.8627			(28a)
100mm Knauf Supafil 34	104.1000	15.3700	88.7300	0.1800	15.9714			(29a)
Plane Ceiling-500mm Loft Roll	52.7900		52.7900	0.1300	6.8627			(30)
Total net area of external elements Aum(A, m2)			209.6800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.4287			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.1594	(36)
Total fabric heat loss					(33) + (36) =		59.5881	(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	53.3191	52.9398	52.5680	50.8219	50.4951	48.9743	48.9743	48.6926	49.5601	50.4951	51.1561	51.8470	(38)
Heat transfer coeff	112.9072	112.5279	112.1561	110.4099	110.0832	108.5624	108.5624	108.2807	109.1482	110.0832	110.7442	111.4351	(39)
Average = Sum(39)m / 12 =												110.4084	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0694	1.0658	1.0623	1.0457	1.0427	1.0282	1.0282	1.0256	1.0338	1.0427	1.0489	1.0555	(40)
HLP (average)												1.0457	(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	2.7855	(42)
Average daily hot water use (litres/day)	100.3563	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	110.3919	106.3776	102.3634	98.3491	94.3349	90.3206	90.3206	94.3349	98.3491	102.3634	106.3776	110.3919	(44)
Energy conte	163.7080	143.1800	147.7490	128.8111	123.5973	106.6551	98.8316	113.4107	114.7652	133.7478	145.9962	158.5424	(45)
Energy content (annual)										Total = Sum(45)m =		1578.9946	(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													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	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													
	34.7879	30.4258	31.3967	27.3724	26.2644	22.6642	21.0017	24.0998	24.3876	28.4214	31.0242	33.6903	(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	139.2763	139.2763	139.2763	139.2763	139.2763	139.2763	139.2763	139.2763	139.2763	139.2763	139.2763	139.2763	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	25.9077	23.0110	18.7138	14.1675	10.5904	8.9409	9.6609	12.5576	16.8548	21.4011	24.9782	26.6278	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	265.0459	267.7963	260.8655	246.1107	227.4854	209.9802	198.2857	195.5353	202.4661	217.2209	235.8462	253.3514	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.9276	36.9276	36.9276	36.9276	36.9276	36.9276	36.9276	36.9276	36.9276	36.9276	36.9276	36.9276	(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)													
	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	(71)
Water heating gains (Table 5)													
	46.7580	45.2764	42.1998	38.0172	35.3017	31.4781	28.2281	32.3922	33.8717	38.2008	43.0892	45.2826	(72)
Total internal gains													
	402.4945	400.8666	386.5620	363.0783	338.1603	315.1820	300.9576	305.2680	317.9755	341.6057	368.6965	390.0447	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	5.4400	11.2829	0.6300	0.7000	0.7700	18.7583	(75)
Southwest	7.2900	36.7938	0.6300	0.7000	0.7700	81.9737	(79)
Northwest	0.6600	11.2829	0.6300	0.7000	0.7700	2.2758	(81)

Solar gains	103.0078	182.4470	268.1898	363.4060	435.4370	444.7768	423.6151	367.9675	300.8629	206.6465	124.6519	87.3299	(83)
Total gains	505.5023	583.3136	654.7518	726.4843	773.5973	759.9589	724.5727	673.2355	618.8384	548.2522	493.3484	477.3746	(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	64.9378	65.1567	65.3727	66.4066	66.6036	67.5367	67.5367	67.7124	67.1742	66.6036	66.2062	65.7956	
alpha	5.3292	5.3438	5.3582	5.4271	5.4402	5.5024	5.5024	5.5142	5.4783	5.4402	5.4137	5.3864	
util living area													
	0.9993	0.9984	0.9954	0.9829	0.9363	0.8059	0.6349	0.6973	0.9155	0.9904	0.9986	0.9995	(86)
MIT	19.7538	19.8895	20.1191	20.4361	20.7283	20.9251	20.9840	20.9739	20.8305	20.4540	20.0515	19.7374	(87)
Th 2	20.0259	20.0289	20.0318	20.0454	20.0479	20.0599	20.0599	20.0621	20.0553	20.0479	20.0428	20.0374	(88)
util rest of house													
	0.9991	0.9978	0.9937	0.9757	0.9075	0.7254	0.5116	0.5755	0.8656	0.9852	0.9980	0.9994	(89)
MIT 2	18.8789	19.0167	19.2480	19.5723	19.8511	20.0221	20.0554	20.0538	19.9514	19.5944	19.1900	18.8718	(90)
Living area fraction									fLA = Living area / (4) =			0.1555	(91)
MIT	19.0150	19.1525	19.3834	19.7067	19.9875	20.1626	20.1998	20.1969	20.0881	19.7281	19.3240	19.0064	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.0150	19.1525	19.3834	19.7067	19.9875	20.1626	20.1998	20.1969	20.0881	19.7281	19.3240	19.0064	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9988	0.9971	0.9921	0.9724	0.9053	0.7352	0.5309	0.5944	0.8678	0.9828	0.9973	0.9991	(94)
Useful gains	504.8821	581.6424	649.5665	706.4198	700.3104	558.7561	384.6655	400.1395	537.0083	538.8368	492.0189	476.9485	(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													
	1661.4266	1603.8008	1444.9568	1193.1632	912.3201	603.8854	390.8016	411.1314	653.5895	1004.8487	1353.7372	1649.9554	(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													
	860.4691	686.8904	591.7704	350.4553	157.7352	0.0000	0.0000	0.0000	0.0000	346.7128	620.4372	872.7171	(98)
Space heating												4487.1875	(98)
Space heating per m2											(98) / (4) =	42.5004	(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	1020.4863	803.3616	822.9336	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8363	0.9087	0.8801	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	853.4607	730.0533	724.2280	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	997.3117	953.6729	895.9311	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	103.5728	166.3730	127.7471	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												397.6929	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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	25.8932	41.5933	31.9368	0.0000	0.0000	0.0000		0.0000 (107)
Space cooling													99.4232 (107)
Space cooling per m2													0.9417 (108)
Energy for space heating													42.5004 (99)
Energy for space cooling													0.9417 (108)
Total													43.4420 (109)
Target Fabric Energy Efficiency (TFEE)													50.0 (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	52.7900 (1b)	x	2.3900 (2b)	=	126.1681	(1b) - (3b)
First floor	52.7900 (1c)	x	2.6100 (2c)	=	137.7819	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 105.5800						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	263.9500	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							0 * 10	=	0.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =		0.0000	(8)
Pressure test			Yes	
Measured/design AP50			4.0100	
Infiltration rate			0.2005	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.1855	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.1947	0.1855	0.1855	0.1716	0.1716	0.1530	0.1576	0.1484	0.1530	0.1623	0.1623	0.1762	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			1.9800	1.0000	1.9800			(26)
Window (Uw = 1.20)			10.2400	1.1450	11.7252			(27)
French Door (Uw = 1.40)			3.1500	1.3258	4.1761			(27)
FP McCann System			52.7900	0.1100	5.8069	75.0000	3959.2500	(28a)
100mm Knauf Supafil 34	104.1000	15.3700	88.7300	0.2500	22.1825	52.8000	4684.9440	(29a)
Plane Ceiling-500mm Loft Roll	52.7900		52.7900	0.0900	4.7511	9.0000	475.1100	(30)
Total net area of external elements Aum(A, m2)			209.6800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.6218			(33)
E-WM-30			43.7000	0.0000	0.0000	45.0000	1966.5000	(32)
Timber GF			41.1600			9.0000	370.4400	(32c)
Timber FF			130.1500			9.0000	1171.3500	(32c)
Masonry GF			31.8300			39.0000	1241.3700	(32c)
Internal Floor			52.7900			12.6000	665.1540	(32d)
Internal Ceiling			52.7900			9.0000	475.1100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 15009.2280	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	142.1598	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	5.1972	(36)
Total fabric heat loss	(33) + (36) = 55.8190	(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	43.5518	43.5518	43.5518	43.5518	43.5518	43.5518	43.5518	43.5518	43.5518	43.5518	43.5518	43.5518	(38)
Heat transfer coeff	99.3708	99.3708	99.3708	99.3708	99.3708	99.3708	99.3708	99.3708	99.3708	99.3708	99.3708	99.3708	(39)
Average = Sum(39)m / 12 =												99.3708	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9412	0.9412	0.9412	0.9412	0.9412	0.9412	0.9412	0.9412	0.9412	0.9412	0.9412	0.9412	(40)
HLP (average)												0.9412	(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	2.7855	(42)
Average daily hot water use (litres/day)	100.3563	(43)

CALCULATION OF HEAT DEMAND 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	110.3919	106.3776	102.3634	98.3491	94.3349	90.3206	90.3206	94.3349	98.3491	102.3634	106.3776	110.3919	(44)
Energy conte	163.7080	143.1800	147.7490	128.8111	123.5973	106.6551	98.8316	113.4107	114.7652	133.7478	145.9962	158.5424	(45)
Energy content (annual)										Total = Sum(45)m =		1578.9946	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.5562	21.4770	22.1623	19.3217	18.5396	15.9983	14.8247	17.0116	17.2148	20.0622	21.8994	23.7814	(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													
	213.0848	187.7784	197.1258	176.5951	172.9741	154.4391	148.2084	162.7875	162.5492	183.1246	193.7802	207.9192	(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													
	213.0848	187.7784	197.1258	176.5951	172.9741	154.4391	148.2084	162.7875	162.5492	183.1246	193.7802	207.9192	(64)
								Total per year (kWh/year) = Sum(64)m =				2160.3666	(64)
RHI water heating demand												2160	(64)
Heat gains from water heating, kWh/month													
	93.9343	83.2861	88.6280	81.0569	80.5976	73.6900	72.3630	77.2105	76.3866	83.9726	86.7709	92.2168	(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	167.1316	167.1316	167.1316	167.1316	167.1316	167.1316	167.1316	167.1316	167.1316	167.1316	167.1316	167.1316	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	64.7693	57.5275	46.7845	35.4189	26.4760	22.3522	24.1523	31.3941	42.1371	53.5027	62.4456	66.5694	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	395.5909	399.6959	389.3515	367.3294	339.5304	313.4033	295.9487	291.8437	302.1882	324.2103	352.0093	378.1364	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.4987	54.4987	54.4987	54.4987	54.4987	54.4987	54.4987	54.4987	54.4987	54.4987	54.4987	54.4987	(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)													
	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	(71)
Water heating gains (Table 5)													
	126.2558	123.9376	119.1236	112.5790	108.3300	102.3473	97.2620	103.7776	106.0926	112.8664	120.5152	123.9473	(72)
Total internal gains													
	696.8253	691.3703	665.4688	625.5365	584.5457	548.3119	527.5723	537.2246	560.6271	600.7886	645.1793	678.8623	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	5.4400	12.9236	0.4600	0.0000	0.7700	24.9017	(75)
Southwest	4.1400	40.4699	0.4600	0.0000	0.7700	59.3446	(79)
Northwest	0.6600	12.9236	0.4600	0.0000	0.7700	3.0212	(81)
Southwest	3.1500	40.4699	0.4300	0.0000	0.7700	42.2087	(79)

Solar gains	129.4762	207.0286	302.4995	425.5458	499.1016	546.4574	514.4946	455.4515	368.9525	250.8978	160.6488	108.6316	(83)
Total gains	826.3015	898.3989	967.9683	1051.0823	1083.6473	1094.7693	1042.0669	992.6761	929.5796	851.6864	805.8281	787.4940	(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	41.9563	41.9563	41.9563	41.9563	41.9563	41.9563	41.9563	41.9563	41.9563	41.9563	41.9563	41.9563	
alpha	3.7971	3.7971	3.7971	3.7971	3.7971	3.7971	3.7971	3.7971	3.7971	3.7971	3.7971	3.7971	
util living area													
	0.9574	0.9407	0.8999	0.8102	0.6557	0.4412	0.2936	0.3174	0.5773	0.8264	0.9300	0.9630	(86)
Tweekday	18.6453	18.8567	19.2703	19.7154	20.0146	20.1195	20.1316	20.1311	20.0878	19.7649	19.1518	18.5787	
Tweekend	20.2694	20.3655	20.5551	20.7671	20.9218	20.9872	20.9980	20.9973	20.9633	20.7868	20.4977	20.2391	
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	19.8725	20.0185	20.3134	20.6364	20.8793	20.9803	20.9970	20.9959	20.9426	20.6709	20.2157	19.8257	(87)
Th 2	20.1326	20.1326	20.1326	20.1326	20.1326	20.1326	20.1326	20.1326	20.1326	20.1326	20.1326	20.1326	(88)
util rest of house													
	0.9499	0.9305	0.8825	0.7782	0.6022	0.3694	0.2124	0.2328	0.5043	0.7898	0.9160	0.9564	(89)
Tweekday	18.6453	18.8567	19.2703	19.7154	20.0146	20.1195	20.1316	20.1311	20.0878	19.7649	19.1518	18.5787	
Tweekend	18.6453	18.8567	19.2703	19.7154	20.0146	20.1195	20.1316	20.1311	20.0878	19.7649	19.1518	18.5787	
MIT 2	18.6453	18.8567	19.2703	19.7154	20.0146	20.1195	20.1316	20.1311	20.0878	19.7649	19.1518	18.5787	(90)
Living area fraction									fLA = Living area / (4) =			0.1555	(91)
MIT	18.8361	19.0374	19.4325	19.8587	20.1491	20.2534	20.2662	20.2656	20.2207	19.9058	19.3173	18.7726	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8361	19.0374	19.4325	19.8587	20.1491	20.2534	20.2662	20.2656	20.2207	19.9058	19.3173	18.7726	(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	0.9355	0.9146	0.8660	0.7670	0.6032	0.3796	0.2250	0.2459	0.5121	0.7789	0.8998	0.9428	(94)
Useful gains	773.0176	821.6543	838.2319	806.2263	653.6904	415.5954	234.4904	244.1005	475.9934	663.4074	725.0812	742.4681	(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	1364.9707	1335.2876	1195.6802	989.6007	710.4116	422.6619	235.1293	245.0113	498.9119	825.3567	1124.6076	1358.6583	(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	440.4131	345.1616	265.9416	132.0296	42.2006	0.0000	0.0000	0.0000	0.0000	120.4903	287.6590	458.4456	(98)
Space heating												2092.3412	(98)
RHI space heating demand												2092	(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	52.7900 (1b)	x	2.3900 (2b)	=	126.1681	(1b) - (3b)
First floor	52.7900 (1c)	x	2.6100 (2c)	=	137.7819	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 105.5800						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	263.9500	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							0 * 10	=	0.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =		0.0000	(8)
Pressure test			Yes	
Measured/design AP50			4.0100	
Infiltration rate			0.2005	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.1855	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.2365	0.2318	0.2272	0.2040	0.1994	0.1762	0.1762	0.1716	0.1855	0.1994	0.2086	0.2179	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			1.9800	1.0000	1.9800			(26)
Window (Uw = 1.20)			10.2400	1.1450	11.7252			(27)
French Door (Uw = 1.40)			3.1500	1.3258	4.1761			(27)
FP McCann System			52.7900	0.1100	5.8069	75.0000	3959.2500	(28a)
100mm Knauf Supafil 34	104.1000	15.3700	88.7300	0.2500	22.1825	52.8000	4684.9440	(29a)
Plane Ceiling-500mm Loft Roll	52.7900		52.7900	0.0900	4.7511	9.0000	475.1100	(30)
Total net area of external elements Aum(A, m2)			209.6800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.6218			(33)
E-WM-30			43.7000	0.0000	0.0000	45.0000	1966.5000	(32)
Timber GF			41.1600			9.0000	370.4400	(32c)
Timber FF			130.1500			9.0000	1171.3500	(32c)
Masonry GF			31.8300			39.0000	1241.3700	(32c)
Internal Floor			52.7900			12.6000	665.1540	(32d)
Internal Ceiling			52.7900			9.0000	475.1100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 15009.2280	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	142.1598	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	5.1972	(36)
Total fabric heat loss	(33) + (36) = 55.8190	(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	43.5518	43.5518	43.5518	43.5518	43.5518	43.5518	43.5518	43.5518	43.5518	43.5518	43.5518	43.5518	(38)
Heat transfer coeff	99.3708	99.3708	99.3708	99.3708	99.3708	99.3708	99.3708	99.3708	99.3708	99.3708	99.3708	99.3708	(39)
Average = Sum(39)m / 12 =												99.3708	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9412	0.9412	0.9412	0.9412	0.9412	0.9412	0.9412	0.9412	0.9412	0.9412	0.9412	0.9412	(40)
HLP (average)												0.9412	(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	2.7855	(42)
Average daily hot water use (litres/day)	100.3563	(43)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	110.3919	106.3776	102.3634	98.3491	94.3349	90.3206	90.3206	94.3349	98.3491	102.3634	106.3776	110.3919	(44)
Energy conte	163.7080	143.1800	147.7490	128.8111	123.5973	106.6551	98.8316	113.4107	114.7652	133.7478	145.9962	158.5424	(45)
Energy content (annual)										Total = Sum(45)m =		1578.9946	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.5562	21.4770	22.1623	19.3217	18.5396	15.9983	14.8247	17.0116	17.2148	20.0622	21.8994	23.7814	(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													
	213.0848	187.7784	197.1258	176.5951	172.9741	154.4391	148.2084	162.7875	162.5492	183.1246	193.7802	207.9192	(62)
WWHRS	-51.2286	-45.0754	-46.0049	-37.8458	-35.1377	-28.9848	-24.5270	-29.6978	-30.5659	-37.7895	-43.7795	-49.5160	eq.(G10)
Total of WWHRS savings												-460.1529	
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													
	161.8562	142.7030	151.1209	138.7493	137.8365	125.4543	123.6814	133.0897	131.9834	145.3351	150.0007	158.4032	(64)
								Total per year (kWh/year) = Sum(64)m =				1700.2137	(64)
Heat gains from water heating, kWh/month													
	93.9343	83.2861	88.6280	81.0569	80.5976	73.6900	72.3630	77.2105	76.3866	83.9726	86.7709	92.2168	(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	167.1316	167.1316	167.1316	167.1316	167.1316	167.1316	167.1316	167.1316	167.1316	167.1316	167.1316	167.1316	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	64.7693	57.5275	46.7845	35.4189	26.4760	22.3522	24.1523	31.3941	42.1371	53.5027	62.4456	66.5694	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	395.5909	399.6959	389.3515	367.3294	339.5304	313.4033	295.9487	291.8437	302.1882	324.2103	352.0093	378.1364	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.4987	54.4987	54.4987	54.4987	54.4987	54.4987	54.4987	54.4987	54.4987	54.4987	54.4987	54.4987	(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)													
	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	(71)
Water heating gains (Table 5)													
	126.2558	123.9376	119.1236	112.5790	108.3300	102.3473	97.2620	103.7776	106.0926	112.8664	120.5152	123.9473	(72)
Total internal gains													
	696.8253	691.3703	665.4688	625.5365	584.5457	548.3119	527.5723	537.2246	560.6271	600.7886	645.1793	678.8623	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	5.4400	11.2829	0.4600	0.0000	0.7700	21.7405	(75)
Southwest	4.1400	36.7938	0.4600	0.0000	0.7700	53.9540	(79)
Northwest	0.6600	11.2829	0.4600	0.0000	0.7700	2.6376	(81)
Southwest	3.1500	36.7938	0.4300	0.0000	0.7700	38.3747	(79)

Solar gains	116.7069	206.8924	304.5874	413.4497	496.0039	506.8912	482.6737	418.8718	341.9383	234.4593	141.2625	98.9226	(83)
Total gains	813.5321	898.2627	970.0563	1038.9862	1080.5496	1055.2031	1010.2460	956.0964	902.5654	835.2480	786.4418	777.7849	(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	41.9563	41.9563	41.9563	41.9563	41.9563	41.9563	41.9563	41.9563	41.9563	41.9563	41.9563	41.9563	
alpha	3.7971	3.7971	3.7971	3.7971	3.7971	3.7971	3.7971	3.7971	3.7971	3.7971	3.7971	3.7971	
util living area													
	0.9648	0.9477	0.9144	0.8451	0.7257	0.5643	0.4224	0.4625	0.6719	0.8665	0.9456	0.9698	(86)
Tweekday	18.4682	18.7264	19.1220	19.5759	19.9193	20.0840	20.1239	20.1194	20.0287	19.6141	18.9582	18.3849	
Tweekend	20.1901	20.3068	20.4871	20.6996	20.8703	20.9625	20.9903	20.9862	20.9266	20.7132	20.4096	20.1526	
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	19.7500	19.9277	20.2085	20.5310	20.7999	20.9424	20.9850	20.9787	20.8854	20.5573	20.0781	19.6921	(87)
Th 2	20.1326	20.1326	20.1326	20.1326	20.1326	20.1326	20.1326	20.1326	20.1326	20.1326	20.1326	20.1326	(88)
util rest of house													
	0.9588	0.9390	0.9000	0.8189	0.6814	0.4991	0.3434	0.3814	0.6093	0.8382	0.9350	0.9646	(89)
Tweekday	18.4682	18.7264	19.1220	19.5759	19.9193	20.0840	20.1239	20.1194	20.0287	19.6141	18.9582	18.3849	
Tweekend	18.4682	18.7264	19.1220	19.5759	19.9193	20.0840	20.1239	20.1194	20.0287	19.6141	18.9582	18.3849	
MIT 2	18.4682	18.7264	19.1220	19.5759	19.9193	20.0840	20.1239	20.1194	20.0287	19.6141	18.9582	18.3849	(90)
Living area fraction									fLA = Living area / (4) =			0.1555	(91)
MIT	18.6676	18.9132	19.2910	19.7244	20.0563	20.2175	20.2578	20.2531	20.1620	19.7608	19.1323	18.5882	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6676	18.9132	19.2910	19.7244	20.0563	20.2175	20.2578	20.2531	20.1620	19.7608	19.1323	18.5882	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9455	0.9235	0.8832	0.8050	0.6772	0.5057	0.3550	0.3929	0.6116	0.8242	0.9195	0.9522	(94)
Useful gains	769.1916	829.5311	856.7331	836.4171	731.7643	533.6267	358.6454	375.6831	551.9875	688.3777	723.1039	740.6382	(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	1427.7163	1392.5027	1271.0507	1075.6321	830.3693	558.2171	363.4797	382.8807	602.3823	910.3125	1195.6629	1429.7700	(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	489.9424	378.3169	308.2523	172.2348	73.3621	0.0000	0.0000	0.0000	0.0000	165.1195	340.2425	512.7141	(98)

Space heating 2440.1847 (98)
Space heating per m2 (98) / (4) = 23.1122 (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 %)	264.8045 (206)
Efficiency of secondary/supplementary heating system, %	100.0000 (208)
Space heating requirement	921.5042 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	489.9424	378.3169	308.2523	172.2348	73.3621	0.0000	0.0000	0.0000	0.0000	165.1195	340.2425	512.7141	(98)
Space heating efficiency (main heating system 1)	264.8045	264.8045	264.8045	264.8045	264.8045	0.0000	0.0000	0.0000	0.0000	264.8045	264.8045	264.8045	(210)
Space heating fuel (main heating system)	185.0204	142.8665	116.4075	65.0422	27.7043	0.0000	0.0000	0.0000	0.0000	62.3553	128.4882	193.6199	(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	161.8562	142.7030	151.1209	138.7493	137.8365	125.4543	123.6814	133.0897	131.9834	145.3351	150.0007	158.4032	(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	95.0529	83.8049	88.7485	81.4830	80.9470	73.6753	72.6341	78.1593	77.5096	85.3507	88.0906	93.0251	(219)

Water heating fuel used	998.4811 (219)
Annual totals kWh/year	
Space heating fuel - main system	921.5042 (211)
Space heating fuel - secondary	0.0000 (215)
Electricity for pumps and fans:	
(MEVDecentralised, Database: total watage = 8.4890, total flow = 37.0000, SFP = 0.2294)	
mechanical ventilation fans (SFP = 0.2294)	73.8816 (230a)
Total electricity for the above, kWh/year	73.8816 (231)
Electricity for lighting (calculated in Appendix L)	457.5382 (232)
Total delivered energy for all uses	2451.4052 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	921.5042	13.1900	121.5464	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	998.4811	13.1900	131.6997	(247)
Mechanical ventilation fans	73.8816	13.1900	9.7450	(249)
Pumps and fans for heating	0.0000	0.0000	0.0000	(249)
Energy for lighting	457.5382	13.1900	60.3493	(250)
Additional standing charges			0.0000	(251)
Total energy cost			323.3403	(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] =	0.9019	(257)
SAP value	87.4190	
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	921.5042	0.5190	478.2607	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	998.4811	0.5190	518.2117	(264)
Space and water heating			996.4724	(265)
Pumps and fans	73.8816	0.5190	38.3446	(267)
Energy for lighting	457.5382	0.5190	237.4623	(268)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Total kg/year	1272.2793	(272)
CO2 emissions per m2	12.0500	(273)
EI value	88.6781	
EI rating	89	(274)
EI band	B	

Calculation of stars for heating and DHW

Main heating energy efficiency	13.19 × (1 + 0.29 × 0.00) / 2.6480 = 4.981, stars = 4
Main heating environmental impact	0.519 × (1 + 0.29 × 0.00) / 2.6480 = 0.1960, 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

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	52.7900 (1b)	x	2.3900 (2b)	=	126.1681	(1b) - (3b)
First floor	52.7900 (1c)	x	2.6100 (2c)	=	137.7819	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	105.5800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	263.9500	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							0 * 10	=	0.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =		0.0000	(8)
Pressure test			Yes	
Measured/design AP50			4.0100	
Infiltration rate			0.2005	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.1855	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.1947	0.1855	0.1855	0.1716	0.1716	0.1530	0.1576	0.1484	0.1530	0.1623	0.1623	0.1762	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			1.9800	1.0000	1.9800			(26)
Window (Uw = 1.20)			10.2400	1.1450	11.7252			(27)
French Door (Uw = 1.40)			3.1500	1.3258	4.1761			(27)
FP McCann System			52.7900	0.1100	5.8069	75.0000	3959.2500	(28a)
100mm Knauf Supafil 34	104.1000	15.3700	88.7300	0.2500	22.1825	52.8000	4684.9440	(29a)
Plane Ceiling-500mm Loft Roll	52.7900		52.7900	0.0900	4.7511	9.0000	475.1100	(30)
Total net area of external elements Aum(A, m2)			209.6800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.6218			(33)
E-WM-30			43.7000	0.0000	0.0000	45.0000	1966.5000	(32)
Timber GF			41.1600			9.0000	370.4400	(32c)
Timber FF			130.1500			9.0000	1171.3500	(32c)
Masonry GF			31.8300			39.0000	1241.3700	(32c)
Internal Floor			52.7900			12.6000	665.1540	(32d)
Internal Ceiling			52.7900			9.0000	475.1100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 15009.2280	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	142.1598	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	5.1972	(36)
Total fabric heat loss	(33) + (36) = 55.8190	(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	43.5518	43.5518	43.5518	43.5518	43.5518	43.5518	43.5518	43.5518	43.5518	43.5518	43.5518	43.5518	(38)
Heat transfer coeff	99.3708	99.3708	99.3708	99.3708	99.3708	99.3708	99.3708	99.3708	99.3708	99.3708	99.3708	99.3708	(39)
Average = Sum(39)m / 12 =												99.3708	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9412	0.9412	0.9412	0.9412	0.9412	0.9412	0.9412	0.9412	0.9412	0.9412	0.9412	0.9412	(40)
HLP (average)												0.9412	(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	2.7855	(42)
Average daily hot water use (litres/day)	100.3563	(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													
	110.3919	106.3776	102.3634	98.3491	94.3349	90.3206	90.3206	94.3349	98.3491	102.3634	106.3776	110.3919	(44)
Energy conte	163.7080	143.1800	147.7490	128.8111	123.5973	106.6551	98.8316	113.4107	114.7652	133.7478	145.9962	158.5424	(45)
Energy content (annual)										Total = Sum(45)m =		1578.9946	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.5562	21.4770	22.1623	19.3217	18.5396	15.9983	14.8247	17.0116	17.2148	20.0622	21.8994	23.7814	(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													
	213.0848	187.7784	197.1258	176.5951	172.9741	154.4391	148.2084	162.7875	162.5492	183.1246	193.7802	207.9192	(62)
WWHRS	-51.2286	-45.0754	-46.0049	-37.8458	-35.1377	-28.9848	-24.5270	-29.6978	-30.5659	-37.7895	-43.7795	-49.5160	eq.(G10)
Total of WWHRS savings												-460.1529	
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													
	161.8562	142.7030	151.1209	138.7493	137.8365	125.4543	123.6814	133.0897	131.9834	145.3351	150.0007	158.4032	(64)
								Total per year (kWh/year) = Sum(64)m =				1700.2137	(64)
Heat gains from water heating, kWh/month													
	93.9343	83.2861	88.6280	81.0569	80.5976	73.6900	72.3630	77.2105	76.3866	83.9726	86.7709	92.2168	(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	167.1316	167.1316	167.1316	167.1316	167.1316	167.1316	167.1316	167.1316	167.1316	167.1316	167.1316	167.1316	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	64.7693	57.5275	46.7845	35.4189	26.4760	22.3522	24.1523	31.3941	42.1371	53.5027	62.4456	66.5694	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	395.5909	399.6959	389.3515	367.3294	339.5304	313.4033	295.9487	291.8437	302.1882	324.2103	352.0093	378.1364	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.4987	54.4987	54.4987	54.4987	54.4987	54.4987	54.4987	54.4987	54.4987	54.4987	54.4987	54.4987	(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)													
	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	(71)
Water heating gains (Table 5)													
	126.2558	123.9376	119.1236	112.5790	108.3300	102.3473	97.2620	103.7776	106.0926	112.8664	120.5152	123.9473	(72)
Total internal gains													
	696.8253	691.3703	665.4688	625.5365	584.5457	548.3119	527.5723	537.2246	560.6271	600.7886	645.1793	678.8623	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	5.4400	12.9236	0.4600	0.0000	0.7700	24.9017	(75)
Southwest	4.1400	40.4699	0.4600	0.0000	0.7700	59.3446	(79)
Northwest	0.6600	12.9236	0.4600	0.0000	0.7700	3.0212	(81)
Southwest	3.1500	40.4699	0.4300	0.0000	0.7700	42.2087	(79)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	129.4762	207.0286	302.4995	425.5458	499.1016	546.4574	514.4946	455.4515	368.9525	250.8978	160.6488	108.6316	(83)
Total gains	826.3015	898.3989	967.9683	1051.0823	1083.6473	1094.7693	1042.0669	992.6761	929.5796	851.6864	805.8281	787.4940	(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	41.9563	41.9563	41.9563	41.9563	41.9563	41.9563	41.9563	41.9563	41.9563	41.9563	41.9563	41.9563	
alpha	3.7971	3.7971	3.7971	3.7971	3.7971	3.7971	3.7971	3.7971	3.7971	3.7971	3.7971	3.7971	
util living area													
	0.9574	0.9407	0.8999	0.8102	0.6557	0.4412	0.2936	0.3174	0.5773	0.8264	0.9300	0.9630	(86)
Tweekday	18.6453	18.8567	19.2703	19.7154	20.0146	20.1195	20.1316	20.1311	20.0878	19.7649	19.1518	18.5787	
Tweekend	20.2694	20.3655	20.5551	20.7671	20.9218	20.9872	20.9980	20.9973	20.9633	20.7868	20.4977	20.2391	
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	19.8725	20.0185	20.3134	20.6364	20.8793	20.9803	20.9970	20.9959	20.9426	20.6709	20.2157	19.8257	(87)
Th 2	20.1326	20.1326	20.1326	20.1326	20.1326	20.1326	20.1326	20.1326	20.1326	20.1326	20.1326	20.1326	(88)
util rest of house													
	0.9499	0.9305	0.8825	0.7782	0.6022	0.3694	0.2124	0.2328	0.5043	0.7898	0.9160	0.9564	(89)
Tweekday	18.6453	18.8567	19.2703	19.7154	20.0146	20.1195	20.1316	20.1311	20.0878	19.7649	19.1518	18.5787	
Tweekend	18.6453	18.8567	19.2703	19.7154	20.0146	20.1195	20.1316	20.1311	20.0878	19.7649	19.1518	18.5787	
MIT 2	18.6453	18.8567	19.2703	19.7154	20.0146	20.1195	20.1316	20.1311	20.0878	19.7649	19.1518	18.5787	(90)
Living area fraction									fLA = Living area / (4) =			0.1555	(91)
MIT	18.8361	19.0374	19.4325	19.8587	20.1491	20.2534	20.2662	20.2656	20.2207	19.9058	19.3173	18.7726	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8361	19.0374	19.4325	19.8587	20.1491	20.2534	20.2662	20.2656	20.2207	19.9058	19.3173	18.7726	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9355	0.9146	0.8660	0.7670	0.6032	0.3796	0.2250	0.2459	0.5121	0.7789	0.8998	0.9428	(94)
Useful gains	773.0176	821.6543	838.2319	806.2263	653.6904	415.5954	234.4904	244.1005	475.9934	663.4074	725.0812	742.4681	(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	1364.9707	1335.2876	1195.6802	989.6007	710.4116	422.6619	235.1293	245.0113	498.9119	825.3567	1124.6076	1358.6583	(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	440.4131	345.1616	265.9416	132.0296	42.2006	0.0000	0.0000	0.0000	0.0000	120.4903	287.6590	458.4456	(98)
Space heating												2092.3412	(98)
Space heating per m2											(98) / (4) =	19.8176	(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 %)	264.8045	(206)
Efficiency of secondary/supplementary heating system, %	100.0000	(208)
Space heating requirement	790.1456	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	440.4131	345.1616	265.9416	132.0296	42.2006	0.0000	0.0000	0.0000	0.0000	120.4903	287.6590	458.4456	(98)
Space heating efficiency (main heating system 1)	264.8045	264.8045	264.8045	264.8045	264.8045	0.0000	0.0000	0.0000	0.0000	264.8045	264.8045	264.8045	(210)
Space heating fuel (main heating system)	166.3163	130.3458	100.4294	49.8593	15.9365	0.0000	0.0000	0.0000	0.0000	45.5016	108.6307	173.1260	(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	161.8562	142.7030	151.1209	138.7493	137.8365	125.4543	123.6814	133.0897	131.9834	145.3351	150.0007	158.4032	(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	95.0529	83.8049	88.7485	81.4830	80.9470	73.6753	72.6341	78.1593	77.5096	85.3507	88.0906	93.0251	(219)
Water heating fuel used												998.4811	(219)

Annual totals kWh/year

Space heating fuel - main system	790.1456	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
(MEVDecentralised, Database: total watage = 8.4890, total flow = 37.0000, SFP = 0.2294)		
mechanical ventilation fans (SFP = 0.2294)	73.8816	(230a)
Total electricity for the above, kWh/year	73.8816	(231)
Electricity for lighting (calculated in Appendix L)	457.5382	(232)
Total delivered energy for all uses	2320.0466	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	790.1456	16.9600	134.0087	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	998.4811	16.9600	169.3424	(247)
Mechanical ventilation fans	73.8816	16.9600	12.5303	(249)
Pumps and fans for heating	0.0000	0.0000	0.0000	(249)
Energy for lighting	457.5382	16.9600	77.5985	(250)
Additional standing charges			0.0000	(251)
Total energy cost			393.4799	(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	790.1456	0.5190	410.0856	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	998.4811	0.5190	518.2117	(264)
Space and water heating			928.2973	(265)
Pumps and fans	73.8816	0.5190	38.3446	(267)
Energy for lighting	457.5382	0.5190	237.4623	(268)
Total kg/year			1204.1042	(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	790.1456	3.0700	2425.7471	(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)	998.4811	3.0700	3065.3371 (264)
Space and water heating			5491.0842 (265)
Pumps and fans	73.8816	3.0700	226.8165 (267)
Energy for lighting	457.5382	3.0700	1404.6422 (268)
Primary energy kWh/year			7122.5430 (272)
Primary energy kWh/m2/year			67.4611 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 87
Current environmental impact rating: B 89

(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	+ 2.0	-£ 68	-207 kg (17.2%)
U Solar photovoltaic panels	+ 8.9	-£ 309	-947 kg (95.0%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£68	1.96 kg/m²	B 89	B 90
Solar photovoltaic panels	£309	8.97 kg/m²	A 98	A 98
Total Savings	£377	10.93 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	£393	£326	£68
Space heating	£147	£147	-£0
Water heating	£169	£101	£68
Lighting	£78	£78	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£393	£17	£377
Total cost of uses	£394	£17	£377
Delivered energy	22 kWh/m²	1 kWh/m²	21 kWh/m²
Carbon dioxide emissions	1.2 tonnes	0.1 tonnes	1.2 tonnes
CO2 emissions per m²	11 kg/m²	0 kg/m²	11 kg/m²
Primary energy	67 kWh/m²	3 kWh/m²	65 kWh/m²

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	52.7900 (1b)	x	2.3900 (2b)	=	126.1681	(1b) - (3b)
First floor	52.7900 (1c)	x	2.6100 (2c)	=	137.7819	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	105.5800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		263.9500	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							0 * 10 =		0.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =	0.0000	(8)
Pressure test		Yes	
Measured/design AP50		4.0100	
Infiltration rate		0.2005	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.1855	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.2365	0.2318	0.2272	0.2040	0.1994	0.1762	0.1762	0.1716	0.1855	0.1994	0.2086	0.2179	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			1.9800	1.0000	1.9800			(26)
Window (Uw = 1.20)			10.2400	1.1450	11.7252			(27)
French Door (Uw = 1.40)			3.1500	1.3258	4.1761			(27)
FP McCann System			52.7900	0.1100	5.8069	75.0000	3959.2500	(28a)
100mm Knauf Supafil 34	104.1000	15.3700	88.7300	0.2500	22.1825	52.8000	4684.9440	(29a)
Plane Ceiling-500mm Loft Roll	52.7900		52.7900	0.0900	4.7511	9.0000	475.1100	(30)
Total net area of external elements Aum(A, m2)			209.6800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.6218			(33)
E-WM-30			43.7000	0.0000	0.0000	45.0000	1966.5000	(32)
Timber GF			41.1600			9.0000	370.4400	(32c)
Timber FF			130.1500			9.0000	1171.3500	(32c)
Masonry GF			31.8300			39.0000	1241.3700	(32c)
Internal Floor			52.7900			12.6000	665.1540	(32d)
Internal Ceiling			52.7900			9.0000	475.1100	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		15009.2280	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							142.1598	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							5.1972	(36)
Total fabric heat loss					(33) + (36) =		55.8190	(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	43.5518	43.5518	43.5518	43.5518	43.5518	43.5518	43.5518	43.5518	43.5518	43.5518	43.5518	43.5518	(38)
Heat transfer coeff	99.3708	99.3708	99.3708	99.3708	99.3708	99.3708	99.3708	99.3708	99.3708	99.3708	99.3708	99.3708	(39)
Average = Sum(39)m / 12 =												99.3708	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9412	0.9412	0.9412	0.9412	0.9412	0.9412	0.9412	0.9412	0.9412	0.9412	0.9412	0.9412	(40)
HLP (average)												0.9412	(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	2.7855	(42)
Average daily hot water use (litres/day)	100.3563	(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													
	110.3919	106.3776	102.3634	98.3491	94.3349	90.3206	90.3206	94.3349	98.3491	102.3634	106.3776	110.3919	(44)
Energy conte	163.7080	143.1800	147.7490	128.8111	123.5973	106.6551	98.8316	113.4107	114.7652	133.7478	145.9962	158.5424	(45)
Energy content (annual)										Total = Sum(45)m =		1578.9946	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.5562	21.4770	22.1623	19.3217	18.5396	15.9983	14.8247	17.0116	17.2148	20.0622	21.8994	23.7814	(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													
	213.0848	187.7784	195.7300	169.8415	160.1798	141.8324	135.1815	150.6911	157.1464	181.7289	193.7802	207.9192	(62)
WWHRS	-51.2286	-45.0754	-46.0049	-37.8458	-35.1377	-28.9848	-24.5270	-29.6978	-30.5659	-37.7895	-43.7795	-49.5160	eq.(G10)
Total of WWHRS savings												-460.1529	
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												1.6210	(H8)
Utilisation factor												0.4604	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												100.3563	(H14)
Volume ratio Veff/V												0.7473	(H15)
Solar storage volume factor												0.9418	(H16)
Solar input												-691.4210	(H17)
Solar input	-20.0498	-33.4574	-56.9818	-76.3668	-94.3448	-92.7559	-91.5301	-79.9703	-62.6328	-42.7708	-23.7820	-16.7783	(63)
								Solar input (sum of months) = Sum(63)m =				-691.4210	(63)
Output from w/h													
	141.8063	109.2456	92.7433	55.6289	30.6974	20.0917	19.1243	41.0229	63.9477	101.1686	126.2187	141.6249	(64)
								Total per year (kWh/year) = Sum(64)m =				943.3203	(64)
Heat gains from water heating, kWh/month													
	93.9343	83.2861	87.5114	75.6540	70.3621	63.6046	61.9414	67.5334	72.0643	82.8560	86.7709	92.2168	(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	167.1316	167.1316	167.1316	167.1316	167.1316	167.1316	167.1316	167.1316	167.1316	167.1316	167.1316	167.1316	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	64.7693	57.5275	46.7845	35.4189	26.4760	22.3522	24.1523	31.3941	42.1371	53.5027	62.4456	66.5694	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	395.5909	399.6959	389.3515	367.3294	339.5304	313.4033	295.9487	291.8437	302.1882	324.2103	352.0093	378.1364	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.4987	54.4987	54.4987	54.4987	54.4987	54.4987	54.4987	54.4987	54.4987	54.4987	54.4987	54.4987	(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)													
	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	(71)
Water heating gains (Table 5)													
	126.2558	123.9376	117.6228	105.0750	94.5727	88.3398	83.2546	90.7706	100.0894	111.3656	120.5152	123.9473	(72)
Total internal gains													
	696.8253	691.3703	663.9680	618.0325	570.7883	534.3044	513.5648	524.2177	554.6239	599.2878	645.1793	678.8623	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	5.4400	11.2829	0.4600	0.0000	0.7700	21.7405	(75)
Southwest	4.1400	36.7938	0.4600	0.0000	0.7700	53.9540	(79)
Northwest	0.6600	11.2829	0.4600	0.0000	0.7700	2.6376	(81)
Southwest	3.1500	36.7938	0.4300	0.0000	0.7700	38.3747	(79)

Solar gains	116.7069	206.8924	304.5874	413.4497	496.0039	506.8912	482.6737	418.8718	341.9383	234.4593	141.2625	98.9226	(83)
Total gains	813.5321	898.2627	968.5555	1031.4822	1066.7922	1041.1956	996.2386	943.0894	896.5622	833.7472	786.4418	777.7849	(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	41.9563	41.9563	41.9563	41.9563	41.9563	41.9563	41.9563	41.9563	41.9563	41.9563	41.9563	41.9563	
alpha	3.7971	3.7971	3.7971	3.7971	3.7971	3.7971	3.7971	3.7971	3.7971	3.7971	3.7971	3.7971	
util living area													
	0.9648	0.9477	0.9148	0.8475	0.7313	0.5704	0.4279	0.4682	0.6750	0.8670	0.9456	0.9698	(86)
Tweekday	18.4682	18.7264	19.1200	19.5687	19.9128	20.0821	20.1235	20.1188	20.0269	19.6125	18.9582	18.3849	

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Tweekend	20.1901	20.3068	20.4862	20.6961	20.8667	20.9611	20.9898	20.9856	20.9255	20.7124	20.4096	20.1526	
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	19.7500	19.9277	20.2070	20.5254	20.7942	20.9402	20.9843	20.9778	20.8836	20.5561	20.0781	19.6921	(87)
Th 2	20.1326	20.1326	20.1326	20.1326	20.1326	20.1326	20.1326	20.1326	20.1326	20.1326	20.1326	20.1326	(88)
util rest of house	0.9588	0.9390	0.9003	0.8216	0.6873	0.5049	0.3480	0.3863	0.6124	0.8388	0.9350	0.9646	(89)
Tweekday	18.4682	18.7264	19.1200	19.5687	19.9128	20.0821	20.1235	20.1188	20.0269	19.6125	18.9582	18.3849	
Tweekend	18.4682	18.7264	19.1200	19.5687	19.9128	20.0821	20.1235	20.1188	20.0269	19.6125	18.9582	18.3849	
MIT 2	18.4682	18.7264	19.1200	19.5687	19.9128	20.0821	20.1235	20.1188	20.0269	19.6125	18.9582	18.3849	(90)
Living area fraction									fLA = Living area / (4) =			0.1555	(91)
MIT	18.6676	18.9132	19.2890	19.7175	20.0499	20.2155	20.2574	20.2524	20.1601	19.7593	19.1323	18.5882	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6676	18.9132	19.2890	19.7175	20.0499	20.2155	20.2574	20.2524	20.1601	19.7593	19.1323	18.5882	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9455	0.9235	0.8836	0.8076	0.6828	0.5114	0.3597	0.3980	0.6146	0.8247	0.9195	0.9522	(94)
Useful gains	769.1916	829.5311	855.7828	832.9757	728.3661	532.4933	358.3778	375.3037	550.9830	687.6329	723.1039	740.6382	(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	1427.7163	1392.5027	1270.8554	1074.9461	829.7367	558.0216	363.4349	382.8170	602.2014	910.1632	1195.6629	1429.7700	(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	489.9424	378.3169	308.8141	174.2186	75.4197	0.0000	0.0000	0.0000	0.0000	165.5625	340.2425	512.7141	(98)
Space heating												2445.2308	(98)
Space heating per m2											(98) / (4) =	23.1600	(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 %)	264.8045	(206)
Efficiency of secondary/supplementary heating system, %	100.0000	(208)
Space heating requirement	923.4098	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	489.9424	378.3169	308.8141	174.2186	75.4197	0.0000	0.0000	0.0000	0.0000	165.5625	340.2425	512.7141	(98)
Space heating efficiency (main heating system 1)	264.8045	264.8045	264.8045	264.8045	264.8045	0.0000	0.0000	0.0000	0.0000	264.8045	264.8045	264.8045	(210)
Space heating fuel (main heating system)	185.0204	142.8665	116.6196	65.7914	28.4813	0.0000	0.0000	0.0000	0.0000	62.5225	128.4882	193.6199	(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	141.8063	109.2456	92.7433	55.6289	30.6974	20.0917	19.1243	41.0229	63.9477	101.1686	126.2187	141.6249	(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	83.2783	64.1564	54.4652	32.6691	18.0276	11.7992	11.2311	24.0915	37.5544	59.4131	74.1242	83.1718	(219)
Water heating fuel used												553.9818	(219)
Annual totals kWh/year													
Space heating fuel - main system												923.4098	(211)
Space heating fuel - secondary												0.0000	(215)

Electricity for pumps and fans:
(MEVDecentralised, Database: total watage = 8.4890, total flow = 37.0000, SFP = 0.2294)

mechanical ventilation fans (SFP = 0.2294)	73.8816	(230a)
pump for solar water heating	50.0000	(230g)
Total electricity for the above, kWh/year	123.8816	(231)
Electricity for lighting (calculated in Appendix L)	457.5382	(232)

Energy saving/generation technologies (Appendices M ,N and Q)

PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =	-1727.2394	-1727.2394	(233)
Total delivered energy for all uses		331.5721	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	923.4098	13.1900	121.7978	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	553.9818	13.1900	73.0702	(247)
Mechanical ventilation fans	73.8816	13.1900	9.7450	(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	457.5382	13.1900	60.3493	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)

Total energy cost		43.7344	(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] =	0.1220	(257)
SAP value		98.2983	
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	923.4098	0.5190	479.2497	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	553.9818	0.5190	287.5166	(264)
Space and water heating			766.7663	(265)
Pumps and fans	123.8816	0.5190	64.2946	(267)
Energy for lighting	457.5382	0.5190	237.4623	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			172.0859	(272)
CO2 emissions per m2			1.6300	(273)
EI value			98.4686	
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	52.7900 (1b)	x	2.3900 (2b)	=	126.1681	(1b) - (3b)
First floor	52.7900 (1c)	x	2.6100 (2c)	=	137.7819	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	105.5800					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	263.9500	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							0 * 10	=	0.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000 / (5) =		0.0000	(8)
Pressure test			Yes	
Measured/design AP50			4.0100	
Infiltration rate			0.2005	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.1855	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.1947	0.1855	0.1855	0.1716	0.1716	0.1530	0.1576	0.1484	0.1530	0.1623	0.1623	0.1762	(22b)

Mechanical extract ventilation - decentralised
If mechanical ventilation: 0.5000 (23a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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)
Window (Uw = 1.20)			10.2400	1.1450	11.7252			(27)
French Door (Uw = 1.40)			3.1500	1.3258	4.1761			(27)
FP McCann System			52.7900	0.1100	5.8069	75.0000	3959.2500	(28a)
100mm Knauf Supafil 34	104.1000	15.3700	88.7300	0.2500	22.1825	52.8000	4684.9440	(29a)
Plane Ceiling-500mm Loft Roll	52.7900		52.7900	0.0900	4.7511	9.0000	475.1100	(30)
Total net area of external elements Aum(A, m2)			209.6800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	50.6218			(33)
E-WM-30			43.7000	0.0000	0.0000	45.0000	1966.5000	(32)
Timber GF			41.1600			9.0000	370.4400	(32c)
Timber FF			130.1500			9.0000	1171.3500	(32c)
Masonry GF			31.8300			39.0000	1241.3700	(32c)
Internal Floor			52.7900			12.6000	665.1540	(32d)
Internal Ceiling			52.7900			9.0000	475.1100	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 15009.2280	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	142.1598	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	5.1972	(36)
Total fabric heat loss	(33) + (36) = 55.8190	(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	43.5518	43.5518	43.5518	43.5518	43.5518	43.5518	43.5518	43.5518	43.5518	43.5518	43.5518	43.5518	(38)
Heat transfer coeff	99.3708	99.3708	99.3708	99.3708	99.3708	99.3708	99.3708	99.3708	99.3708	99.3708	99.3708	99.3708	(39)
Average = Sum(39)m / 12 =												99.3708	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9412	0.9412	0.9412	0.9412	0.9412	0.9412	0.9412	0.9412	0.9412	0.9412	0.9412	0.9412	(40)
HLP (average)												0.9412	(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	2.7855	(42)
Average daily hot water use (litres/day)	100.3563	(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													
	110.3919	106.3776	102.3634	98.3491	94.3349	90.3206	90.3206	94.3349	98.3491	102.3634	106.3776	110.3919	(44)
Energy conte	163.7080	143.1800	147.7490	128.8111	123.5973	106.6551	98.8316	113.4107	114.7652	133.7478	145.9962	158.5424	(45)
Energy content (annual)										Total = Sum(45)m =		1578.9946	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.5562	21.4770	22.1623	19.3217	18.5396	15.9983	14.8247	17.0116	17.2148	20.0622	21.8994	23.7814	(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													
	213.0848	187.7784	195.7300	169.8415	160.1798	141.8324	135.1815	150.6911	157.1464	181.7289	193.7802	207.9192	(62)
WWHRS	-51.2286	-45.0754	-46.0049	-37.8458	-35.1377	-28.9848	-24.5270	-29.6978	-30.5659	-37.7895	-43.7795	-49.5160	eq.(G10)
Total of WWHRS savings												-460.1529	
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												1.7119	(H8)
Utilisation factor												0.4424	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												100.3563	(H14)
Volume ratio Veff/V												0.7473	(H15)
Solar storage volume factor												0.9418	(H16)
Solar input												-701.7009	(H17)
Solar input	-21.5980	-32.4618	-54.6697	-75.5703	-91.0120	-95.7862	-93.4862	-83.4837	-65.1593	-44.3267	-26.2529	-17.8941	(63)
								Solar input (sum of months) = Sum(63)m =				-701.7009	(63)
Output from w/h													
	140.2582	110.2412	95.0554	56.4255	34.0301	17.0614	17.1683	37.5096	61.4212	99.6127	123.7477	140.5091	(64)
								Total per year (kWh/year) = Sum(64)m =				933.0404	(64)
Heat gains from water heating, kWh/month													
	93.9343	83.2861	87.5114	75.6540	70.3621	63.6046	61.9414	67.5334	72.0643	82.8560	86.7709	92.2168	(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	167.1316	167.1316	167.1316	167.1316	167.1316	167.1316	167.1316	167.1316	167.1316	167.1316	167.1316	167.1316	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	64.7693	57.5275	46.7845	35.4189	26.4760	22.3522	24.1523	31.3941	42.1371	53.5027	62.4456	66.5694	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	395.5909	399.6959	389.3515	367.3294	339.5304	313.4033	295.9487	291.8437	302.1882	324.2103	352.0093	378.1364	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.4987	54.4987	54.4987	54.4987	54.4987	54.4987	54.4987	54.4987	54.4987	54.4987	54.4987	54.4987	(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)													
	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	-111.4211	(71)
Water heating gains (Table 5)													
	126.2558	123.9376	117.6228	105.0750	94.5727	88.3398	83.2546	90.7706	100.0894	111.3656	120.5152	123.9473	(72)
Total internal gains													
	696.8253	691.3703	663.9680	618.0325	570.7883	534.3044	513.5648	524.2177	554.6239	599.2878	645.1793	678.8623	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	5.4400	12.9236	0.4600	0.0000	0.7700	24.9017	(75)
Southwest	4.1400	40.4699	0.4600	0.0000	0.7700	59.3446	(79)
Northwest	0.6600	12.9236	0.4600	0.0000	0.7700	3.0212	(81)
Southwest	3.1500	40.4699	0.4300	0.0000	0.7700	42.2087	(79)

Solar gains	129.4762	207.0286	302.4995	425.5458	499.1016	546.4574	514.4946	455.4515	368.9525	250.8978	160.6488	108.6316	(83)
Total gains	826.3015	898.3989	966.4675	1043.5783	1069.8899	1080.7618	1028.0594	979.6692	923.5764	850.1856	805.8281	787.4940	(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	41.9563	41.9563	41.9563	41.9563	41.9563	41.9563	41.9563	41.9563	41.9563	41.9563	41.9563	41.9563	
alpha	3.7971	3.7971	3.7971	3.7971	3.7971	3.7971	3.7971	3.7971	3.7971	3.7971	3.7971	3.7971	
util living area													
	0.9574	0.9407	0.9003	0.8129	0.6616	0.4464	0.2975	0.3215	0.5803	0.8271	0.9300	0.9630	(86)
Tweekday	18.6453	18.8567	19.2684	19.7096	20.0106	20.1189	20.1315	20.1311	20.0869	19.7637	19.1518	18.5787	

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

Tweekend	20.2694	20.3655	20.5542	20.7641	20.9194	20.9867	20.9979	20.9972	20.9626	20.7861	20.4977	20.2391	
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	19.8725	20.0185	20.3120	20.6317	20.8755	20.9795	20.9968	20.9957	20.9416	20.6699	20.2157	19.8257	(87)
Th 2	20.1326	20.1326	20.1326	20.1326	20.1326	20.1326	20.1326	20.1326	20.1326	20.1326	20.1326	20.1326	(88)
util rest of house	0.9499	0.9305	0.8829	0.7811	0.6081	0.3739	0.2153	0.2358	0.5071	0.7905	0.9160	0.9564	(89)
Tweekday	18.6453	18.8567	19.2684	19.7096	20.0106	20.1189	20.1315	20.1311	20.0869	19.7637	19.1518	18.5787	
Tweekend	18.6453	18.8567	19.2684	19.7096	20.0106	20.1189	20.1315	20.1311	20.0869	19.7637	19.1518	18.5787	
MIT 2	18.6453	18.8567	19.2684	19.7096	20.0106	20.1189	20.1315	20.1311	20.0869	19.7637	19.1518	18.5787	(90)
Living area fraction									fLA = Living area / (4) =			0.1555	(91)
MIT	18.8361	19.0374	19.4307	19.8530	20.1451	20.2528	20.2661	20.2655	20.2198	19.9046	19.3173	18.7726	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8361	19.0374	19.4307	19.8530	20.1451	20.2528	20.2661	20.2655	20.2198	19.9046	19.3173	18.7726	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9355	0.9146	0.8664	0.7698	0.6089	0.3842	0.2281	0.2491	0.5148	0.7796	0.8998	0.9428	(94)
Useful gains	773.0176	821.6543	837.3452	803.3289	651.4867	415.2421	234.4530	244.0492	475.4887	662.7982	725.0812	742.4681	(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	1364.9707	1335.2876	1195.4991	989.0344	710.0160	422.6028	235.1229	245.0025	498.8245	825.2373	1124.6076	1358.6583	(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	440.4131	345.1616	266.4665	133.7079	43.5458	0.0000	0.0000	0.0000	0.0000	120.8547	287.6590	458.4456	(98)
Space heating												2096.2541	(98)
Space heating per m2											(98) / (4) =	19.8547	(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 %)	264.8045	(206)
Efficiency of secondary/supplementary heating system, %	100.0000	(208)
Space heating requirement	791.6233	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	440.4131	345.1616	266.4665	133.7079	43.5458	0.0000	0.0000	0.0000	0.0000	120.8547	287.6590	458.4456	(98)
Space heating efficiency (main heating system 1)	264.8045	264.8045	264.8045	264.8045	264.8045	0.0000	0.0000	0.0000	0.0000	264.8045	264.8045	264.8045	(210)
Space heating fuel (main heating system)	166.3163	130.3458	100.6276	50.4931	16.4445	0.0000	0.0000	0.0000	0.0000	45.6392	108.6307	173.1260	(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	140.2582	110.2412	95.0554	56.4255	34.0301	17.0614	17.1683	37.5096	61.4212	99.6127	123.7477	140.5091	(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	82.3691	64.7411	55.8230	33.1369	19.9848	10.0196	10.0824	22.0282	36.0707	58.4994	72.6731	82.5165	(219)
Water heating fuel used												547.9448	(219)
Annual totals kWh/year													
Space heating fuel - main system												791.6233	(211)
Space heating fuel - secondary												0.0000	(215)

Electricity for pumps and fans:
(MEVDecentralised, Database: total watage = 8.4890, total flow = 37.0000, SFP = 0.2294)

mechanical ventilation fans (SFP = 0.2294)	73.8816	(230a)
pump for solar water heating	50.0000	(230g)
Total electricity for the above, kWh/year	123.8816	(231)
Electricity for lighting (calculated in Appendix L)	457.5382	(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		96.8283	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	791.6233	16.9600	134.2593	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	547.9448	16.9600	92.9314	(247)
Mechanical ventilation fans	73.8816	16.9600	12.5303	(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	457.5382	16.9600	77.5985	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	16.9600	-309.3775	(252)

Total energy cost 16.4221 (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	791.6233	0.5190	410.8525	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	547.9448	0.5190	284.3833	(264)
Space and water heating			695.2358	(265)
Pumps and fans	123.8816	0.5190	64.2946	(267)
Energy for lighting	457.5382	0.5190	237.4623	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	0.5190	-946.7389	(269)
Total kg/year			50.2539	(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	791.6233	3.0700	2430.2835	(261)
Space heating - secondary	0.0000	3.0700	0.0000	(263)
Water heating (other fuel)	547.9448	3.0700	1682.1905	(264)
Space and water heating			4112.4741	(265)
Pumps and fans	123.8816	3.0700	380.3165	(267)
Energy for lighting	457.5382	3.0700	1404.6422	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			297.2627	(272)
Primary energy kWh/m2/year			2.8155	(273)

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

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	North East
Overshading	Average or unknown
Thermal mass parameter	142.2 (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	348.41	(P1)
Transmission heat loss coefficient	55.82	(37)
Summer heat loss coefficient	404.23	(P2)

Overhangs

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

Solar shading

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

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	5.4400	98.8453	0.4600	0.0000	0.9000	222.6154
South West	4.1400	119.9223	0.4600	0.0000	0.9000	205.5421
North West	0.6600	98.8453	0.4600	0.0000	0.9000	27.0085
South West	3.1500	119.9223	0.4300	0.0000	0.9000	146.1913
total:						601.3573

	Jun	Jul	Aug	
Solar gains	639	601	532	(P3/P4)
Internal gains	548	528	537	
Total summer gains	1187	1129	1070	(P5)
Summer gain/loss ratio	2.94	2.79	2.65	(P6)

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Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 142.2)	1.00	1.00	1.00	
Threshold temperature	19.94	21.70	21.45	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight