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

AES Sustainability Consultants

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

SAP Rating	87 B	**DER**	15.46	**TER**	26.41
Environmental	88 B	**% DER<TER**	41.45		
CO_2 Emissions (t/year)	1.06	**DFEE**	39.52	**TFEE**	51.07
General Requirements Compliance	Pass	**% DFEE<TFEE**	22.62		

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 80 m²

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

1a TER and DER
Fuel for main heating:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 26.41 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 15.46 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)51.1 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)39.5 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.11 (max. 0.25)	0.11 (max. 0.70)	OK
Roof	0.09 (max. 0.20)	0.09 (max. 0.35)	OK
Openings	1.22 (max. 2.00)	1.40 (max. 3.30)	OK

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

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3 Air permeability
Air permeability at 50 pascals: 4.01 (design value)
Maximum 10.0 OK

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

Secondary heating system: None

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

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

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

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

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8 Mechanical ventilation
Continuous extract system (decentralised)
Specific fan power: 0.1700 0.1800
Maximum 0.7 OK

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9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North: 7.23 m², No overhang
Windows facing South: 4.33 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	40.0200 (1b)	x	2.3100 (2b)	=	92.4462	(1b) - (3b)
First floor	40.0200 (1c)	x	2.6100 (2c)	=	104.4522	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 80.0400						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	196.8984	(5)

2. Ventilation rate

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

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

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

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1500	1.0000	2.1500			(26)
Window (Uw = 1.20)			8.2300	1.1450	9.4237			(27)
French Door (Uw = 1.40)			3.3300	1.3258	4.4148			(27)
FP McCann System			40.0200	0.1100	4.4022	75.0000	3001.5000	(28a)
100mm Knauf Supafil 34	88.4600	13.7100	74.7500	0.2500	18.6875	52.8000	3946.8000	(29a)
Plane Ceiling-500mm Loft Roll	40.0200		40.0200	0.0900	3.6018	9.0000	360.1800	(30)
Total net area of external elements Aum(A, m2)			168.5000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	42.6799			(33)
E-WM-30			39.9000	0.0000	0.0000	45.0000	1795.5000	(32)
Timber GF			20.5700			9.0000	185.1300	(32c)
Timber 1F			76.2500			9.0000	686.2500	(32c)
AAC GF			49.2000			39.0000	1918.8000	(32c)
Internal Floor			40.0200			12.6000	504.2520	(32d)
Internal Ceiling			40.0200			9.0000	360.1800	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 12758.5920	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	159.4027	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	4.2388	(36)
Total fabric heat loss	(33) + (36) = 46.9187	(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	32.4882	32.4882	32.4882	32.4882	32.4882	32.4882	32.4882	32.4882	32.4882	32.4882	32.4882	32.4882	(38)
Heat transfer coeff	79.4070	79.4070	79.4070	79.4070	79.4070	79.4070	79.4070	79.4070	79.4070	79.4070	79.4070	79.4070	(39)
Average = Sum(39)m / 12 =												79.4070	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9921	0.9921	0.9921	0.9921	0.9921	0.9921	0.9921	0.9921	0.9921	0.9921	0.9921	0.9921	(40)
HLP (average)												0.9921	(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	2.4636	(42)
Average daily hot water use (litres/day)	92.7110	(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													
	101.9821	98.2736	94.5652	90.8567	87.1483	83.4399	83.4399	87.1483	90.8567	94.5652	98.2736	101.9821	(44)
Energy conte	151.2365	132.2724	136.4932	118.9981	114.1815	98.5300	91.3025	104.7710	106.0223	123.5587	134.8740	146.4644	(45)
Energy content (annual)										Total = Sum(45)m =		1458.7045	(45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6855	19.8409	20.4740	17.8497	17.1272	14.7795	13.6954	15.7156	15.9033	18.5338	20.2311	21.9697	(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													
	200.6133	176.8708	185.8700	166.7821	163.5583	146.3140	140.6793	154.1478	153.8063	172.9355	182.6580	195.8412	(62)
WWHRS	-49.5541	-43.5996	-44.5000	-36.6247	-34.0127	-28.0630	-23.7583	-28.7632	-29.5989	-36.5818	-42.3638	-47.8937	eq.(G10)
Total of WWHRS savings												-445.3138	
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													
	151.0591	133.2712	141.3701	130.1574	129.5456	118.2510	116.9210	125.3846	124.2074	136.3537	140.2942	147.9475	(64)
								Total per year (kWh/year) = Sum(64)m =				1594.7627	(64)
Heat gains from water heating, kWh/month													
	89.7876	79.6593	84.8854	77.7941	77.4668	70.9884	69.8595	74.3378	73.4796	80.5847	83.0728	88.2009	(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	123.1810	123.1810	123.1810	123.1810	123.1810	123.1810	123.1810	123.1810	123.1810	123.1810	123.1810	123.1810	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.8550	18.5232	15.0641	11.4045	8.5250	7.1972	7.7768	10.1085	13.5677	17.2273	20.1068	21.4346	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	219.5241	221.8021	216.0617	203.8410	188.4146	173.9160	164.2300	161.9520	167.6924	179.9131	195.3395	209.8381	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3181	35.3181	35.3181	35.3181	35.3181	35.3181	35.3181	35.3181	35.3181	35.3181	35.3181	35.3181	(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)													
	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	(71)
Water heating gains (Table 5)													
	120.6822	118.5406	114.0933	108.0473	104.1220	98.5950	93.8972	99.9164	102.0550	108.3128	115.3789	118.5495	(72)
Total internal gains													
	421.0156	418.8202	405.1734	383.2471	361.0159	339.6624	325.8582	331.9312	343.2694	365.4074	390.7795	409.7766	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	3.9000	10.6334	0.4600	0.0000	0.7700	14.6888	(74)
South	4.3300	46.7521	0.4600	0.0000	0.7700	71.7030	(78)
North	3.3300	10.6334	0.4300	0.0000	0.7700	11.7240	(74)

Solar gains	98.1157	167.9071	235.3575	306.8356	361.7658	368.2247	351.1487	308.0398	259.3853	186.7456	117.5760	83.9769	(83)
Total gains	519.1313	586.7273	640.5309	690.0827	722.7817	707.8872	677.0070	639.9710	602.6547	552.1530	508.3555	493.7535	(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	44.6315	44.6315	44.6315	44.6315	44.6315	44.6315	44.6315	44.6315	44.6315	44.6315	44.6315	44.6315	
alpha	3.9754	3.9754	3.9754	3.9754	3.9754	3.9754	3.9754	3.9754	3.9754	3.9754	3.9754	3.9754	
util living area													
	0.9852	0.9750	0.9544	0.9064	0.8075	0.6508	0.4974	0.5427	0.7593	0.9227	0.9747	0.9878	(86)
Tweekday	18.2228	18.4909	18.9004	19.3939	19.8060	20.0227	20.0780	20.0717	19.9480	19.4478	18.7370	18.1441	
Tweekend	20.0976	20.2175	20.4017	20.6285	20.8285	20.9473	20.9860	20.9801	20.9000	20.6495	20.3262	20.0625	
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	19.6073	19.7896	20.0767	20.4199	20.7353	20.9191	20.9784	20.9693	20.8438	20.4591	19.9479	19.5531	(87)
Th 2	20.0899	20.0899	20.0899	20.0899	20.0899	20.0899	20.0899	20.0899	20.0899	20.0899	20.0899	20.0899	(88)
util rest of house													
	0.9822	0.9699	0.9448	0.8858	0.7652	0.5780	0.4023	0.4465	0.6954	0.9014	0.9686	0.9853	(89)
Tweekday	18.2228	18.4909	18.9004	19.3939	19.8060	20.0227	20.0780	20.0717	19.9480	19.4478	18.7370	18.1441	
Tweekend	18.2228	18.4909	18.9004	19.3939	19.8060	20.0227	20.0780	20.0717	19.9480	19.4478	18.7370	18.1441	
MIT 2	18.2228	18.4909	18.9004	19.3939	19.8060	20.0227	20.0780	20.0717	19.9480	19.4478	18.7370	18.1441	(90)
Living area fraction									fLA = Living area / (4) =			0.1685	(91)
MIT	18.4561	18.7098	19.0986	19.5669	19.9626	20.1738	20.2297	20.2230	20.0990	19.6182	18.9411	18.3816	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4561	18.7098	19.0986	19.5669	19.9626	20.1738	20.2297	20.2230	20.0990	19.6182	18.9411	18.3816	(93)

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8. Space heating requirement

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9745	0.9595	0.9314	0.8717	0.7586	0.5851	0.4174	0.4612	0.6961	0.8878	0.9582	0.9785	(94)
Useful gains	505.8958	562.9664	596.6040	601.5130	548.3186	414.2128	282.5937	295.1362	419.5293	490.1910	487.1033	483.1210	(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	1124.0965	1096.5940	1000.4190	847.0229	656.1094	442.5991	288.2271	303.5708	476.3626	716.1098	940.2626	1126.1179	(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	459.9413	358.5977	300.4383	176.7671	80.1963	0.0000	0.0000	0.0000	0.0000	168.0836	326.2747	478.3897	(98)
Space heating												2348.6888	(98)
Space heating per m2											(98) / (4) =	29.3439	(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 %)	229.3004	(206)
Efficiency of secondary/supplementary heating system, %	100.0000	(208)
Space heating requirement	1024.2845	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	459.9413	358.5977	300.4383	176.7671	80.1963	0.0000	0.0000	0.0000	0.0000	168.0836	326.2747	478.3897	(98)
Space heating efficiency (main heating system 1)	229.3004	229.3004	229.3004	229.3004	229.3004	0.0000	0.0000	0.0000	0.0000	229.3004	229.3004	229.3004	(210)
Space heating fuel (main heating system)	200.5846	156.3877	131.0239	77.0898	34.9744	0.0000	0.0000	0.0000	0.0000	73.3028	142.2913	208.6301	(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	151.0591	133.2712	141.3701	130.1574	129.5456	118.2510	116.9210	125.3846	124.2074	136.3537	140.2942	147.9475	(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	88.7122	78.2659	83.0221	76.4373	76.0780	69.4450	68.6640	73.6343	72.9430	80.0762	82.3903	86.8848	(219)
Water heating fuel used												936.5532	(219)

Annual totals kWh/year

Space heating fuel - main system	1024.2845	(211)
Space heating fuel - secondary	0.0000	(215)

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

mechanical ventilation fans (SFP = 0.2282)	54.8107	(230a)
Total electricity for the above, kWh/year	54.8107	(231)
Electricity for lighting (calculated in Appendix L)	368.3056	(232)
Total delivered energy for all uses	2383.9538	(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	1024.2845	0.5190	531.6036	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	936.5532	0.5190	486.0711	(264)
Space and water heating			1017.6747	(265)
Pumps and fans	54.8107	0.5190	28.4467	(267)
Energy for lighting	368.3056	0.5190	191.1506	(268)
Total CO2, kg/year			1237.2720	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			15.4600	(273)

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

DER		15.4600	ZC1
Total Floor Area	TFA	80.0400	
Assumed number of occupants	N	2.4636	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.2525	ZC2
CO2 emissions from cooking, equation (L16)		2.2255	ZC3
Total CO2 emissions		33.9380	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		33.9380	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	40.0200 (1b)	x	2.3100 (2b)	=	92.4462	(1b) - (3b)
First floor	40.0200 (1c)	x	2.6100 (2c)	=	104.4522	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.0400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	196.8984	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =		0.1524	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.4024	(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) =		0.3722	(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	0.4745	0.4652	0.4559	0.4094	0.4001	0.3536	0.3536	0.3443	0.3722	0.4001	0.4187	0.4373	(22b)
Effective ac	0.6126	0.6082	0.6039	0.5838	0.5800	0.5625	0.5625	0.5593	0.5693	0.5800	0.5877	0.5956	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1500	1.0000	2.1500			(26)
TER Opening Type (Uw = 1.40)			11.5600	1.3258	15.3258			(27)
FP McCann System			40.0200	0.1300	5.2026			(28a)
100mm Knauf Supafil 34	88.4600	13.7100	74.7500	0.1800	13.4550			(29a)
Plane Ceiling-500mm Loft Roll	40.0200		40.0200	0.1300	5.2026			(30)
Total net area of external elements Aum(A, m2)			168.5000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	41.3360			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.7591	(36)
Total fabric heat loss					(33) + (36) =		50.0951	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.8041	39.5200	39.2416	37.9336	37.6889	36.5498	36.5498	36.3388	36.9886	37.6889	38.1840	38.7015	(38)
Heat transfer coeff	89.8992	89.6151	89.3366	88.0287	87.7840	86.6449	86.6449	86.4339	87.0836	87.7840	88.2790	88.7966	(39)
Average = Sum(39)m / 12 =												88.0275	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1232	1.1196	1.1161	1.0998	1.0968	1.0825	1.0825	1.0799	1.0880	1.0968	1.1029	1.1094	(40)
HLP (average)												1.0998	(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	2.4636	(42)
Average daily hot water use (litres/day)	92.7110	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.9821	98.2736	94.5652	90.8567	87.1483	83.4399	83.4399	87.1483	90.8567	94.5652	98.2736	101.9821	(44)
Energy conte	151.2365	132.2724	136.4932	118.9981	114.1815	98.5300	91.3025	104.7710	106.0223	123.5587	134.8740	146.4644	(45)
Energy content (annual)										Total = Sum(45)m =		1458.7045	(45)
Distribution loss (46)m = 0.15 x (45)m	22.6855	19.8409	20.4740	17.8497	17.1272	14.7795	13.6954	15.7156	15.9033	18.5338	20.2311	21.9697	(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	202.1625	178.2701	187.4193	168.2814	165.1076	147.8133	142.2286	155.6970	155.3055	174.4848	184.1573	197.3905	(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	202.1625	178.2701	187.4193	168.2814	165.1076	147.8133	142.2286	155.6970	155.3055	174.4848	184.1573	197.3905	(64)
Total per year (kWh/year) = Sum(64)m =												2058.3179	(64)
Heat gains from water heating, kWh/month	91.0270	80.7788	86.1249	78.9935	78.7062	72.1879	71.0989	75.5772	74.6790	81.8241	84.2722	89.4403	(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	123.1810	123.1810	123.1810	123.1810	123.1810	123.1810	123.1810	123.1810	123.1810	123.1810	123.1810	123.1810	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	20.8550	18.5232	15.0641	11.4045	8.5250	7.1972	7.7768	10.1085	13.5677	17.2273	20.1068	21.4346	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	219.5241	221.8021	216.0617	203.8410	188.4146	173.9160	164.2300	161.9520	167.6924	179.9131	195.3395	209.8381	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.3181	35.3181	35.3181	35.3181	35.3181	35.3181	35.3181	35.3181	35.3181	35.3181	35.3181	35.3181	(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)	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	(71)
Water heating gains (Table 5)	122.3481	120.2065	115.7592	109.7132	105.7879	100.2609	95.5631	101.5823	103.7209	109.9787	117.0448	120.2154	(72)
Total internal gains	425.6815	423.4861	409.8393	387.9130	365.6818	344.3283	330.5241	336.5971	347.9353	370.0733	395.4453	414.4425	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	7.2300	10.6334	0.6300	0.7000	0.7700	23.4954	(74)
South	4.3300	46.7521	0.6300	0.7000	0.7700	61.8672	(78)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	85.3626	146.2234	205.3644	268.4270	317.0999	323.0226	307.9367	269.7170	226.5599	162.7344	102.3183	73.0458	(83)
Total gains	511.0441	569.7095	615.2037	656.3400	682.7817	667.3509	638.4608	606.3141	574.4952	532.8078	497.7636	487.4883	(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	61.8285	62.0245	62.2179	63.1423	63.3183	64.1508	64.1508	64.3073	63.8275	63.3183	62.9632	62.5963	
alpha	5.1219	5.1350	5.1479	5.2095	5.2212	5.2767	5.2767	5.2872	5.2552	5.2212	5.1975	5.1731	
util living area	0.9974	0.9949	0.9885	0.9676	0.9041	0.7540	0.5806	0.6297	0.8584	0.9741	0.9945	0.9979	(86)
MIT	19.8308	19.9664	20.1886	20.4907	20.7641	20.9390	20.9875	20.9812	20.8721	20.5332	20.1336	19.8116	(87)
Th 2	19.9819	19.9848	19.9877	20.0010	20.0035	20.0151	20.0151	20.0173	20.0106	20.0035	19.9984	19.9932	(88)
util rest of house	0.9965	0.9931	0.9844	0.9549	0.8654	0.6665	0.4591	0.5080	0.7907	0.9614	0.9923	0.9972	(89)
MIT 2	18.4267	18.6265	18.9513	19.3931	19.7639	19.9727	20.0103	20.0092	19.9055	19.4599	18.8809	18.4068	(90)
Living area fraction									fLA = Living area / (4) =			0.1685	(91)
MIT	18.6633	18.8523	19.1598	19.5781	19.9325	20.1356	20.1750	20.1730	20.0684	19.6408	19.0920	18.6436	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6633	18.8523	19.1598	19.5781	19.9325	20.1356	20.1750	20.1730	20.0684	19.6408	19.0920	18.6436	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9947	0.9903	0.9797	0.9480	0.8621	0.6782	0.4796	0.5283	0.7953	0.9552	0.9894	0.9958	(94)
Useful gains	508.3568	564.1874	602.6969	622.1783	588.6324	452.6201	306.2097	320.3232	456.8901	508.9413	492.4934	485.4553	(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	1291.2515	1250.3361	1130.9836	939.9811	722.6814	479.6290	309.7567	326.1186	519.7519	793.6384	1058.6428	1282.5412	(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	582.4737	461.0920	393.0453	228.8180	99.7325	0.0000	0.0000	0.0000	0.0000	211.8146	407.6276	593.0319	(98)
Space heating												2977.6356	(98)
Space heating per m2											(98) / (4) =	37.2018	(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	3184.6370	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	582.4737	461.0920	393.0453	228.8180	99.7325	0.0000	0.0000	0.0000	0.0000	211.8146	407.6276	593.0319	(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)													
	622.9665	493.1465	420.3693	244.7251	106.6658	0.0000	0.0000	0.0000	0.0000	226.5397	435.9653	634.2588	(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													
	202.1625	178.2701	187.4193	168.2814	165.1076	147.8133	142.2286	155.6970	155.3055	174.4848	184.1573	197.3905	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.4779	87.2385	86.7446	85.6341	83.5185	79.8000	79.8000	79.8000	79.8000	85.3320	86.8751	87.5678	(217)
Fuel for water heating, kWh/month													
	231.1013	204.3480	216.0589	196.5122	197.6898	185.2297	178.2313	195.1091	194.6185	204.4777	211.9795	225.4145	(219)
Water heating fuel used												2440.7703	(219)

Annual totals kWh/year		
Space heating fuel - main system	3184.6370	(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)	368.3056	(232)
Total delivered energy for all uses	6068.7128	(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	3184.6370	0.2160	687.8816	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2440.7703	0.2160	527.2064	(264)
Space and water heating			1215.0880	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	368.3056	0.5190	191.1506	(268)
Total CO2, kg/m2/year			1445.1636	(272)
Emissions per m2 for space and water heating			15.1810	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			2.3882	(272b)
Emissions per m2 for pumps and fans			0.4863	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.1810 * 1.55) + 2.3882 + 0.4863, rounded to 2 d.p.			26.4100	(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	40.0200 (1b)	x	2.3100 (2b)	=	92.4462	(1b) - (3b)
First floor	40.0200 (1c)	x	2.6100 (2c)	=	104.4522	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.0400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	196.8984	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =		0.1524	(8)
Pressure test			Yes	
Measured/design AP50			4.0100	
Infiltration rate			0.3529	(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)	=	0.3264	(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	0.4162	0.4080	0.3998	0.3590	0.3509	0.3101	0.3101	0.3019	0.3264	0.3509	0.3672	0.3835	(22b)
Effective ac	0.5866	0.5832	0.5799	0.5645	0.5616	0.5481	0.5481	0.5456	0.5533	0.5616	0.5674	0.5735	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1500	1.0000	2.1500			(26)
Window (Uw = 1.20)			8.2300	1.1450	9.4237			(27)
French Door (Uw = 1.40)			3.3300	1.3258	4.4148			(27)
FP McCann System			40.0200	0.1100	4.4022	75.0000	3001.5000	(28a)
100mm Knauf Supafil 34	88.4600	13.7100	74.7500	0.2500	18.6875	52.8000	3946.8000	(29a)
Plane Ceiling-500mm Loft Roll	40.0200		40.0200	0.0900	3.6018	9.0000	360.1800	(30)
Total net area of external elements Aum(A, m2)			168.5000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	42.6799			(33)
E-WM-30			39.9000	0.0000	0.0000	45.0000	1795.5000	(32)
Timber GF			20.5700			9.0000	185.1300	(32c)
Timber 1F			76.2500			9.0000	686.2500	(32c)
AAC GF			49.2000			39.0000	1918.8000	(32c)
Internal Floor			40.0200			12.6000	504.2520	(32d)
Internal Ceiling			40.0200			9.0000	360.1800	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12758.5920	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		159.4027	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		4.2388	(36)
Total fabric heat loss	(33) + (36) =	46.9187	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	38.1148	37.8963	37.6821	36.6762	36.4880	35.6119	35.6119	35.4497	35.9494	36.4880	36.8688	37.2668	(38)
Heat transfer coeff	85.0335	84.8150	84.6009	83.5950	83.4068	82.5307	82.5307	82.3684	82.8681	83.4068	83.7875	84.1855	(39)
Average = Sum(39)m / 12 =												83.5941	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0624	1.0597	1.0570	1.0444	1.0421	1.0311	1.0311	1.0291	1.0353	1.0421	1.0468	1.0518	(40)
HLP (average)												1.0444	(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	2.4636	(42)
Average daily hot water use (litres/day)	92.7110	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.9821	98.2736	94.5652	90.8567	87.1483	83.4399	83.4399	87.1483	90.8567	94.5652	98.2736	101.9821	(44)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy conte	151.2365	132.2724	136.4932	118.9981	114.1815	98.5300	91.3025	104.7710	106.0223	123.5587	134.8740	146.4644	(45)
Energy content (annual)										Total = Sum(45)m =		1458.7045	(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													
	32.1377	28.1079	29.0048	25.2871	24.2636	20.9376	19.4018	22.2638	22.5297	26.2562	28.6607	31.1237	(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	123.1810	123.1810	123.1810	123.1810	123.1810	123.1810	123.1810	123.1810	123.1810	123.1810	123.1810	123.1810	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.8550	18.5232	15.0641	11.4045	8.5250	7.1972	7.7768	10.1085	13.5677	17.2273	20.1068	21.4346	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	219.5241	221.8021	216.0617	203.8410	188.4146	173.9160	164.2300	161.9520	167.6924	179.9131	195.3395	209.8381	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3181	35.3181	35.3181	35.3181	35.3181	35.3181	35.3181	35.3181	35.3181	35.3181	35.3181	35.3181	(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)													
	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	(71)
Water heating gains (Table 5)													
	43.1959	41.8272	38.9850	35.1210	32.6123	29.0800	26.0777	29.9245	31.2913	35.2906	39.8066	41.8329	(72)
Total internal gains													
	343.5293	342.1068	330.0650	310.3208	289.5062	270.1474	258.0387	261.9393	272.5057	292.3853	315.2071	333.0600	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	3.9000	10.6334	0.4600	0.0000	0.7700	14.6888	(74)
South	4.3300	46.7521	0.4600	0.0000	0.7700	71.7030	(78)
North	3.3300	10.6334	0.4300	0.0000	0.7700	11.7240	(74)

Solar gains	98.1157	167.9071	235.3575	306.8356	361.7658	368.2247	351.1487	308.0398	259.3853	186.7456	117.5760	83.9769	(83)
Total gains	441.6450	510.0139	565.4225	617.1563	651.2720	638.3722	609.1874	569.9791	531.8910	479.1309	432.7831	417.0369	(84)

7. Mean internal temperature (heating season)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
tau	41.6783	41.7857	41.8915	42.3955	42.4912	42.9423	42.9423	43.0268	42.7674	42.4912	42.2981	42.0981	
alpha	3.7786	3.7857	3.7928	3.8264	3.8327	3.8628	3.8628	3.8685	3.8512	3.8327	3.8199	3.8065	
util living area													
	0.9916	0.9848	0.9707	0.9352	0.8561	0.7133	0.5606	0.6115	0.8215	0.9512	0.9856	0.9932	(86)
MIT	19.3480	19.5469	19.8582	20.2659	20.6311	20.8765	20.9633	20.9485	20.7716	20.3038	19.7534	19.3131	(87)
Th 2	20.0317	20.0339	20.0361	20.0465	20.0484	20.0575	20.0575	20.0592	20.0540	20.0484	20.0445	20.0404	(88)
util rest of house													
	0.9898	0.9815	0.9639	0.9191	0.8187	0.6394	0.4548	0.5066	0.7630	0.9360	0.9818	0.9917	(89)
MIT 2	18.5168	18.7159	19.0252	19.4304	19.7726	19.9859	20.0434	20.0377	19.9057	19.4742	18.9303	18.4887	(90)
Living area fraction									fLA = Living area / (4) =			0.1685	(91)
MIT	18.6569	18.8559	19.1656	19.5712	19.9173	20.1360	20.1984	20.1912	20.0516	19.6140	19.0690	18.6276	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6569	18.8559	19.1656	19.5712	19.9173	20.1360	20.1984	20.1912	20.0516	19.6140	19.0690	18.6276	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9862	0.9761	0.9561	0.9094	0.8128	0.6461	0.4714	0.5224	0.7629	0.9272	0.9767	0.9887	(94)
Useful gains	435.5508	497.8144	540.6252	561.2648	529.3640	412.4740	287.1967	297.7308	405.7630	444.2706	422.6799	412.3288	(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													
	1220.8159	1183.6717	1071.5212	892.0596	685.3789	456.8880	296.9811	312.2768	493.2004	751.8275	1002.8558	1214.5964	(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													
	584.2372	460.8961	394.9866	238.1723	116.0751	0.0000	0.0000	0.0000	0.0000	228.8224	417.7266	596.8871	(98)
Space heating												3037.8034	(98)
Space heating per m2											(98) / (4) =	37.9536	(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												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	775.7882	610.7269	626.0000	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8241	0.8868	0.8631	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	639.2941	541.5958	540.3155	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	838.5592	802.5903	758.4795	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	143.4709	194.1799	162.3140	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												499.9648	(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	35.8677	48.5450	40.5785	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												124.9912	(107)
Space cooling per m2												1.5616	(108)
Energy for space heating												37.9536	(99)
Energy for space cooling												1.5616	(108)
Total												39.5152	(109)
Dwelling Fabric Energy Efficiency (DFEE)												39.5	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.0200 (1b)	x	2.3100 (2b)	=	92.4462	(1b) - (3b)
First floor	40.0200 (1c)	x	2.6100 (2c)	=	104.4522	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 80.0400						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	196.8984	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =		0.1524	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.4024	(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) =		0.3722	(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	0.4745	0.4652	0.4559	0.4094	0.4001	0.3536	0.3536	0.3443	0.3722	0.4001	0.4187	0.4373	(22b)
Effective ac	0.6126	0.6082	0.6039	0.5838	0.5800	0.5625	0.5625	0.5593	0.5693	0.5800	0.5877	0.5956	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1500	1.0000	2.1500			(26)
TER Opening Type (Uw = 1.40)			11.5600	1.3258	15.3258			(27)
FP McCann System			40.0200	0.1300	5.2026			(28a)
100mm Knauf Supafil 34	88.4600	13.7100	74.7500	0.1800	13.4550			(29a)
Plane Ceiling-500mm Loft Roll	40.0200		40.0200	0.1300	5.2026			(30)
Total net area of external elements Aum(A, m2)			168.5000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	41.3360			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.7591	(36)
Total fabric heat loss					(33) + (36) =		50.0951	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	39.8041	39.5200	39.2416	37.9336	37.6889	36.5498	36.5498	36.3388	36.9886	37.6889	38.1840	38.7015	(38)
Heat transfer coeff	89.8992	89.6151	89.3366	88.0287	87.7840	86.6449	86.6449	86.4339	87.0836	87.7840	88.2790	88.7966	(39)
Average = Sum(39)m / 12 =												88.0275	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1232	1.1196	1.1161	1.0998	1.0968	1.0825	1.0825	1.0799	1.0880	1.0968	1.1029	1.1094	(40)
HLP (average)												1.0998	(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	2.4636	(42)
Average daily hot water use (litres/day)	92.7110	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	101.9821	98.2736	94.5652	90.8567	87.1483	83.4399	83.4399	87.1483	90.8567	94.5652	98.2736	101.9821	(44)
Energy conte	151.2365	132.2724	136.4932	118.9981	114.1815	98.5300	91.3025	104.7710	106.0223	123.5587	134.8740	146.4644	(45)
Energy content (annual)										Total = Sum(45)m =		1458.7045	(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													
	32.1377	28.1079	29.0048	25.2871	24.2636	20.9376	19.4018	22.2638	22.5297	26.2562	28.6607	31.1237	(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	123.1810	123.1810	123.1810	123.1810	123.1810	123.1810	123.1810	123.1810	123.1810	123.1810	123.1810	123.1810	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	20.8550	18.5232	15.0641	11.4045	8.5250	7.1972	7.7768	10.1085	13.5677	17.2273	20.1068	21.4346	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	219.5241	221.8021	216.0617	203.8410	188.4146	173.9160	164.2300	161.9520	167.6924	179.9131	195.3395	209.8381	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.3181	35.3181	35.3181	35.3181	35.3181	35.3181	35.3181	35.3181	35.3181	35.3181	35.3181	35.3181	(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)													
	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	(71)
Water heating gains (Table 5)													
	43.1959	41.8272	38.9850	35.1210	32.6123	29.0800	26.0777	29.9245	31.2913	35.2906	39.8066	41.8329	(72)
Total internal gains													
	343.5293	342.1068	330.0650	310.3208	289.5062	270.1474	258.0387	261.9393	272.5057	292.3853	315.2071	333.0600	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	7.2300	10.6334	0.6300	0.7000	0.7700	23.4954	(74)
South	4.3300	46.7521	0.6300	0.7000	0.7700	61.8672	(78)

Solar gains	85.3626	146.2234	205.3644	268.4270	317.0999	323.0226	307.9367	269.7170	226.5599	162.7344	102.3183	73.0458	(83)
Total gains	428.8919	488.3302	535.4294	578.7477	606.6061	593.1701	565.9754	531.6564	499.0656	455.1197	417.5254	406.1058	(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	61.8285	62.0245	62.2179	63.1423	63.3183	64.1508	64.1508	64.3073	63.8275	63.3183	62.9632	62.5963	
alpha	5.1219	5.1350	5.1479	5.2095	5.2212	5.2767	5.2767	5.2872	5.2552	5.2212	5.1975	5.1731	
util living area													
	0.9988	0.9975	0.9938	0.9805	0.9353	0.8111	0.6438	0.6995	0.9070	0.9866	0.9976	0.9991	(86)
MIT	19.7349	19.8724	20.0988	20.4107	20.7049	20.9128	20.9799	20.9694	20.8241	20.4503	20.0407	19.7162	(87)
Th 2	19.9819	19.9848	19.9877	20.0010	20.0035	20.0151	20.0151	20.0173	20.0106	20.0035	19.9984	19.9932	(88)
util rest of house													
	0.9984	0.9966	0.9914	0.9723	0.9056	0.7287	0.5145	0.5729	0.8528	0.9795	0.9965	0.9988	(89)
MIT 2	18.8246	18.9640	19.1918	19.5102	19.7907	19.9713	20.0096	20.0077	19.9049	19.5536	19.1433	18.8149	(90)
Living area fraction									fLA = Living area / (4) =			0.1685	(91)
MIT	18.9780	19.1171	19.3447	19.6619	19.9448	20.1299	20.1731	20.1698	20.0598	19.7047	19.2945	18.9668	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9780	19.1171	19.3447	19.6619	19.9448	20.1299	20.1731	20.1698	20.0598	19.7047	19.2945	18.9668	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9979	0.9955	0.9894	0.9687	0.9034	0.7396	0.5365	0.5942	0.8561	0.9765	0.9955	0.9984	(94)
Useful gains	427.9752	486.1353	529.7333	560.6161	548.0232	438.6909	303.6448	315.9046	427.2597	444.4401	415.6598	405.4532	(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													
	1319.5380	1274.0680	1147.4976	947.3589	723.7603	479.1408	309.5918	325.8386	519.0026	799.2490	1076.5198	1311.2420	(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													
	663.3227	529.4907	459.6166	278.4548	130.7484	0.0000	0.0000	0.0000	0.0000	263.9778	475.8192	673.9069	(98)
Space heating												3475.3371	(98)
Space heating per m2											(98) / (4) =	43.4200	(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	814.4616	641.1719	656.8976	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8252	0.8996	0.8737	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	672.0978	576.7714	573.8999	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	785.7256	752.0827	713.6867	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	81.8120	130.4316	104.0014	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												316.2450	(104)
Cooled fraction									fC = cooled area / (4) =			1.0000	(105)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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	20.4530	32.6079	26.0003	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												79.0612	(107)
Space cooling per m2												0.9878	(108)
Energy for space heating												43.4200	(99)
Energy for space cooling												0.9878	(108)
Total												44.4078	(109)
Target Fabric Energy Efficiency (TFEE)												51.1	(109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.0200 (1b)	x	2.3100 (2b)	=	92.4462	(1b) - (3b)
First floor	40.0200 (1c)	x	2.6100 (2c)	=	104.4522	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 80.0400						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	196.8984	(5)

2. Ventilation rate

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

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

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

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1500	1.0000	2.1500			(26)
Window (Uw = 1.20)			8.2300	1.1450	9.4237			(27)
French Door (Uw = 1.40)			3.3300	1.3258	4.4148			(27)
FP McCann System			40.0200	0.1100	4.4022	75.0000	3001.5000	(28a)
100mm Knauf Supafil 34	88.4600	13.7100	74.7500	0.2500	18.6875	52.8000	3946.8000	(29a)
Plane Ceiling-500mm Loft Roll	40.0200		40.0200	0.0900	3.6018	9.0000	360.1800	(30)
Total net area of external elements Aum(A, m2)			168.5000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	42.6799			(33)
E-WM-30			39.9000	0.0000	0.0000	45.0000	1795.5000	(32)
Timber GF			20.5700			9.0000	185.1300	(32c)
Timber 1F			76.2500			9.0000	686.2500	(32c)
AAC GF			49.2000			39.0000	1918.8000	(32c)
Internal Floor			40.0200			12.6000	504.2520	(32d)
Internal Ceiling			40.0200			9.0000	360.1800	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 12758.5920	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	159.4027	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	4.2388	(36)
Total fabric heat loss	(33) + (36) = 46.9187	(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	32.4882	32.4882	32.4882	32.4882	32.4882	32.4882	32.4882	32.4882	32.4882	32.4882	32.4882	32.4882	(38)
Heat transfer coeff	79.4070	79.4070	79.4070	79.4070	79.4070	79.4070	79.4070	79.4070	79.4070	79.4070	79.4070	79.4070	(39)
Average = Sum(39)m / 12 =												79.4070	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9921	0.9921	0.9921	0.9921	0.9921	0.9921	0.9921	0.9921	0.9921	0.9921	0.9921	0.9921	(40)
HLP (average)												0.9921	(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	2.4636	(42)
Average daily hot water use (litres/day)	92.7110	(43)

CALCULATION OF HEAT DEMAND 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	101.9821	98.2736	94.5652	90.8567	87.1483	83.4399	83.4399	87.1483	90.8567	94.5652	98.2736	101.9821	(44)
Energy conte	151.2365	132.2724	136.4932	118.9981	114.1815	98.5300	91.3025	104.7710	106.0223	123.5587	134.8740	146.4644	(45)
Energy content (annual)										Total = Sum(45)m =		1458.7045	(45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6855	19.8409	20.4740	17.8497	17.1272	14.7795	13.6954	15.7156	15.9033	18.5338	20.2311	21.9697	(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													
	200.6133	176.8708	185.8700	166.7821	163.5583	146.3140	140.6793	154.1478	153.8063	172.9355	182.6580	195.8412	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
								Solar input (sum of months) = Sum(63)m =				0.0000	(63)
Output from w/h													
	200.6133	176.8708	185.8700	166.7821	163.5583	146.3140	140.6793	154.1478	153.8063	172.9355	182.6580	195.8412	(64)
								Total per year (kWh/year) = Sum(64)m =				2040.0765	(64)
RHI water heating demand												2040	(64)
Heat gains from water heating, kWh/month													
	89.7876	79.6593	84.8854	77.7941	77.4668	70.9884	69.8595	74.3378	73.4796	80.5847	83.0728	88.2009	(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	147.8172	147.8172	147.8172	147.8172	147.8172	147.8172	147.8172	147.8172	147.8172	147.8172	147.8172	147.8172	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	52.1375	46.3080	37.6602	28.5112	21.3125	17.9929	19.4419	25.2714	33.9192	43.0682	50.2669	53.5865	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	327.6479	331.0479	322.4801	304.2403	281.2158	259.5760	245.1194	241.7194	250.2872	268.5270	291.5515	313.1912	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2453	52.2453	52.2453	52.2453	52.2453	52.2453	52.2453	52.2453	52.2453	52.2453	52.2453	52.2453	(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)													
	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	(71)
Water heating gains (Table 5)													
	120.6822	118.5406	114.0933	108.0473	104.1220	98.5950	93.8972	99.9164	102.0550	108.3128	115.3789	118.5495	(72)
Total internal gains													
	601.9853	597.4143	575.7514	542.3166	508.1680	477.6817	459.9762	468.4249	487.7791	521.4257	558.7150	586.8451	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	3.9000	11.9814	0.4600	0.0000	0.7700	16.5509	(74)
South	4.3300	50.9848	0.4600	0.0000	0.7700	78.1947	(78)
North	3.3300	11.9814	0.4300	0.0000	0.7700	13.2103	(74)

Solar gains	107.9559	166.5623	231.9403	314.3169	363.2689	396.5539	373.7481	333.7542	278.0038	198.1298	132.5854	91.4835	(83)
Total gains	709.9413	763.9766	807.6917	856.6334	871.4369	874.2356	833.7243	802.1791	765.7828	719.5555	691.3004	678.3285	(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	44.6315	44.6315	44.6315	44.6315	44.6315	44.6315	44.6315	44.6315	44.6315	44.6315	44.6315	44.6315	
alpha	3.9754	3.9754	3.9754	3.9754	3.9754	3.9754	3.9754	3.9754	3.9754	3.9754	3.9754	3.9754	
util living area													
	0.9529	0.9360	0.8961	0.8102	0.6580	0.4432	0.2936	0.3145	0.5669	0.8134	0.9223	0.9590	(86)
Tweekday	18.7846	18.9741	19.3379	19.7267	19.9906	20.0799	20.0892	20.0890	20.0565	19.7924	19.2519	18.7216	
Tweekend	20.3508	20.4375	20.6054	20.7925	20.9315	20.9894	20.9985	20.9980	20.9707	20.8215	20.5628	20.3220	
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	19.9981	20.1299	20.3910	20.6760	20.8943	20.9837	20.9977	20.9969	20.9543	20.7245	20.3173	19.9536	(87)
Th 2	20.0899	20.0899	20.0899	20.0899	20.0899	20.0899	20.0899	20.0899	20.0899	20.0899	20.0899	20.0899	(88)
util rest of house													
	0.9440	0.9241	0.8766	0.7756	0.6006	0.3669	0.2083	0.2262	0.4897	0.7722	0.9057	0.9510	(89)
Tweekday	18.7846	18.9741	19.3379	19.7267	19.9906	20.0799	20.0892	20.0890	20.0565	19.7924	19.2519	18.7216	
Tweekend	18.7846	18.9741	19.3379	19.7267	19.9906	20.0799	20.0892	20.0890	20.0565	19.7924	19.2519	18.7216	
MIT 2	18.7846	18.9741	19.3379	19.7267	19.9906	20.0799	20.0892	20.0890	20.0565	19.7924	19.2519	18.7216	(90)
Living area fraction									fLA = Living area / (4) =			0.1685	(91)
MIT	18.9891	19.1689	19.5154	19.8867	20.1429	20.2322	20.2424	20.2420	20.2078	19.9495	19.4315	18.9293	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9891	19.1689	19.5154	19.8867	20.1429	20.2322	20.2424	20.2420	20.2078	19.9495	19.4315	18.9293	(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	0.9304	0.9095	0.8622	0.7671	0.6041	0.3791	0.2226	0.2411	0.5001	0.7651	0.8912	0.9380	(94)
Useful gains	660.5171	694.8176	696.4191	657.0949	526.4717	331.4005	185.6278	193.3907	382.9666	550.5077	616.0864	636.3000	(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	1102.8898	1077.4681	962.0437	793.0113	567.1944	336.0654	185.9994	193.9110	397.6554	663.0103	907.7412	1098.1389	(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	329.1253	257.1411	197.6247	97.8598	30.2977	0.0000	0.0000	0.0000	0.0000	83.7019	209.9915	343.6081	(98)
Space heating												1549.3502	(98)
RHI space heating demand												1549	(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	40.0200 (1b)	x	2.3100 (2b)	=	92.4462	(1b) - (3b)
First floor	40.0200 (1c)	x	2.6100 (2c)	=	104.4522	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 80.0400						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	196.8984	(5)

2. Ventilation rate

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

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

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

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1500	1.0000	2.1500			(26)
Window (Uw = 1.20)			8.2300	1.1450	9.4237			(27)
French Door (Uw = 1.40)			3.3300	1.3258	4.4148			(27)
FP McCann System			40.0200	0.1100	4.4022	75.0000	3001.5000	(28a)
100mm Knauf Supafil 34	88.4600	13.7100	74.7500	0.2500	18.6875	52.8000	3946.8000	(29a)
Plane Ceiling-500mm Loft Roll	40.0200		40.0200	0.0900	3.6018	9.0000	360.1800	(30)
Total net area of external elements Aum(A, m2)			168.5000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	42.6799			(33)
E-WM-30			39.9000	0.0000	0.0000	45.0000	1795.5000	(32)
Timber GF			20.5700			9.0000	185.1300	(32c)
Timber 1F			76.2500			9.0000	686.2500	(32c)
AAC GF			49.2000			39.0000	1918.8000	(32c)
Internal Floor			40.0200			12.6000	504.2520	(32d)
Internal Ceiling			40.0200			9.0000	360.1800	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 12758.5920	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	159.4027	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	4.2388	(36)
Total fabric heat loss	(33) + (36) = 46.9187	(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	32.4882	32.4882	32.4882	32.4882	32.4882	32.4882	32.4882	32.4882	32.4882	32.4882	32.4882	32.4882	(38)
Heat transfer coeff	79.4070	79.4070	79.4070	79.4070	79.4070	79.4070	79.4070	79.4070	79.4070	79.4070	79.4070	79.4070	(39)
Average = Sum(39)m / 12 =												79.4070	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9921	0.9921	0.9921	0.9921	0.9921	0.9921	0.9921	0.9921	0.9921	0.9921	0.9921	0.9921	(40)
HLP (average)												0.9921	(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	2.4636	(42)
Average daily hot water use (litres/day)	92.7110	(43)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use													
	101.9821	98.2736	94.5652	90.8567	87.1483	83.4399	83.4399	87.1483	90.8567	94.5652	98.2736	101.9821	(44)
Energy conte	151.2365	132.2724	136.4932	118.9981	114.1815	98.5300	91.3025	104.7710	106.0223	123.5587	134.8740	146.4644	(45)
Energy content (annual)										Total = Sum(45)m =		1458.7045	(45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6855	19.8409	20.4740	17.8497	17.1272	14.7795	13.6954	15.7156	15.9033	18.5338	20.2311	21.9697	(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													
	200.6133	176.8708	185.8700	166.7821	163.5583	146.3140	140.6793	154.1478	153.8063	172.9355	182.6580	195.8412	(62)
WWHRS	-49.5541	-43.5996	-44.5000	-36.6247	-34.0127	-28.0630	-23.7583	-28.7632	-29.5989	-36.5818	-42.3638	-47.8937	eq.(G10)
Total of WWHRS savings												-445.3138	
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													
	151.0591	133.2712	141.3701	130.1574	129.5456	118.2510	116.9210	125.3846	124.2074	136.3537	140.2942	147.9475	(64)
								Total per year (kWh/year) = Sum(64)m =				1594.7627	(64)
Heat gains from water heating, kWh/month													
	89.7876	79.6593	84.8854	77.7941	77.4668	70.9884	69.8595	74.3378	73.4796	80.5847	83.0728	88.2009	(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	147.8172	147.8172	147.8172	147.8172	147.8172	147.8172	147.8172	147.8172	147.8172	147.8172	147.8172	147.8172	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	52.1375	46.3080	37.6602	28.5112	21.3125	17.9929	19.4419	25.2714	33.9192	43.0682	50.2669	53.5865	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	327.6479	331.0479	322.4801	304.2403	281.2158	259.5760	245.1194	241.7194	250.2872	268.5270	291.5515	313.1912	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2453	52.2453	52.2453	52.2453	52.2453	52.2453	52.2453	52.2453	52.2453	52.2453	52.2453	52.2453	(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)													
	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	(71)
Water heating gains (Table 5)													
	120.6822	118.5406	114.0933	108.0473	104.1220	98.5950	93.8972	99.9164	102.0550	108.3128	115.3789	118.5495	(72)
Total internal gains													
	601.9853	597.4143	575.7514	542.3166	508.1680	477.6817	459.9762	468.4249	487.7791	521.4257	558.7150	586.8451	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	3.9000	10.6334	0.4600	0.0000	0.7700	14.6888	(74)
South	4.3300	46.7521	0.4600	0.0000	0.7700	71.7030	(78)
North	3.3300	10.6334	0.4300	0.0000	0.7700	11.7240	(74)

Solar gains	98.1157	167.9071	235.3575	306.8356	361.7658	368.2247	351.1487	308.0398	259.3853	186.7456	117.5760	83.9769	(83)
Total gains	700.1011	765.3214	811.1089	849.1521	869.9338	845.9064	811.1250	776.4647	747.1644	708.1713	676.2911	670.8220	(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	44.6315	44.6315	44.6315	44.6315	44.6315	44.6315	44.6315	44.6315	44.6315	44.6315	44.6315	44.6315	
alpha	3.9754	3.9754	3.9754	3.9754	3.9754	3.9754	3.9754	3.9754	3.9754	3.9754	3.9754	3.9754	
util living area													
	0.9611	0.9434	0.9110	0.8451	0.7289	0.5664	0.4220	0.4577	0.6608	0.8553	0.9395	0.9666	(86)
Tweekday	18.6192	18.8551	19.2030	19.6004	19.9054	20.0505	20.0835	20.0803	20.0094	19.6615	19.0741	18.5399	
Tweekend	20.2764	20.3836	20.5431	20.7306	20.8844	20.9678	20.9921	20.9891	20.9400	20.7562	20.4811	20.2405	
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	19.8832	20.0465	20.2948	20.5794	20.8215	20.9505	20.9879	20.9831	20.9063	20.6237	20.1898	19.8278	(87)
Th 2	20.0899	20.0899	20.0899	20.0899	20.0899	20.0899	20.0899	20.0899	20.0899	20.0899	20.0899	20.0899	(88)
util rest of house													
	0.9539	0.9331	0.8947	0.8167	0.6813	0.4968	0.3385	0.3724	0.5936	0.8230	0.9267	0.9603	(89)
Tweekday	18.6192	18.8551	19.2030	19.6004	19.9054	20.0505	20.0835	20.0803	20.0094	19.6615	19.0741	18.5399	
Tweekend	18.6192	18.8551	19.2030	19.6004	19.9054	20.0505	20.0835	20.0803	20.0094	19.6615	19.0741	18.5399	
MIT 2	18.6192	18.8551	19.2030	19.6004	19.9054	20.0505	20.0835	20.0803	20.0094	19.6615	19.0741	18.5399	(90)
Living area fraction									fLA = Living area / (4) =			0.1685	(91)
MIT	18.8323	19.0559	19.3870	19.7654	20.0598	20.2022	20.2359	20.2325	20.1605	19.8237	19.2622	18.7570	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8323	19.0559	19.3870	19.7654	20.0598	20.2022	20.2359	20.2325	20.1605	19.8237	19.2622	18.7570	(93)

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8. Space heating requirement

CALCULATION OF ENERGY RATINGS 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9412	0.9188	0.8799	0.8053	0.6796	0.5057	0.3521	0.3861	0.5992	0.8122	0.9124	0.9483	(94)
Useful gains	658.9075	703.1568	713.6837	683.8450	591.2426	427.7643	285.6374	299.8158	447.6895	575.2014	617.0557	636.1476	(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	1153.9636	1124.0738	1023.3178	862.7895	663.8300	444.8502	288.7171	304.3269	481.2498	732.4223	965.7596	1155.9265	(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	368.3217	282.8562	230.3678	128.8401	54.0050	0.0000	0.0000	0.0000	0.0000	116.9723	251.0668	386.7155	(98)
Space heating												1819.1454	(98)
Space heating per m2											(98) / (4) =	22.7280	(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 %)	229.3004	(206)
Efficiency of secondary/supplementary heating system, %	100.0000	(208)
Space heating requirement	793.3458	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	368.3217	282.8562	230.3678	128.8401	54.0050	0.0000	0.0000	0.0000	0.0000	116.9723	251.0668	386.7155	(98)
Space heating efficiency (main heating system 1)	229.3004	229.3004	229.3004	229.3004	229.3004	0.0000	0.0000	0.0000	0.0000	229.3004	229.3004	229.3004	(210)
Space heating fuel (main heating system)	160.6284	123.3561	100.4655	56.1883	23.5521	0.0000	0.0000	0.0000	0.0000	51.0127	109.4925	168.6501	(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	151.0591	133.2712	141.3701	130.1574	129.5456	118.2510	116.9210	125.3846	124.2074	136.3537	140.2942	147.9475	(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	88.7122	78.2659	83.0221	76.4373	76.0780	69.4450	68.6640	73.6343	72.9430	80.0762	82.3903	86.8848	(219)
Water heating fuel used												936.5532	(219)
Annual totals kWh/year													
Space heating fuel - main system												793.3458	(211)
Space heating fuel - secondary												0.0000	(215)

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

mechanical ventilation fans (SFP = 0.2282)	54.8107	(230a)
Total electricity for the above, kWh/year	54.8107	(231)
Electricity for lighting (calculated in Appendix L)	368.3056	(232)
Total delivered energy for all uses	2153.0152	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	793.3458	13.1900	104.6423	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	936.5532	13.1900	123.5314	(247)
Mechanical ventilation fans	54.8107	13.1900	7.2295	(249)
Pumps and fans for heating	0.0000	0.0000	0.0000	(249)
Energy for lighting	368.3056	13.1900	48.5795	(250)
Additional standing charges			0.0000	(251)
Total energy cost			283.9827	(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] =	0.9539	(257)
SAP value	86.6934	
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	793.3458	0.5190	411.7465	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	936.5532	0.5190	486.0711	(264)
Space and water heating			897.8176	(265)
Pumps and fans	54.8107	0.5190	28.4467	(267)
Energy for lighting	368.3056	0.5190	191.1506	(268)
Total kg/year			1117.4149	(272)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

CO2 emissions per m2	13.9600 (273)
EI value	88.0251
EI rating	88 (274)
EI band	B

Calculation of stars for heating and DHW

Main heating energy efficiency	13.19 × (1 + 0.29 × 0.00) / 2.2930 = 5.752, stars = 3
Main heating environmental impact	0.519 × (1 + 0.29 × 0.00) / 2.2930 = 0.2263, stars = 4
Water heating energy efficiency	13.19 / 1.7028 = 7.746, stars = 3
Water heating environmental impact	0.519 / 1.7028 = 0.3048, stars = 5

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.0200 (1b)	x	2.3100 (2b)	=	92.4462	(1b) - (3b)
First floor	40.0200 (1c)	x	2.6100 (2c)	=	104.4522	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	80.0400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	196.8984	(5)

2. Ventilation rate

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

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

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

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1500	1.0000	2.1500			(26)
Window (Uw = 1.20)			8.2300	1.1450	9.4237			(27)
French Door (Uw = 1.40)			3.3300	1.3258	4.4148			(27)
FP McCann System			40.0200	0.1100	4.4022	75.0000	3001.5000	(28a)
100mm Knauf Supafil 34	88.4600	13.7100	74.7500	0.2500	18.6875	52.8000	3946.8000	(29a)
Plane Ceiling-500mm Loft Roll	40.0200		40.0200	0.0900	3.6018	9.0000	360.1800	(30)
Total net area of external elements Aum(A, m2)			168.5000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	42.6799			(33)
E-WM-30			39.9000	0.0000	0.0000	45.0000	1795.5000	(32)
Timber GF			20.5700			9.0000	185.1300	(32c)
Timber 1F			76.2500			9.0000	686.2500	(32c)
AAC GF			49.2000			39.0000	1918.8000	(32c)
Internal Floor			40.0200			12.6000	504.2520	(32d)
Internal Ceiling			40.0200			9.0000	360.1800	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 12758.5920	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	159.4027	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	4.2388	(36)
Total fabric heat loss	(33) + (36) = 46.9187	(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	32.4882	32.4882	32.4882	32.4882	32.4882	32.4882	32.4882	32.4882	32.4882	32.4882	32.4882	32.4882	(38)
Heat transfer coeff	79.4070	79.4070	79.4070	79.4070	79.4070	79.4070	79.4070	79.4070	79.4070	79.4070	79.4070	79.4070	(39)
Average = Sum(39)m / 12 =												79.4070	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9921	0.9921	0.9921	0.9921	0.9921	0.9921	0.9921	0.9921	0.9921	0.9921	0.9921	0.9921	(40)
HLP (average)												0.9921	(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	2.4636	(42)
Average daily hot water use (litres/day)	92.7110	(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													
	101.9821	98.2736	94.5652	90.8567	87.1483	83.4399	83.4399	87.1483	90.8567	94.5652	98.2736	101.9821	(44)
Energy conte	151.2365	132.2724	136.4932	118.9981	114.1815	98.5300	91.3025	104.7710	106.0223	123.5587	134.8740	146.4644	(45)
Energy content (annual)										Total = Sum(45)m =		1458.7045	(45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6855	19.8409	20.4740	17.8497	17.1272	14.7795	13.6954	15.7156	15.9033	18.5338	20.2311	21.9697	(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													
	200.6133	176.8708	185.8700	166.7821	163.5583	146.3140	140.6793	154.1478	153.8063	172.9355	182.6580	195.8412	(62)
WWHRS	-49.5541	-43.5996	-44.5000	-36.6247	-34.0127	-28.0630	-23.7583	-28.7632	-29.5989	-36.5818	-42.3638	-47.8937	eq.(G10)
Total of WWHRS savings												-445.3138	
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													
	151.0591	133.2712	141.3701	130.1574	129.5456	118.2510	116.9210	125.3846	124.2074	136.3537	140.2942	147.9475	(64)
								Total per year (kWh/year) = Sum(64)m =				1594.7627	(64)
Heat gains from water heating, kWh/month													
	89.7876	79.6593	84.8854	77.7941	77.4668	70.9884	69.8595	74.3378	73.4796	80.5847	83.0728	88.2009	(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	147.8172	147.8172	147.8172	147.8172	147.8172	147.8172	147.8172	147.8172	147.8172	147.8172	147.8172	147.8172	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	52.1375	46.3080	37.6602	28.5112	21.3125	17.9929	19.4419	25.2714	33.9192	43.0682	50.2669	53.5865	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	327.6479	331.0479	322.4801	304.2403	281.2158	259.5760	245.1194	241.7194	250.2872	268.5270	291.5515	313.1912	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2453	52.2453	52.2453	52.2453	52.2453	52.2453	52.2453	52.2453	52.2453	52.2453	52.2453	52.2453	(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)													
	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	(71)
Water heating gains (Table 5)													
	120.6822	118.5406	114.0933	108.0473	104.1220	98.5950	93.8972	99.9164	102.0550	108.3128	115.3789	118.5495	(72)
Total internal gains													
	601.9853	597.4143	575.7514	542.3166	508.1680	477.6817	459.9762	468.4249	487.7791	521.4257	558.7150	586.8451	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	3.9000	11.9814	0.4600	0.0000	0.7700	16.5509	(74)
South	4.3300	50.9848	0.4600	0.0000	0.7700	78.1947	(78)
North	3.3300	11.9814	0.4300	0.0000	0.7700	13.2103	(74)

Solar gains	107.9559	166.5623	231.9403	314.3169	363.2689	396.5539	373.7481	333.7542	278.0038	198.1298	132.5854	91.4835	(83)
Total gains	709.9413	763.9766	807.6917	856.6334	871.4369	874.2356	833.7243	802.1791	765.7828	719.5555	691.3004	678.3285	(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	44.6315	44.6315	44.6315	44.6315	44.6315	44.6315	44.6315	44.6315	44.6315	44.6315	44.6315	44.6315	
alpha	3.9754	3.9754	3.9754	3.9754	3.9754	3.9754	3.9754	3.9754	3.9754	3.9754	3.9754	3.9754	
util living area													
	0.9529	0.9360	0.8961	0.8102	0.6580	0.4432	0.2936	0.3145	0.5669	0.8134	0.9223	0.9590	(86)
Tweekday	18.7846	18.9741	19.3379	19.7267	19.9906	20.0799	20.0892	20.0890	20.0565	19.7924	19.2519	18.7216	
Tweekend	20.3508	20.4375	20.6054	20.7925	20.9315	20.9894	20.9985	20.9980	20.9707	20.8215	20.5628	20.3220	
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	19.9981	20.1299	20.3910	20.6760	20.8943	20.9837	20.9977	20.9969	20.9543	20.7245	20.3173	19.9536	(87)
Th 2	20.0899	20.0899	20.0899	20.0899	20.0899	20.0899	20.0899	20.0899	20.0899	20.0899	20.0899	20.0899	(88)
util rest of house													
	0.9440	0.9241	0.8766	0.7756	0.6006	0.3669	0.2083	0.2262	0.4897	0.7722	0.9057	0.9510	(89)
Tweekday	18.7846	18.9741	19.3379	19.7267	19.9906	20.0799	20.0892	20.0890	20.0565	19.7924	19.2519	18.7216	
Tweekend	18.7846	18.9741	19.3379	19.7267	19.9906	20.0799	20.0892	20.0890	20.0565	19.7924	19.2519	18.7216	
MIT 2	18.7846	18.9741	19.3379	19.7267	19.9906	20.0799	20.0892	20.0890	20.0565	19.7924	19.2519	18.7216	(90)
Living area fraction									fLA = Living area / (4) =			0.1685	(91)
MIT	18.9891	19.1689	19.5154	19.8867	20.1429	20.2322	20.2424	20.2420	20.2078	19.9495	19.4315	18.9293	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9891	19.1689	19.5154	19.8867	20.1429	20.2322	20.2424	20.2420	20.2078	19.9495	19.4315	18.9293	(93)

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8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9304	0.9095	0.8622	0.7671	0.6041	0.3791	0.2226	0.2411	0.5001	0.7651	0.8912	0.9380	(94)
Useful gains	660.5171	694.8176	696.4191	657.0949	526.4717	331.4005	185.6278	193.3907	382.9666	550.5077	616.0864	636.3000	(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	1102.8898	1077.4681	962.0437	793.0113	567.1944	336.0654	185.9994	193.9110	397.6554	663.0103	907.7412	1098.1389	(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	329.1253	257.1411	197.6247	97.8598	30.2977	0.0000	0.0000	0.0000	0.0000	83.7019	209.9915	343.6081	(98)
Space heating												1549.3502	(98)
Space heating per m2											(98) / (4) =	19.3572	(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 %)	229.3004	(206)
Efficiency of secondary/supplementary heating system, %	100.0000	(208)
Space heating requirement	675.6857	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	329.1253	257.1411	197.6247	97.8598	30.2977	0.0000	0.0000	0.0000	0.0000	83.7019	209.9915	343.6081	(98)
Space heating efficiency (main heating system 1)	229.3004	229.3004	229.3004	229.3004	229.3004	0.0000	0.0000	0.0000	0.0000	229.3004	229.3004	229.3004	(210)
Space heating fuel (main heating system)	143.5345	112.1416	86.1859	42.6776	13.2131	0.0000	0.0000	0.0000	0.0000	36.5032	91.5792	149.8506	(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	151.0591	133.2712	141.3701	130.1574	129.5456	118.2510	116.9210	125.3846	124.2074	136.3537	140.2942	147.9475	(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	88.7122	78.2659	83.0221	76.4373	76.0780	69.4450	68.6640	73.6343	72.9430	80.0762	82.3903	86.8848	(219)
Water heating fuel used												936.5532	(219)
Annual totals kWh/year													
Space heating fuel - main system												675.6857	(211)
Space heating fuel - secondary												0.0000	(215)

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

mechanical ventilation fans (SFP = 0.2282)	54.8107	(230a)
Total electricity for the above, kWh/year	54.8107	(231)
Electricity for lighting (calculated in Appendix L)	368.3056	(232)
Total delivered energy for all uses	2035.3550	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	675.6857	16.9600	114.5963	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	936.5532	16.9600	158.8394	(247)
Mechanical ventilation fans	54.8107	16.9600	9.2959	(249)
Pumps and fans for heating	0.0000	0.0000	0.0000	(249)
Energy for lighting	368.3056	16.9600	62.4646	(250)
Additional standing charges			0.0000	(251)
Total energy cost			345.1962	(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	675.6857	0.5190	350.6809	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	936.5532	0.5190	486.0711	(264)
Space and water heating			836.7519	(265)
Pumps and fans	54.8107	0.5190	28.4467	(267)
Energy for lighting	368.3056	0.5190	191.1506	(268)
Total kg/year			1056.3493	(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	675.6857	3.0700	2074.3550	(261)
Space heating - secondary	0.0000	3.0700	0.0000	(263)
Water heating (other fuel)	936.5532	3.0700	2875.2182	(264)

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

Space and water heating			4949.5731 (265)
Pumps and fans	54.8107	3.0700	168.2688 (267)
Energy for lighting	368.3056	3.0700	1130.6980 (268)
Primary energy kWh/year			6248.5400 (272)
Primary energy kWh/m2/year			78.0677 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 87
Current environmental impact rating: B 88

(For testing purposes):

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 2.3	-£ 64	-195 kg (18.5%)
U Solar photovoltaic panels	+ 10.7	-£ 309	-947 kg (109.9%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£64	2.44 kg/m²	B 89	B 90
Solar photovoltaic panels	£309	11.83 kg/m²	A 100	A 100
Total Savings	£373	14.27 kg/m²		

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

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

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

	Current	Potential	Saving
Electricity	£345	£281	£64
Space heating	£124	£124	-£0
Water heating	£159	£95	£64
Lighting	£62	£62	£0
Generated (PV)	-£0	-£309	£309
Total cost of fuels	£345	-£28	£373
Total cost of uses	£345	-£28	£373
Delivered energy	25 kWh/m²	-2 kWh/m²	27 kWh/m²
Carbon dioxide emissions	1.1 tonnes	-0.1 tonnes	1.1 tonnes
CO2 emissions per m²	13 kg/m²	-1 kg/m²	14 kg/m²
Primary energy	78 kWh/m²	-6 kWh/m²	84 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	40.0200 (1b)	x	2.3100 (2b)	=	92.4462	(1b) - (3b)
First floor	40.0200 (1c)	x	2.6100 (2c)	=	104.4522	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 80.0400						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	196.8984	(5)

2. Ventilation rate

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

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

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

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1500	1.0000	2.1500			(26)
Window (Uw = 1.20)			8.2300	1.1450	9.4237			(27)
French Door (Uw = 1.40)			3.3300	1.3258	4.4148			(27)
FP McCann System			40.0200	0.1100	4.4022	75.0000	3001.5000	(28a)
100mm Knauf Supafil 34	88.4600	13.7100	74.7500	0.2500	18.6875	52.8000	3946.8000	(29a)
Plane Ceiling-500mm Loft Roll	40.0200		40.0200	0.0900	3.6018	9.0000	360.1800	(30)
Total net area of external elements Aum(A, m2)			168.5000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	42.6799			(33)
E-WM-30			39.9000	0.0000	0.0000	45.0000	1795.5000	(32)
Timber GF			20.5700			9.0000	185.1300	(32c)
Timber 1F			76.2500			9.0000	686.2500	(32c)
AAC GF			49.2000			39.0000	1918.8000	(32c)
Internal Floor			40.0200			12.6000	504.2520	(32d)
Internal Ceiling			40.0200			9.0000	360.1800	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 12758.5920	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	159.4027	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	4.2388	(36)
Total fabric heat loss	(33) + (36) = 46.9187	(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	32.4882	32.4882	32.4882	32.4882	32.4882	32.4882	32.4882	32.4882	32.4882	32.4882	32.4882	32.4882	(38)
Heat transfer coeff	79.4070	79.4070	79.4070	79.4070	79.4070	79.4070	79.4070	79.4070	79.4070	79.4070	79.4070	79.4070	(39)
Average = Sum(39)m / 12 =												79.4070	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9921	0.9921	0.9921	0.9921	0.9921	0.9921	0.9921	0.9921	0.9921	0.9921	0.9921	0.9921	(40)
HLP (average)												0.9921	(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	2.4636	(42)
Average daily hot water use (litres/day)	92.7110	(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													
	101.9821	98.2736	94.5652	90.8567	87.1483	83.4399	83.4399	87.1483	90.8567	94.5652	98.2736	101.9821	(44)
Energy conte	151.2365	132.2724	136.4932	118.9981	114.1815	98.5300	91.3025	104.7710	106.0223	123.5587	134.8740	146.4644	(45)
Energy content (annual)										Total = Sum(45)m =		1458.7045	(45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6855	19.8409	20.4740	17.8497	17.1272	14.7795	13.6954	15.7156	15.9033	18.5338	20.2311	21.9697	(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													
	200.6133	176.8708	184.4743	160.0285	150.7640	133.7073	127.6524	142.0513	148.4034	171.5398	182.6580	195.8412	(62)
WWHRS	-49.5541	-43.5996	-44.5000	-36.6247	-34.0127	-28.0630	-23.7583	-28.7632	-29.5989	-36.5818	-42.3638	-47.8937	eq.(G10)
Total of WWHRS savings												-445.3138	
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												1.7896	(H8)
Utilisation factor												0.4281	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												92.7110	(H14)
Volume ratio Veff/V												0.8090	(H15)
Solar storage volume factor												0.9576	(H16)
Solar input												-653.7239	(H17)
Solar input	-18.9567	-31.6333	-53.8751	-72.2032	-89.2010	-87.6988	-86.5398	-75.6103	-59.2180	-40.4389	-22.4854	-15.8635	(63)
								Solar input (sum of months) = Sum(63)m =				-653.7239	(63)
Output from w/h													
	132.1025	101.6379	86.0993	51.2006	27.5503	17.9454	17.3543	37.6778	59.5865	94.5190	117.8088	132.0840	(64)
								Total per year (kWh/year) = Sum(64)m =				875.5664	(64)
Heat gains from water heating, kWh/month													
	89.7876	79.6593	83.7688	72.3912	67.2313	60.9030	59.4380	64.6606	69.1573	79.4681	83.0728	88.2009	(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	147.8172	147.8172	147.8172	147.8172	147.8172	147.8172	147.8172	147.8172	147.8172	147.8172	147.8172	147.8172	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	52.1375	46.3080	37.6602	28.5112	21.3125	17.9929	19.4419	25.2714	33.9192	43.0682	50.2669	53.5865	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	327.6479	331.0479	322.4801	304.2403	281.2158	259.5760	245.1194	241.7194	250.2872	268.5270	291.5515	313.1912	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2453	52.2453	52.2453	52.2453	52.2453	52.2453	52.2453	52.2453	52.2453	52.2453	52.2453	52.2453	(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)													
	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	(71)
Water heating gains (Table 5)													
	120.6822	118.5406	112.5925	100.5433	90.3647	84.5876	79.8897	86.9094	96.0518	106.8120	115.3789	118.5495	(72)
Total internal gains													
	601.9853	597.4143	574.2506	534.8126	494.4107	463.6742	445.9688	455.4179	481.7759	519.9249	558.7150	586.8451	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	3.9000	10.6334	0.4600	0.0000	0.7700	14.6888	(74)
South	4.3300	46.7521	0.4600	0.0000	0.7700	71.7030	(78)
North	3.3300	10.6334	0.4300	0.0000	0.7700	11.7240	(74)

Solar gains	98.1157	167.9071	235.3575	306.8356	361.7658	368.2247	351.1487	308.0398	259.3853	186.7456	117.5760	83.9769	(83)
Total gains	700.1011	765.3214	809.6081	841.6481	856.1765	831.8990	797.1175	763.4577	741.1612	706.6705	676.2911	670.8220	(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, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	44.6315	44.6315	44.6315	44.6315	44.6315	44.6315	44.6315	44.6315	44.6315	44.6315	44.6315	44.6315	
alpha	3.9754	3.9754	3.9754	3.9754	3.9754	3.9754	3.9754	3.9754	3.9754	3.9754	3.9754	3.9754	
util living area													
	0.9611	0.9434	0.9115	0.8482	0.7361	0.5742	0.4289	0.4648	0.6647	0.8560	0.9395	0.9666	(86)
Tweekday	18.6192	18.8551	19.2006	19.5921	19.8980	20.0484	20.0831	20.0798	20.0075	19.6598	19.0741	18.5399	
Tweekend	20.2764	20.3836	20.5420	20.7264	20.8801	20.9662	20.9917	20.9884	20.9388	20.7553	20.4811	20.2405	

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	19.8832	20.0465	20.2931	20.5728	20.8149	20.9481	20.9872	20.9822	20.9044	20.6223	20.1898	19.8278	(87)
Th 2	20.0899	20.0899	20.0899	20.0899	20.0899	20.0899	20.0899	20.0899	20.0899	20.0899	20.0899	20.0899	(88)
util rest of house													
	0.9539	0.9331	0.8952	0.8201	0.6888	0.5041	0.3442	0.3785	0.5975	0.8238	0.9267	0.9603	(89)
Tweekday	18.6192	18.8551	19.2006	19.5921	19.8980	20.0484	20.0831	20.0798	20.0075	19.6598	19.0741	18.5399	
Tweekend	18.6192	18.8551	19.2006	19.5921	19.8980	20.0484	20.0831	20.0798	20.0075	19.6598	19.0741	18.5399	
MIT 2	18.6192	18.8551	19.2006	19.5921	19.8980	20.0484	20.0831	20.0798	20.0075	19.6598	19.0741	18.5399	(90)
Living area fraction										fLA = Living area / (4) =		0.1685	(91)
MIT	18.8323	19.0559	19.3847	19.7574	20.0525	20.2000	20.2355	20.2319	20.1587	19.8220	19.2622	18.7570	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8323	19.0559	19.3847	19.7574	20.0525	20.2000	20.2355	20.2319	20.1587	19.8220	19.2622	18.7570	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9412	0.9188	0.8804	0.8085	0.6867	0.5130	0.3581	0.3923	0.6029	0.8130	0.9124	0.9483	(94)
Useful gains	658.9075	703.1568	712.7600	680.4839	587.9491	426.7235	285.4126	299.5048	446.8183	574.5117	617.0557	636.1476	(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													
	1153.9636	1124.0738	1023.1382	862.1556	663.2487	444.6794	288.6810	304.2769	481.1018	732.2922	965.7596	1155.9265	(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													
	368.3217	282.8562	230.9214	130.8036	56.0229	0.0000	0.0000	0.0000	0.0000	117.3887	251.0668	386.7155	(98)
Space heating												1824.0968	(98)
Space heating per m2											(98) / (4) =	22.7898	(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 %)	229.3004	(206)
Efficiency of secondary/supplementary heating system, %	100.0000	(208)
Space heating requirement	795.5052	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	368.3217	282.8562	230.9214	130.8036	56.0229	0.0000	0.0000	0.0000	0.0000	117.3887	251.0668	386.7155	(98)
Space heating efficiency (main heating system 1)													
	229.3004	229.3004	229.3004	229.3004	229.3004	0.0000	0.0000	0.0000	0.0000	229.3004	229.3004	229.3004	(210)
Space heating fuel (main heating system)													
	160.6284	123.3561	100.7069	57.0446	24.4321	0.0000	0.0000	0.0000	0.0000	51.1943	109.4925	168.6501	(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													
	132.1025	101.6379	86.0993	51.2006	27.5503	17.9454	17.3543	37.6778	59.5865	94.5190	117.8088	132.0840	(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													
	77.5795	59.6887	50.5633	30.0685	16.1794	10.5388	10.1916	22.1270	34.9932	55.5080	69.1853	77.5687	(219)
Water heating fuel used												514.1921	(219)

Annual totals kWh/year		
Space heating fuel - main system	795.5052	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
(MEVDecentralised, Database: total watage = 6.6170, total flow = 29.0000, SFP = 0.2282)		
mechanical ventilation fans (SFP = 0.2282)	54.8107	(230a)
pump for solar water heating	50.0000	(230g)
Total electricity for the above, kWh/year	104.8107	(231)
Electricity for lighting (calculated in Appendix L)	368.3056	(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	55.5741	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	795.5052	13.1900	104.9271	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	514.1921	13.1900	67.8219	(247)
Mechanical ventilation fans	54.8107	13.1900	7.2295	(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	368.3056	13.1900	48.5795	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			7.3302	(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] =	0.0246	(257)
SAP value		99.6565	
SAP rating (Section 12)		100	(258)
SAP band		A	

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	795.5052	0.5190	412.8672	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	514.1921	0.5190	266.8657	(264)
Space and water heating			679.7329	(265)
Pumps and fans	104.8107	0.5190	54.3967	(267)
Energy for lighting	368.3056	0.5190	191.1506	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			28.8430	(272)
CO2 emissions per m2			0.3600	(273)
EI value			99.6909	
EI rating			100	(274)
EI band			A	

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	40.0200 (1b)	x	2.3100 (2b)	=	92.4462	(1b) - (3b)
First floor	40.0200 (1c)	x	2.6100 (2c)	=	104.4522	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n) 80.0400						(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	196.8984	(5)

2. Ventilation rate

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

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

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

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.1500	1.0000	2.1500			(26)
Window (Uw = 1.20)			8.2300	1.1450	9.4237			(27)
French Door (Uw = 1.40)			3.3300	1.3258	4.4148			(27)
FP McCann System			40.0200	0.1100	4.4022	75.0000	3001.5000	(28a)
100mm Knauf Supafil 34	88.4600	13.7100	74.7500	0.2500	18.6875	52.8000	3946.8000	(29a)
Plane Ceiling-500mm Loft Roll	40.0200		40.0200	0.0900	3.6018	9.0000	360.1800	(30)
Total net area of external elements Aum(A, m2)			168.5000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	42.6799			(33)
E-WM-30			39.9000	0.0000	0.0000	45.0000	1795.5000	(32)
Timber GF			20.5700			9.0000	185.1300	(32c)
Timber 1F			76.2500			9.0000	686.2500	(32c)
AAC GF			49.2000			39.0000	1918.8000	(32c)
Internal Floor			40.0200			12.6000	504.2520	(32d)
Internal Ceiling			40.0200			9.0000	360.1800	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 12758.5920	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	159.4027	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	4.2388	(36)
Total fabric heat loss	(33) + (36) = 46.9187	(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	32.4882	32.4882	32.4882	32.4882	32.4882	32.4882	32.4882	32.4882	32.4882	32.4882	32.4882	32.4882	(38)
Heat transfer coeff	79.4070	79.4070	79.4070	79.4070	79.4070	79.4070	79.4070	79.4070	79.4070	79.4070	79.4070	79.4070	(39)
Average = Sum(39)m / 12 =												79.4070	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.9921	0.9921	0.9921	0.9921	0.9921	0.9921	0.9921	0.9921	0.9921	0.9921	0.9921	0.9921	(40)
HLP (average)												0.9921	(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	2.4636	(42)
Average daily hot water use (litres/day)	92.7110	(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													
	101.9821	98.2736	94.5652	90.8567	87.1483	83.4399	83.4399	87.1483	90.8567	94.5652	98.2736	101.9821	(44)
Energy conte	151.2365	132.2724	136.4932	118.9981	114.1815	98.5300	91.3025	104.7710	106.0223	123.5587	134.8740	146.4644	(45)
Energy content (annual)										Total = Sum(45)m =		1458.7045	(45)
Distribution loss (46)m = 0.15 x (45)m													
	22.6855	19.8409	20.4740	17.8497	17.1272	14.7795	13.6954	15.7156	15.9033	18.5338	20.2311	21.9697	(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													
	200.6133	176.8708	184.4743	160.0285	150.7640	133.7073	127.6524	142.0513	148.4034	171.5398	182.6580	195.8412	(62)
WWHRS	-49.5541	-43.5996	-44.5000	-36.6247	-34.0127	-28.0630	-23.7583	-28.7632	-29.5989	-36.5818	-42.3638	-47.8937	eq.(G10)
Total of WWHRS savings												-445.3138	
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												1.8901	(H8)
Utilisation factor												0.4109	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												92.7110	(H14)
Volume ratio Veff/V												0.8090	(H15)
Solar storage volume factor												0.9576	(H16)
Solar input												-662.6124	(H17)
Solar input	-20.3949	-30.6535	-51.6243	-71.3606	-85.9422	-90.4504	-88.2785	-78.8332	-61.5296	-41.8575	-24.7905	-16.8973	(63)
								Solar input (sum of months) = Sum(63)m =				-662.6124	(63)
Output from w/h													
	130.6643	102.6177	88.3500	52.0432	30.8091	15.1938	15.6156	34.4549	57.2749	93.1005	115.5037	131.0502	(64)
								Total per year (kWh/year) = Sum(64)m =				866.6779	(64)
Heat gains from water heating, kWh/month													
	89.7876	79.6593	83.7688	72.3912	67.2313	60.9030	59.4380	64.6606	69.1573	79.4681	83.0728	88.2009	(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	147.8172	147.8172	147.8172	147.8172	147.8172	147.8172	147.8172	147.8172	147.8172	147.8172	147.8172	147.8172	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	52.1375	46.3080	37.6602	28.5112	21.3125	17.9929	19.4419	25.2714	33.9192	43.0682	50.2669	53.5865	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	327.6479	331.0479	322.4801	304.2403	281.2158	259.5760	245.1194	241.7194	250.2872	268.5270	291.5515	313.1912	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.2453	52.2453	52.2453	52.2453	52.2453	52.2453	52.2453	52.2453	52.2453	52.2453	52.2453	52.2453	(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)													
	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	-98.5448	(71)
Water heating gains (Table 5)													
	120.6822	118.5406	112.5925	100.5433	90.3647	84.5876	79.8897	86.9094	96.0518	106.8120	115.3789	118.5495	(72)
Total internal gains													
	601.9853	597.4143	574.2506	534.8126	494.4107	463.6742	445.9688	455.4179	481.7759	519.9249	558.7150	586.8451	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	3.9000	11.9814	0.4600	0.0000	0.7700	16.5509	(74)
South	4.3300	50.9848	0.4600	0.0000	0.7700	78.1947	(78)
North	3.3300	11.9814	0.4300	0.0000	0.7700	13.2103	(74)

Solar gains	107.9559	166.5623	231.9403	314.3169	363.2689	396.5539	373.7481	333.7542	278.0038	198.1298	132.5854	91.4835	(83)
Total gains	709.9413	763.9766	806.1909	849.1294	857.6796	860.2282	819.7169	789.1722	759.7796	718.0547	691.3004	678.3285	(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, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	44.6315	44.6315	44.6315	44.6315	44.6315	44.6315	44.6315	44.6315	44.6315	44.6315	44.6315	44.6315	
alpha	3.9754	3.9754	3.9754	3.9754	3.9754	3.9754	3.9754	3.9754	3.9754	3.9754	3.9754	3.9754	
util living area													
	0.9529	0.9360	0.8966	0.8136	0.6656	0.4498	0.2985	0.3196	0.5706	0.8142	0.9223	0.9590	(86)
Tweekday	18.7846	18.9741	19.3357	19.7199	19.9861	20.0793	20.0892	20.0889	20.0557	19.7911	19.2519	18.7216	
Tweekend	20.3508	20.4375	20.6044	20.7889	20.9287	20.9888	20.9984	20.9979	20.9701	20.8208	20.5628	20.3220	

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	19.9981	20.1299	20.3894	20.6704	20.8899	20.9828	20.9975	20.9967	20.9532	20.7234	20.3173	19.9536	(87)
Th 2	20.0899	20.0899	20.0899	20.0899	20.0899	20.0899	20.0899	20.0899	20.0899	20.0899	20.0899	20.0899	(88)
util rest of house													
	0.9440	0.9241	0.8771	0.7793	0.6082	0.3726	0.2118	0.2299	0.4931	0.7731	0.9057	0.9510	(89)
Tweekday	18.7846	18.9741	19.3357	19.7199	19.9861	20.0793	20.0892	20.0889	20.0557	19.7911	19.2519	18.7216	
Tweekend	18.7846	18.9741	19.3357	19.7199	19.9861	20.0793	20.0892	20.0889	20.0557	19.7911	19.2519	18.7216	
MIT 2	18.7846	18.9741	19.3357	19.7199	19.9861	20.0793	20.0892	20.0889	20.0557	19.7911	19.2519	18.7216	(90)
Living area fraction										fLA = Living area / (4) =		0.1685	(91)
MIT	18.9891	19.1689	19.5133	19.8801	20.1384	20.2316	20.2423	20.2419	20.2069	19.9482	19.4315	18.9293	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9891	19.1689	19.5133	19.8801	20.1384	20.2316	20.2423	20.2419	20.2069	19.9482	19.4315	18.9293	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9304	0.9095	0.8628	0.7705	0.6114	0.3849	0.2264	0.2450	0.5035	0.7659	0.8912	0.9380	(94)
Useful gains	660.5171	694.8176	695.5611	654.2856	524.3848	331.0919	185.5990	193.3523	382.5468	549.9550	616.0864	636.3000	(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													
	1102.8898	1077.4681	961.8780	792.4919	566.8389	336.0160	185.9945	193.9046	397.5865	662.9086	907.7412	1098.1389	(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													
	329.1253	257.1411	198.1397	99.5085	31.5859	0.0000	0.0000	0.0000	0.0000	84.0375	209.9915	343.6081	(98)
Space heating												1553.1376	(98)
Space heating per m2											(98) / (4) =	19.4045	(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 %)	229.3004	(206)
Efficiency of secondary/supplementary heating system, %	100.0000	(208)
Space heating requirement	677.3374	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	329.1253	257.1411	198.1397	99.5085	31.5859	0.0000	0.0000	0.0000	0.0000	84.0375	209.9915	343.6081	(98)
Space heating efficiency (main heating system 1)													
	229.3004	229.3004	229.3004	229.3004	229.3004	0.0000	0.0000	0.0000	0.0000	229.3004	229.3004	229.3004	(210)
Space heating fuel (main heating system)													
	143.5345	112.1416	86.4105	43.3966	13.7749	0.0000	0.0000	0.0000	0.0000	36.6495	91.5792	149.8506	(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		
	130.6643 102.6177 88.3500 52.0432 30.8091 15.1938 15.6156 34.4549 57.2749 93.1005 115.5037	131.0502 (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		
	76.7349 60.2641 51.8851 30.5633 18.0932 8.9229 9.1705 20.2342 33.6357 54.6749 67.8316	76.9616 (219)
Water heating fuel used		508.9722 (219)
Annual totals kWh/year		
Space heating fuel - main system		677.3374 (211)
Space heating fuel - secondary		0.0000 (215)
Electricity for pumps and fans:		
(MEVDecentralised, Database: total watage = 6.6170, total flow = 29.0000, SFP = 0.2282)		
mechanical ventilation fans (SFP = 0.2282)		54.8107 (230a)
pump for solar water heating		50.0000 (230g)
Total electricity for the above, kWh/year		104.8107 (231)
Electricity for lighting (calculated in Appendix L)		368.3056 (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		-164.7338 (238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	677.3374	16.9600	114.8764	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	508.9722	16.9600	86.3217	(247)
Mechanical ventilation fans	54.8107	16.9600	9.2959	(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	368.3056	16.9600	62.4646	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-1824.1596	16.9600	-309.3775	(252)
Total energy cost			-27.9389	(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	677.3374	0.5190	351.5381	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	508.9722	0.5190	264.1566	(264)
Space and water heating			615.6947	(265)
Pumps and fans	104.8107	0.5190	54.3967	(267)
Energy for lighting	368.3056	0.5190	191.1506	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	0.5190	-946.7389	(269)
Total kg/year			-85.4969	(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	677.3374	3.0700	2079.4258	(261)
Space heating - secondary	0.0000	3.0700	0.0000	(263)
Water heating (other fuel)	508.9722	3.0700	1562.5447	(264)
Space and water heating			3641.9705	(265)
Pumps and fans	104.8107	3.0700	321.7688	(267)
Energy for lighting	368.3056	3.0700	1130.6980	(268)
Energy saving/generation technologies				
PV Unit	-1824.1596	3.0700	-5600.1701	(269)
Primary energy kWh/year			-505.7328	(272)
Primary energy kWh/m2/year			-6.3185	(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	South
Overshading	Average or unknown
Thermal mass parameter	159.4 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	259.91	(P1)
Transmission heat loss coefficient	46.92	(37)
Summer heat loss coefficient	306.82	(P2)

Overhangs

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

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North	1.000	0.90	1.000	0.900	(P8)
South	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	3.9000	81.1852	0.4600	0.0000	0.9000	131.0816
South	4.3300	112.2060	0.4600	0.0000	0.9000	201.1427
North	3.3300	81.1852	0.4300	0.0000	0.9000	104.6241
total:						436.8484

	Jun	Jul	Aug	
Solar gains	464	437	390	(P3/P4)
Internal gains	478	460	468	
Total summer gains	941	897	859	(P5)
Summer gain/loss ratio	3.07	2.92	2.80	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 159.4)	0.88	0.88	0.88	
Threshold temperature	19.95	21.71	21.48	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature:	Slight