

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



Property Reference	Cartwright End/Semi(ASHP + PV)			Issued on Date	15/12/2022
Assessment Reference	Cartwright - End/Semi(ASHP+PV)	Prop Type Ref			
Property	Plot, 2 Bed, K, WC, B				
SAP Rating	93 A	DER	8.82	TER	27.03
Environmental	94 A	% DER<TER	67.38		
CO ₂ Emissions (t/year)	0.43	DFEE	39.23	TFEE	50.22
General Requirements Compliance	Pass	% DFEE<TFEE	21.89		
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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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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DWELLING AS DESIGNED

Semi-Detached House, total floor area 71 m²

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

1a TER and DER

Fuel for main heating:Electricity

Fuel factor:1.55 (electricity)

Target Carbon Dioxide Emission Rate (TER) 27.03 kgCO₂/m²

Dwelling Carbon Dioxide Emission Rate (DER) 8.82 kgCO₂/m²OK

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)50.2 kWh/m²/yr

Dwelling Fabric Energy Efficiency (DFEE)39.2 kWh/m²/yrOK

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

3 Air permeability

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

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

5 Cylinder insulation

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

6 Controls

Space heating controls: Time and temperature zone control OK

Hot water controls:

Cylinderstat OK
Independent timer for DHW OK

7 Low energy lights

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

8 Mechanical ventilation

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

9 Summertime temperature

Overheating risk (Thames Valley): Slight OK

Based on:

Overshading: Average
Windows facing North: 3.56 m², No overhang
Windows facing East: 0.66 m², No overhang
Windows facing South: 5.55 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

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 0.029 W/m²K
Photovoltaic array 1.20 kW

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CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	35.7200 (1b)	x 2.3100 (2b)	= 82.5132 (1b) - (3b)
First floor	35.7200 (1c)	x 2.6100 (2c)	= 93.2292 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.4400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 175.7424 (5)

2. Ventilation rate

										main	secondary	other	total	m3 per hour			
										heating	heating						
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)
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)			
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec					
	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)					
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)					
Adj infilt rate																	
	0.2365	0.2318	0.2272	0.2040	0.1994	0.1762	0.1762	0.1716	0.1855	0.1994	0.2086	0.2179 (22b)					
Mechanical extract ventilation - decentralised																	
If mechanical ventilation:																0.5000 (23a)	
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (25)					

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K					
Solid Door			1.9800	1.0000	1.9800		(26)					
Window (Uw = 1.20)			6.6200	1.1450	7.5802		(27)					
French Door (Uw = 1.40)			3.1500	1.3258	4.1761		(27)					
FP McCann System			35.7200	0.1100	3.9292	75.0000	2679.0000 (28a)					
100mm Knauf Supafil 34	83.1500	11.7500	71.4000	0.2500	17.8500	52.8000	3769.9200 (29a)					
Plane Ceiling-500mm Loft Roll	35.7200		35.7200	0.0900	3.2148	9.0000	321.4800 (30)					
Total net area of external elements Aum(A, m2)			154.5900				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	38.7303		(33)					
E-WM-30			41.9200	0.0000	0.0000	45.0000	1886.4000 (32)					
Timber GF			58.1700			9.0000	523.5300 (32c)					
Timber 1F			72.3200			9.0000	650.8800 (32c)					
Internal Floor			35.7200			12.6000	450.0720 (32d)					
Internal Ceiling			35.7200			9.0000	321.4800 (32e)					
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		10602.7620 (34)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							148.4149 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.4867 (36)					
Total fabric heat loss						(33) + (36) =	43.2170 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 28.9975	Feb 28.9975	Mar 28.9975	Apr 28.9975	May 28.9975	Jun 28.9975	Jul 28.9975	Aug 28.9975	Sep 28.9975	Oct 28.9975	Nov 28.9975	Dec 28.9975 (38)
Heat transfer coeff	72.2145	72.2145	72.2145	72.2145	72.2145	72.2145	72.2145	72.2145	72.2145	72.2145	72.2145	72.2145 (39)
Average = Sum(39)m / 12 =												72.2145 (39)
HLP	Jan 1.0108	Feb 1.0108	Mar 1.0108	Apr 1.0108	May 1.0108	Jun 1.0108	Jul 1.0108	Aug 1.0108	Sep 1.0108	Oct 1.0108	Nov 1.0108	Dec 1.0108 (40)
HLP (average)												1.0108 (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												2.2806 (42)
Average daily hot water use (litres/day)												88.3636 (43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

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Daily hot water use	97.1999	93.6654	90.1308	86.5963	83.0617	79.5272	79.5272	83.0617	86.5963	90.1308	93.6654	97.1999 (44)
Energy conte	144.1447	126.0698	130.0928	113.4180	108.8273	93.9097	87.0211	99.8580	101.0506	117.7648	128.5495	139.5964 (45)
Energy content (annual)												1390.3028 (45)
Distribution loss (46)m = 0.15 x (45)m	21.6217	18.9105	19.5139	17.0127	16.3241	14.0865	13.0532	14.9787	15.1576	17.6647	19.2824	20.9395 (46)
Water storage loss:												
Store volume												200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5600 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.8424 (55)
Total storage loss	26.1144	23.5872	26.1144	25.2720	26.1144	25.2720	26.1144	26.1144	25.2720	26.1144	25.2720	26.1144 (56)
If cylinder contains dedicated solar storage	26.1144	23.5872	26.1144	25.2720	26.1144	25.2720	26.1144	26.1144	25.2720	26.1144	25.2720	26.1144 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Total heat required for water heating calculated for each month	193.5215	170.6682	179.4696	161.2020	158.2041	141.6937	136.3979	149.2348	148.8346	167.1416	176.3335	188.9732 (62)
WWHRS	-46.4201	-40.8406	-41.6849	-34.3185	-31.8766	-26.3044	-22.2765	-26.9669	-27.7472	-34.2857	-39.6943	-44.8624 eq. (G10)
Total of WWHRS savings												-417.2782
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	147.1013	129.8276	137.7847	126.8835	126.3275	115.3893	114.1214	122.2679	121.0874	132.8559	136.6392	144.1108 (64)
Total per year (kWh/year) = Sum(64)m =												1554.3966 (64)
Heat gains from water heating, kWh/month	87.4295	77.5969	82.7573	75.9387	75.6865	69.4522	68.4360	72.7042	71.8265	78.6582	80.9699	85.9172 (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	114.0285	114.0285	114.0285	114.0285	114.0285	114.0285	114.0285	114.0285	114.0285	114.0285	114.0285	114.0285 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	19.2876	17.1311	13.9319	10.5474	7.8843	6.6562	7.1923	9.3488	12.5480	15.9325	18.5956	19.8237 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	200.6343	202.7163	197.4698	186.3007	172.2017	158.9507	150.0982	148.0162	153.2627	164.4318	178.5307	191.7818 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.4029	34.4029	34.4029	34.4029	34.4029	34.4029	34.4029	34.4029	34.4029	34.4029	34.4029	34.4029 (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)	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228 (71)
Water heating gains (Table 5)	117.5128	115.4716	111.2329	105.4704	101.7292	96.4614	91.9838	97.7207	99.7591	105.7234	112.4582	115.4802 (72)
Total internal gains	394.6433	392.5275	379.8432	359.5270	339.0238	319.2768	306.4828	312.2943	322.7783	343.2963	366.7931	384.2942 (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					3.5600	10.6334	0.4600	0.0000	0.7700		13.4082 (74)	
East					0.6600	19.6403	0.4600	0.0000	0.7700		4.5913 (76)	
South					2.4000	46.7521	0.4600	0.0000	0.7700		39.7430 (78)	
South					3.1500	46.7521	0.4300	0.0000	0.7700		48.7608 (78)	

Solar gains	106.5033	179.5518	242.9684	300.1892	338.1070	337.1936	324.4009	295.4094	262.4276	197.4975	127.1727	91.4288 (83)
Total gains	501.1466	572.0793	622.8117	659.7163	677.1307	656.4704	630.8838	607.7037	585.2058	540.7937	493.9659	475.7230 (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	40.7842	40.7842	40.7842	40.7842	40.7842	40.7842	40.7842	40.7842	40.7842	40.7842	40.7842	40.7842
alpha	3.7189	3.7189	3.7189	3.7189	3.7189	3.7189	3.7189	3.7189	3.7189	3.7189	3.7189	3.7189
util living area	0.9773	0.9623	0.9358	0.8827	0.7848	0.6342	0.4833	0.5188	0.7207	0.8952	0.9623	0.9811 (86)
Tweekday	18.1545	18.4557	18.8806	19.3671	19.7717	19.9970	20.0597	20.0537	19.9334	19.4440	18.7021	18.0665
Tweekend	20.0685	20.2039	20.3961	20.6209	20.8177	20.9404	20.9833	20.9780	20.9005	20.6529	20.3127	20.0291
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	19.5624	19.7685	20.0680	20.4081	20.7187	20.9084	20.9743	20.9661	20.8446	20.4643	19.9268	19.5016 (87)
Th 2	20.0743	20.0743	20.0743	20.0743	20.0743	20.0743	20.0743	20.0743	20.0743	20.0743	20.0743	20.0743 (88)
util rest of house	0.9730	0.9553	0.9235	0.8594	0.7414	0.5622	0.3898	0.4251	0.6555	0.8696	0.9540	0.9774 (89)
Tweekday	18.1545	18.4557	18.8806	19.3671	19.7717	19.9970	20.0597	20.0537	19.9334	19.4440	18.7021	18.0665
Tweekend	18.1545	18.4557	18.8806	19.3671	19.7717	19.9970	20.0597	20.0537	19.9334	19.4440	18.7021	18.0665
MIT 2	18.1545	18.4557	18.8806	19.3671	19.7717	19.9970	20.0597	20.0537	19.9334	19.4440	18.7021	18.0665 (90)
Living area fraction									fLA = Living area / (4) =			0.2070 (91)
MIT	18.4460	18.7275	19.1265	19.5827	19.9678	20.1857	20.2490	20.2426	20.1220	19.6553	18.9557	18.3636 (92)
Temperature adjustment												0.0000
adjusted MIT	18.4460	18.7275	19.1265	19.5827	19.9678	20.1857	20.2490	20.2426	20.1220	19.6553	18.9557	18.3636 (93)

8. Space heating requirement

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	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9627	0.9420	0.9080	0.8450	0.7359	0.5714	0.4081	0.4428	0.6592	0.8558	0.9409	0.9681	(94)
Useful gains	482.4336	538.9009	565.4986	557.4360	498.3220	375.1084	257.4451	269.1115	385.7410	462.8103	464.7597	460.5470	(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													
Month fracti	1021.5442	998.5442	911.8124	771.4420	597.0520	403.3658	263.5131	277.4893	434.8757	653.9203	856.1504	1022.8183	(97)
Space heating kWh	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	401.0983	308.8803	257.6575	154.0843	73.4552	0.0000	0.0000	0.0000	0.0000	142.1858	281.8013	418.3299	(98)
Space heating per m2												2037.4926	(98)
											(98) / (4) =	28.5203	(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 %)													215.0089	(206)
Efficiency of secondary/supplementary heating system, %													100.0000	(208)
Space heating requirement													947.6318	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	401.0983	308.8803	257.6575	154.0843	73.4552	0.0000	0.0000	0.0000	0.0000	142.1858	281.8013	418.3299	(98)	
Space heating efficiency (main heating system 1)	215.0089	215.0089	215.0089	215.0089	215.0089	0.0000	0.0000	0.0000	0.0000	215.0089	215.0089	215.0089	(210)	
Space heating fuel (main heating system)	186.5496	143.6593	119.8357	71.6642	34.1638	0.0000	0.0000	0.0000	0.0000	66.1302	131.0650	194.5640	(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	147.1013	129.8276	137.7847	126.8835	126.3275	115.3893	114.1214	122.2679	121.0874	132.8559	136.6392	144.1108	(64)	
Efficiency of water heater													170.2800	(216)
(217)m	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	(217)	
Fuel for water heating, kWh/month	86.3879	76.2436	80.9166	74.5146	74.1881	67.7644	67.0199	71.8040	71.1108	78.0220	80.2438	84.6317	(219)	
Water heating fuel used													912.8474	(219)
Annual totals kWh/year														
Space heating fuel - main system													947.6318	(211)
Space heating fuel - secondary													0.0000	(215)
Electricity for pumps and fans:														
(MEV)Decentralised, Database: total watage = 6.6170, total flow = 29.0000, SFP = 0.2282)														
mechanical ventilation fans (SFP = 0.2282)													48.9215	(230a)
Total electricity for the above, kWh/year													48.9215	(231)
Electricity for lighting (calculated in Appendix L)													340.6249	(232)
Energy saving/generation technologies (Appendices M ,N and Q)														
PV Unit 0 (0.80 * 1.20 * 1080 * 1.00) =										-1036.3436			-1036.3436	(233)
Total delivered energy for all uses													1213.6820	(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	947.6318	0.5190	491.8209	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	912.8474	0.5190	473.7678	(264)
Space and water heating			965.5887	(265)
Pumps and fans	48.9215	0.5190	25.3902	(267)
Energy for lighting	340.6249	0.5190	176.7843	(268)
Energy saving/generation technologies				
PV Unit	-1036.3436	0.5190	-537.8623	(269)
Total CO2, kg/year			629.9009	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			8.8200	(273)

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

DER			8.8200	ZC1
Total Floor Area		TFA	71.4400	
Assumed number of occupants		N	2.2806	
CO2 emission factor in Table 12 for electricity displaced from grid		EF	0.5190	
CO2 emissions from appliances, equation (L14)			16.6422	ZC2
CO2 emissions from cooking, equation (L16)			2.4319	ZC3
Total CO2 emissions			27.8941	ZC4
Residual CO2 emissions offset from biofuel CHP			0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year			0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation			0.0000	ZC7
Net CO2 emissions			27.8941	ZC8

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Calculation Type: New Build (As Designed)

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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	35.7200 (1b)	x 2.3100 (2b)	= 82.5132 (1b) - (3b)
First floor	35.7200 (1c)	x 2.6100 (2c)	= 93.2292 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.4400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 175.7424 (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) =	0.1707 (8)				
Pressure test							Yes					
Measured/design AP50							5.0000					
Infiltration rate							0.4207 (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) =	0.3892 (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	0.4962	0.4864	0.4767	0.4281	0.4183	0.3697	0.3697	0.3600	0.3892	0.4183	0.4378	0.4573 (22b)
Effective ac	0.6231	0.6183	0.6136	0.5916	0.5875	0.5683	0.5683	0.5648	0.5757	0.5875	0.5958	0.6045 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K					
TER Opaque door			1.9800	1.0000	1.9800		(26)					
TER Opening Type (Uw = 1.40)			9.7700	1.3258	12.9527		(27)					
FP McCann System			35.7200	0.1300	4.6436		(28a)					
100mm Knauf Supafil 34	83.1500	11.7500	71.4000	0.1800	12.8520		(29a)					
Plane Ceiling-500mm Loft Roll	35.7200		35.7200	0.1300	4.6436		(30)					
Total net area of external elements Aum(A, m2)			154.5900				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26) ... (30) + (32) =	37.0719		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.5820 (36)					
Total fabric heat loss						(33) + (36) =	45.6539 (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	36.1362	35.8590	35.5873	34.3110	34.0722	32.9607	32.9607	32.7548	33.3888	34.0722	34.5553	35.0603 (38)
Heat transfer coeff	81.7900	81.5128	81.2411	79.9649	79.7261	78.6145	78.6145	78.4087	79.0427	79.7261	80.2091	80.7142 (39)
Average = Sum(39)m / 12 =												79.9637 (39)
HLP Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec												
HLP (average)	1.1449	1.1410	1.1372	1.1193	1.1160	1.1004	1.1004	1.0975	1.1064	1.1160	1.1227	1.1298 (40)
Days in month												1.1193 (40)
	31	28	31	30	31	30	31	31	30	31	30	31 (41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.2806 (42)
Average daily hot water use (litres/day)												88.3636 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	97.1999	93.6654	90.1308	86.5963	83.0617	79.5272	79.5272	83.0617	86.5963	90.1308	93.6654	97.1999 (44)
Energy content (annual)	144.1447	126.0698	130.0928	113.4180	108.8273	93.9097	87.0211	99.8580	101.0506	117.7648	128.5495	139.5964 (45)
Distribution loss	Total = Sum(45)m =											1390.3028 (45)
	(46)m = 0.15 x (45)m											
	21.6217	18.9105	19.5139	17.0127	16.3241	14.0865	13.0532	14.9787	15.1576	17.6647	19.2824	20.9395 (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)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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	195.0707	172.0676	181.0189	162.7013	159.7534	143.1930	137.9472	150.7841	150.3339	168.6909	177.8328	190.5225 (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)
Output from w/h	195.0707	172.0676	181.0189	162.7013	159.7534	143.1930	137.9472	150.7841	150.3339	168.6909	177.8328	190.5225 (64)
Heat gains from water heating, kWh/month	88.6690	78.7164	83.9967	77.1381	76.9259	70.6516	69.6754	73.9437	73.0260	79.8977	82.1693	87.1567 (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	114.0285	114.0285	114.0285	114.0285	114.0285	114.0285	114.0285	114.0285	114.0285	114.0285	114.0285	114.0285	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	19.2876	17.1311	13.9319	10.5474	7.8843	6.6562	7.1923	9.3488	12.5480	15.9325	18.5956	19.8237	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	200.6343	202.7163	197.4698	186.3007	172.2017	158.9507	150.0982	148.0162	153.2627	164.4318	178.5307	191.7818	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.4029	34.4029	34.4029	34.4029	34.4029	34.4029	34.4029	34.4029	34.4029	34.4029	34.4029	34.4029	(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)	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	(71)
Water heating gains (Table 5)	119.1787	117.1375	112.8988	107.1363	103.3951	98.1272	93.6497	99.3866	101.4250	107.3893	114.1241	117.1461	(72)
Total internal gains	399.3092	397.1934	384.5091	364.1929	343.6896	323.9427	311.1487	316.9602	327.4442	347.9622	371.4590	388.9601	(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					3.5600	10.6334	0.6300	0.7000			0.7700			11.5689 (74)
East					0.6600	19.6403	0.6300	0.7000			0.7700			3.9615 (76)
South					5.5500	46.7521	0.6300	0.7000			0.7700			79.2986 (78)
Solar gains	94.8291	159.7291	215.7630	265.9320	298.9395	297.8800	286.6830	261.4726	232.8261	175.5910	113.2072			81.4235 (83)
Total gains	494.1383	556.9226	600.2721	630.1249	642.6292	621.8227	597.8317	578.4328	560.2703	523.5531	484.6662			470.3836 (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	60.6567	60.8629	61.0665	62.0411	62.2269	63.1068	63.1068	63.2725	62.7650	62.2269	61.8522	61.4652
alpha	5.0438	5.0575	5.0711	5.1361	5.1485	5.2071	5.2071	5.2182	5.1843	5.1485	5.1235	5.0977
util living area	0.9962	0.9924	0.9837	0.9585	0.8909	0.7390	0.5640	0.6025	0.8268	0.9633	0.9920	0.9970 (86)
MIT	19.8504	19.9997	20.2258	20.5193	20.7765	20.9422	20.9884	20.9838	20.8911	20.5703	20.1622	19.8296 (87)
Th 2	19.9644	19.9675	19.9706	19.9851	19.9878	20.0005	20.0005	20.0028	19.9956	19.9878	19.9823	19.9766 (88)
util rest of house	0.9950	0.9899	0.9779	0.9429	0.8488	0.6500	0.4434	0.4824	0.7526	0.9463	0.9889	0.9961 (89)
MIT 2	18.4427	18.6620	18.9915	19.4191	19.7644	19.9609	19.9961	19.9961	19.9095	19.4976	18.9103	18.4211 (90)
Living area fraction									fLA = Living area / (4) =			0.2070 (91)
MIT	18.7341	18.9390	19.2470	19.6469	19.9739	20.1641	20.2015	20.2006	20.1127	19.7197	19.1695	18.7127 (92)
Temperature adjustment												0.0000
adjusted MIT	18.7341	18.9390	19.2470	19.6469	19.9739	20.1641	20.2015	20.2006	20.1127	19.7197	19.1695	18.7127 (93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	490.5669	549.3378	583.7872	589.9921	545.0145	414.0054	280.0621	293.3863	427.1439	492.3936	477.5750	467.6846	(94)
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	1180.5696	1144.3558	1035.5804	859.3729	659.6490	437.4156	283.1337	297.9978	475.2607	727.0769	968.0838	1171.3818	(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	513.3620	399.8520	336.1341	193.9542	85.2880	0.0000	0.0000	0.0000	0.0000	174.6044	353.1663	523.5507	(98)
Space heating	513.3620	399.8520	336.1341	193.9542	85.2880	0.0000	0.0000	0.0000	0.0000	174.6044	353.1663	523.5507	(98)
Space heating per m2													(98) / (4) =

8c. Space cooling requirement

Not applicable

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000 (201)
Fraction of space heat from main system(s)												1.0000 (202)
Efficiency of main space heating system 1 (in %)												93.5000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement												2759.2640 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	513.3620	399.8520	336.1341	193.9542	85.2880	0.0000	0.0000	0.0000	0.0000	174.6044	353.1663	523.5507 (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)	549.0503	427.6492	359.5018	207.4376	91.2172	0.0000	0.0000	0.0000	0.0000	186.7426	377.7180	559.9473 (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 requirement	195.0707	172.0676	181.0189	162.7013	159.7534	143.1930	137.9472	150.7841	150.3339	168.6909	177.8328	190.5225 (64)
Efficiency of water heater (217)m	87.2776	86.9907	86.4429	85.2834	83.2248	79.8000	79.8000	79.8000	79.8000	84.9058	86.6107	79.8000 (216)
Fuel for water heating, kWh/month	223.5060	197.7999	209.4086	190.7773	191.9540	179.4398	172.8662	188.9525	188.3884	198.6801	205.3242	218.0536 (219)
Water heating fuel used												2365.1507 (219)
Annual totals kWh/year												
Space heating fuel - main system												2759.2640 (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)												340.6249 (232)
Total delivered energy for all uses												5540.0396 (238)

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

	Energy kWh/year	Emission factor kg CO ₂ /kWh	Emissions kg CO ₂ /year
Space heating - main system 1	2759.2640	0.2160	596.0010 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2365.1507	0.2160	510.8726 (264)
Space and water heating			1106.8736 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	340.6249	0.5190	176.7843 (268)
Total CO ₂ , kg/m ² /year			1322.5829 (272)
Emissions per m ² for space and water heating			15.4938 (272a)
Fuel factor (electricity)			1.5500
Emissions per m ² for lighting			2.4746 (272b)
Emissions per m ² for pumps and fans			0.5449 (272c)
Target Carbon Dioxide Emission Rate (TER) = (15.4938 * 1.55) + 2.4746 + 0.5449, rounded to 2 d.p.			27.0300 (273)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	35.7200 (1b)	x 2.3100 (2b)	= 82.5132 (1b) - (3b)
First floor	35.7200 (1c)	x 2.6100 (2c)	= 93.2292 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.4400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 175.7424 (5)

2. Ventilation rate

	main heating	secondary heating	other	total	m3 per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	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)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					30.0000 / (5) = 0.1707 (8)
Pressure test					Yes
Measured/design AP50					4.0100
Infiltration rate					0.3712 (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) =	0.3434 (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	0.4378	0.4292	0.4206	0.3777	0.3691	0.3262	0.3262	0.3176	0.3434	0.3691	0.3863	0.4035 (22b)
Effective ac	0.5958	0.5921	0.5885	0.5713	0.5681	0.5532	0.5532	0.5504	0.5589	0.5681	0.5746	0.5814 (25)

3. Heat losses and heat loss parameter

Element	Gross m ²	Openings m ²	NetArea m ²	U-value W/m ² K	A x U W/K	K-value kJ/m ² K	A x K kJ/K
Solid Door			1.9800	1.0000	1.9800		(26)
Window (Uw = 1.20)			6.6200	1.1450	7.5802		(27)
French Door (Uw = 1.40)			3.1500	1.3258	4.1761		(27)
FP McCann System			35.7200	0.1100	3.9292	75.0000	2679.0000 (28a)
100mm Knauf Supafil 34	83.1500	11.7500	71.4000	0.2500	17.8500	52.8000	3769.9200 (29a)
Plane Ceiling-500mm Loft Roll	35.7200		35.7200	0.0900	3.2148	9.0000	321.4800 (30)
Total net area of external elements Aum(A, m ²)			154.5900				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	38.7303		(33)
E-WM-30			41.9200	0.0000	0.0000	45.0000	1886.4000 (32)
Timber GF			58.1700			9.0000	523.5300 (32c)
Timber 1F			72.3200			9.0000	650.8800 (32c)
Internal Floor			35.7200			12.6000	450.0720 (32d)
Internal Ceiling			35.7200			9.0000	321.4800 (32e)

Heat capacity Cm = Sum(A x k)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m²K
Thermal bridges (Sum(L x Psi) calculated using Appendix K)
Total fabric heat loss
(28)...(30) + (32) + (32a)...(32e) = 10602.7620 (34)
148.4149 (35)
4.4867 (36)
(33) + (36) = 43.2170 (37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(38)m	34.5551	34.3393	34.1278	33.1342	32.9483	32.0829	32.0829	31.9227	32.4163	32.9483	33.3244	33.7175 (38)
Heat transfer coeff	77.7721	77.5563	77.3448	76.3512	76.1653	75.2999	75.2999	75.1397	75.6332	76.1653	76.5413	76.9345 (39)
Average = Sum(39)m / 12 =												76.3503 (39)
HLP	1.0886	1.0856	1.0827	1.0687	1.0661	1.0540	1.0540	1.0518	1.0587	1.0661	1.0714	1.0769 (40)
HLP (average)												1.0687 (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												2.2806 (42)
Average daily hot water use (litres/day)												88.3636 (43)
Daily hot water use	97.1999	93.6654	90.1308	86.5963	83.0617	79.5272	79.5272	83.0617	86.5963	90.1308	93.6654	97.1999 (44)
Energy conte	144.1447	126.0698	130.0928	113.4180	108.8273	93.9097	87.0211	99.8580	101.0506	117.7648	128.5495	139.5964 (45)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)	Total = Sum(45)m = 1390.3028 (45)											
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (59)
Heat gains from water heating, kWh/month	30.6307	26.7898	27.6447	24.1013	23.1258	19.9558	18.4920	21.2198	21.4733	25.0250	27.3168	29.6642 (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)
(66)m	114.0285	114.0285	114.0285	114.0285	114.0285	114.0285	114.0285	114.0285	114.0285	114.0285	114.0285	114.0285	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	19.2876	17.1311	13.9319	10.5474	7.8843	6.6562	7.1923	9.3488	12.5480	15.9325	18.5956	19.8237	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	200.6343	202.7163	197.4698	186.3007	172.2017	158.9507	150.0982	148.0162	153.2627	164.4318	178.5307	191.7818	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.4029	34.4029	34.4029	34.4029	34.4029	34.4029	34.4029	34.4029	34.4029	34.4029	34.4029	34.4029	(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)	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	(71)
Water heating gains (Table 5)	41.1704	39.8658	37.1569	33.4741	31.0831	27.7164	24.8548	28.5213	29.8240	33.6358	37.9399	39.8713	(72)
Total internal gains	318.3008	316.9217	305.7672	287.5307	268.3776	250.5319	239.3538	243.0949	252.8432	271.2086	292.2749	308.6853	(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					3.5600	10.6334	0.4600	0.0000			0.7700	13.4082	(74)
East					0.6600	19.6403	0.4600	0.0000			0.7700	4.5913	(76)
South					2.4000	46.7521	0.4600	0.0000			0.7700	39.7430	(78)
South					3.1500	46.7521	0.4300	0.0000			0.7700	48.7608	(78)

Solar gains	106.5033	179.5518	242.9684	300.1892	338.1070	337.1936	324.4009	295.4094	262.4276	197.4975	127.1727	91.4288	(83)
Total gains	424.8041	496.4735	548.7356	587.7199	606.4846	587.7254	563.7548	538.5043	515.2707	468.7061	419.4476	400.1141	(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	37.8698	37.9751	38.0790	38.5745	38.6687	39.1131	39.1131	39.1965	38.9407	38.6687	38.4787	38.2821	
alpha	3.5247	3.5317	3.5386	3.5716	3.5779	3.6075	3.6075	3.6131	3.5960	3.5779	3.5652	3.5521	
util living area	0.9868	0.9765	0.9576	0.9172	0.8378	0.6996	0.5487	0.5887	0.7874	0.9313	0.9777	0.9892	(86)
MIT	19.2679	19.4946	19.8244	20.2381	20.6033	20.8594	20.9563	20.9430	20.7694	20.2954	19.7065	19.2286	(87)
Th 2	20.0101	20.0126	20.0150	20.0264	20.0286	20.0386	20.0386	20.0404	20.0347	20.0286	20.0243	20.0197	(88)
util rest of house	0.9841	0.9717	0.9487	0.8985	0.7988	0.6260	0.4439	0.4853	0.7256	0.9121	0.9724	0.9870	(89)
MIT 2	18.4274	18.6534	18.9800	19.3900	19.7316	19.9558	20.0213	20.0162	19.8858	19.4527	18.8740	18.3955	(90)
Living area fraction	18.6014	18.8275	19.1548	19.5656	19.9120	20.1429	20.2148	20.2081	20.0687	19.6272	19.0464	18.5680	(92)
Temperature adjustment	18.6014	18.8275	19.1548	19.5656	19.9120	20.1429	20.2148	20.2081	20.0687	19.6272	19.0464	18.5680	(93)
adjusted MIT	18.6014	18.8275	19.1548	19.5656	19.9120	20.1429	20.2148	20.2081	20.0687	19.6272	19.0464	18.5680	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	415.8611	478.7183	515.2031	521.8640	481.2111	373.0232	261.6481	271.7029	375.1243	422.9055	404.9270	393.1378	(94)
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	1112.2505	1080.1688	978.7856	814.3295	625.4714	417.3797	272.1976	286.1358	451.4338	687.5583	914.3914	1105.3957	(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	518.1137	404.1747	344.9054	210.5752	107.3297	0.0000	0.0000	0.0000	0.0000	196.9017	366.8144	529.9198	(98)
Space heating												2678.7346	(98)
Space heating per m2												37.4963	(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													

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Calculation Type: New Build (As Designed)



CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	707.8191	557.2193	571.0614	0.0000	0.0000	0.0000	0.0000 (100)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.8157	0.8793	0.8614	0.0000	0.0000	0.0000	0.0000 (101)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	577.3874	489.9496	491.9225	0.0000	0.0000	0.0000	0.0000 (102)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	772.2946	742.6080	714.6722	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	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	0.0000	0.0000	0.0000	0.0000	0.0000	140.3332	187.9778	165.7258	0.0000	0.0000	0.0000	0.0000 (104)
Cooled fraction									FC = cooled area / (4) =			494.0368 (104)
Intermittency factor (Table 10b)												1.0000 (105)
Space cooling kWh	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	0.0000	0.0000	0.0000	0.0000	0.0000	35.0833	46.9945	41.4314	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling per m2												123.5092 (107)
Energy for space heating												1.7289 (108)
Energy for space cooling												37.4963 (99)
Total												1.7289 (108)
Dwelling Fabric Energy Efficiency (DFEE)												39.2251 (109)
												39.2 (109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	35.7200 (1b)	x 2.3100 (2b)	= 82.5132 (1b) - (3b)
First floor	35.7200 (1c)	x 2.6100 (2c)	= 93.2292 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.4400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 175.7424 (5)

2. Ventilation rate

										main	secondary	other	total	m3 per hour			
										heating	heating						
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) =	0.1707 (8)
Pressure test										Yes							
Measured/design AP50										5.0000							
Infiltration rate										0.4207 (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) =					0.3892 (21)		
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec					
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	(22)				
Adj infilt rate	0.4962	0.4864	0.4767	0.4281	0.4183	0.3697	0.3697	0.3600	0.3892	0.4183	0.4378	0.4573	(22a)				
Effective ac	0.6231	0.6183	0.6136	0.5916	0.5875	0.5683	0.5683	0.5648	0.5757	0.5875	0.5958	0.6045	(22b)				
													(25)				

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K					
TER Opaque door			1.9800	1.0000	1.9800		(26)					
TER Opening Type (Uw = 1.40)			9.7700	1.3258	12.9527		(27)					
FP McCann System			35.7200	0.1300	4.6436		(28a)					
100mm Knauf Supafil 34	83.1500	11.7500	71.4000	0.1800	12.8520		(29a)					
Plane Ceiling-500mm Loft Roll	35.7200		35.7200	0.1300	4.6436		(30)					
Total net area of external elements Aum(A, m2)			154.5900				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26) ... (30) + (32) =	37.0719		(33)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.5820 (36)					
Total fabric heat loss						(33) + (36) =	45.6539 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 36.1362	Feb 35.8590	Mar 35.5873	Apr 34.3110	May 34.0722	Jun 32.9607	Jul 32.9607	Aug 32.7548	Sep 33.3888	Oct 34.0722	Nov 34.5553	Dec 35.0603 (38)
Heat transfer coeff	81.7900	81.5128	81.2411	79.9649	79.7261	78.6145	78.6145	78.4087	79.0427	79.7261	80.2091	80.7142 (39)
Average = Sum(39)m / 12 =												79.9637 (39)
HLP	Jan 1.1449	Feb 1.1410	Mar 1.1372	Apr 1.1193	May 1.1160	Jun 1.1004	Jul 1.1004	Aug 1.0975	Sep 1.1064	Oct 1.1160	Nov 1.1227	Dec 1.1298 (40)
HLP (average)												1.1193 (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												2.2806 (42)
Average daily hot water use (litres/day)												88.3636 (43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	97.1999	93.6654	90.1308	86.5963	83.0617	79.5272	79.5272	83.0617	86.5963	90.1308	93.6654	97.1999 (44)
Energy content (annual)	144.1447	126.0698	130.0928	113.4180	108.8273	93.9097	87.0211	99.8580	101.0506	117.7648	128.5495	139.5964 (45)
Distribution loss	Total = Sum(45)m = 1390.3028 (45)											
	(46)m = 0.15 x (45)m											
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (46)
Water storage loss:												
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)
If cylinder contains dedicated solar storage												

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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 (57)
Heat gains from water heating, kWh/month	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)
	30.6307	26.7898	27.6447	24.1013	23.1258	19.9558	18.4920	21.2198	21.4733	25.0250	27.3168	29.6642 (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	114.0285	114.0285	114.0285	114.0285	114.0285	114.0285	114.0285	114.0285	114.0285	114.0285	114.0285	114.0285	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	19.2876	17.1311	13.9319	10.5474	7.8843	6.6562	7.1923	9.3488	12.5480	15.9325	18.5956	19.8237	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	200.6343	202.7163	197.4698	186.3007	172.2017	158.9507	150.0982	148.0162	153.2627	164.4318	178.5307	191.7818	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.4029	34.4029	34.4029	34.4029	34.4029	34.4029	34.4029	34.4029	34.4029	34.4029	34.4029	34.4029	(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)	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	(71)
Water heating gains (Table 5)	41.1704	39.8658	37.1569	33.4741	31.0831	27.7164	24.8548	28.5213	29.8240	33.6358	37.9399	39.8713	(72)
Total internal gains	318.3008	316.9217	305.7672	287.5307	268.3776	250.5319	239.3538	243.0949	252.8432	271.2086	292.2749	308.6853	(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			3.5600		10.6334		0.6300		0.7000		0.7700		11.5689 (74)
East			0.6600		19.6403		0.6300		0.7000		0.7700		3.9615 (76)
South			5.5500		46.7521		0.6300		0.7000		0.7700		79.2986 (78)
Solar gains	94.8291	159.7291	215.7630	265.9320	298.9395	297.8800	286.6830	261.4726	232.8261	175.5910	113.2072		81.4235 (83)
Total gains	413.1299	476.6509	521.5302	553.4627	567.3172	548.4119	526.0368	504.5675	485.6693	446.7996	405.4821		390.1088 (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, nilm (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	60.6567	60.8629	61.0665	62.0411	62.2269	63.1068	63.1068	63.2725	62.7650	62.2269	61.8522	61.4652	
alpha	5.0438	5.0575	5.0711	5.1361	5.1485	5.2071	5.2071	5.2182	5.1843	5.1485	5.1235	5.0977	
util living area	0.9983	0.9962	0.9910	0.9749	0.9267	0.8007	0.6302	0.6745	0.8828	0.9804	0.9964	0.9988	(86)
MIT	19.7454	19.8972	20.1288	20.4342	20.7146	20.9151	20.9809	20.9730	20.8454	20.4827	20.0608	19.7249	(87)
Th 2	19.9644	19.9675	19.9706	19.9851	19.9878	20.0005	20.0005	20.0028	19.9956	19.9878	19.9823	19.9766	(88)
util rest of house	0.9977	0.9949	0.9877	0.9646	0.8940	0.7162	0.5007	0.5476	0.8205	0.9705	0.9949	0.9983	(89)
MIT 2	18.8209	18.9747	19.2073	19.5190	19.7846	19.9583	19.9953	19.9946	19.9061	19.5713	19.1502	18.8102	(90)
Living area fraction									fLA = Living area / (4) =			0.2070	(91)
MIT	19.0123	19.1657	19.3981	19.7085	19.9772	20.1564	20.1993	20.1972	20.1006	19.7600	19.3387	18.9996	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.0123	19.1657	19.3981	19.7085	19.9772	20.1564	20.1993	20.1972	20.1006	19.7600	19.3387	18.9996	(93)

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Useful gains	411.8930	473.5448	513.8050	531.8914	506.9313	400.8744	277.6671	289.6446	402.2373	432.2694	402.9049	389.2330	(94)
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	1203.3194	1162.8337	1047.8523	864.2985	659.9060	436.8143	282.9584	297.7304	474.3019	730.2899	981.6551	1194.5371	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	588.8212	463.2022	397.3312	239.3331	113.8132	0.0000	0.0000	0.0000	0.0000	221.7273	416.7002	599.1462	(98)
Space heating												3040.0745	(98)
Space heating per m2												42.5542	(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	738.9767	581.7476	595.9061	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8316	0.9050	0.8866	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	614.5150	526.4732	528.3363	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	726.3436	698.5221	675.0058	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	80.5166	128.0043	109.1221	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												317.6431	(104)

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Cooled fraction											FC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	20.1292	32.0011	27.2805	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												79.4108 (107)
Space cooling per m2												1.1116 (108)
Energy for space heating												42.5542 (99)
Energy for space cooling												1.1116 (108)
Total												43.6658 (109)
Target Fabric Energy Efficiency (TFEE)												50.2 (109)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	35.7200 (1b)	x 2.3100 (2b)	= 82.5132 (1b) - (3b)
First floor	35.7200 (1c)	x 2.6100 (2c)	= 93.2292 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.4400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 175.7424 (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)
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)
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000 (22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500 (22a)
Adj infilt rate	0.1947	0.1855	0.1855	0.1716	0.1716	0.1530	0.1576	0.1484	0.1530	0.1623	0.1623	0.1762 (22b)
Mechanical extract ventilation - decentralised												
If mechanical ventilation:												0.5000 (23a)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K					
Solid Door			1.9800	1.0000	1.9800		(26)					
Window (Uw = 1.20)			6.6200	1.1450	7.5802		(27)					
French Door (Uw = 1.40)			3.1500	1.3258	4.1761		(27)					
FP McCann System			35.7200	0.1100	3.9292	75.0000	2679.0000 (28a)					
100mm Knauf Supafil 34	83.1500	11.7500	71.4000	0.2500	17.8500	52.8000	3769.9200 (29a)					
Plane Ceiling-500mm Loft Roll	35.7200		35.7200	0.0900	3.2148	9.0000	321.4800 (30)					
Total net area of external elements Aum(A, m2)			154.5900				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	38.7303		(33)					
E-WM-30			41.9200	0.0000	0.0000	45.0000	1886.4000 (32)					
Timber GF			58.1700			9.0000	523.5300 (32c)					
Timber 1F			72.3200			9.0000	650.8800 (32c)					
Internal Floor			35.7200			12.6000	450.0720 (32d)					
Internal Ceiling			35.7200			9.0000	321.4800 (32e)					
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		10602.7620 (34)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							148.4149 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.4867 (36)					
Total fabric heat loss						(33) + (36) =	43.2170 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 28.9975	Feb 28.9975	Mar 28.9975	Apr 28.9975	May 28.9975	Jun 28.9975	Jul 28.9975	Aug 28.9975	Sep 28.9975	Oct 28.9975	Nov 28.9975	Dec 28.9975 (38)
Heat transfer coeff	72.2145	72.2145	72.2145	72.2145	72.2145	72.2145	72.2145	72.2145	72.2145	72.2145	72.2145	72.2145 (39)
Average = Sum(39)m / 12 =												72.2145 (39)
HLP	Jan 1.0108	Feb 1.0108	Mar 1.0108	Apr 1.0108	May 1.0108	Jun 1.0108	Jul 1.0108	Aug 1.0108	Sep 1.0108	Oct 1.0108	Nov 1.0108	Dec 1.0108 (40)
HLP (average)												1.0108 (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												2.2806 (42)
Average daily hot water use (litres/day)												88.3636 (43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Daily hot water use	97.1999	93.6654	90.1308	86.5963	83.0617	79.5272	79.5272	83.0617	86.5963	90.1308	93.6654	97.1999 (44)
Energy conte	144.1447	126.0698	130.0928	113.4180	108.8273	93.9097	87.0211	99.8580	101.0506	117.7648	128.5495	139.5964 (45)
Energy content (annual)										Total = Sum (45)m =		1390.3028 (45)
Distribution loss (46)m = 0.15 x (45)m	21.6217	18.9105	19.5139	17.0127	16.3241	14.0865	13.0532	14.9787	15.1576	17.6647	19.2824	20.9395 (46)
Water storage loss:												
Store volume												200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5600 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.8424 (55)
Total storage loss	26.1144	23.5872	26.1144	25.2720	26.1144	25.2720	26.1144	26.1144	25.2720	26.1144	25.2720	26.1144 (56)
If cylinder contains dedicated solar storage	26.1144	23.5872	26.1144	25.2720	26.1144	25.2720	26.1144	26.1144	25.2720	26.1144	25.2720	26.1144 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Total heat required for water heating calculated for each month	193.5215	170.6682	179.4696	161.2020	158.2041	141.6937	136.3979	149.2348	148.8346	167.1416	176.3335	188.9732 (62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (63)
Solar input (sum of months) = Sum (63)m =												0.0000 (63)
Output from w/h	193.5215	170.6682	179.4696	161.2020	158.2041	141.6937	136.3979	149.2348	148.8346	167.1416	176.3335	188.9732 (64)
RHI water heating demand												1971.6748 (64)
Heat gains from water heating, kWh/month	87.4295	77.5969	82.7573	75.9387	75.6865	69.4522	68.4360	72.7042	71.8265	78.6582	80.9699	85.9172 (65)

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

Metabolic gains (Table 5), Watts												
(66)m	136.8342	136.8342	136.8342	136.8342	136.8342	136.8342	136.8342	136.8342	136.8342	136.8342	136.8342	136.8342 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	48.2190	42.8277	34.8298	26.3684	19.7107	16.6406	17.9807	23.3721	31.3699	39.8313	46.4890	49.5591 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	299.4542	302.5616	294.7311	278.0608	257.0175	237.2398	224.0271	220.9197	228.7502	245.4205	266.4638	286.2415 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.9640	50.9640	50.9640	50.9640	50.9640	50.9640	50.9640	50.9640	50.9640	50.9640	50.9640	50.9640 (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)	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228 (71)
Water heating gains (Table 5)	117.5128	115.4716	111.2329	105.4704	101.7292	96.4614	91.9838	97.7207	99.7591	105.7234	112.4582	115.4802 (72)
Total internal gains	561.7614	557.4363	537.3692	506.4750	475.0328	446.9172	430.5671	438.5879	456.4547	487.5507	521.9864	547.8562 (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				3.5600	11.9814	0.4600	0.0000	0.7700	15.1080 (74)			
East				0.6600	22.3313	0.4600	0.0000	0.7700	5.2204 (76)			
South				2.4000	50.9848	0.4600	0.0000	0.7700	43.3412 (78)			
South				3.1500	50.9848	0.4300	0.0000	0.7700	53.1754 (78)			
Solar gains	116.8450	177.2551	237.5750	304.5394	336.3962	360.0933	342.2515	316.9748	278.7828	208.2919	142.9178	99.3597 (83)
Total gains	678.6064	734.6914	774.9442	811.0144	811.4289	807.0105	772.8186	755.5628	735.2375	695.8426	664.9042	647.2159 (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	40.7842	40.7842	40.7842	40.7842	40.7842	40.7842	40.7842	40.7842	40.7842	40.7842	40.7842	40.7842
Feb	3.7189	3.7189	3.7189	3.7189	3.7189	3.7189	3.7189	3.7189	3.7189	3.7189	3.7189	3.7189
util living area	0.9369	0.9154	0.8701	0.7835	0.6394	0.4347	0.2876	0.3032	0.5371	0.7782	0.8994	0.9445 (86)
Tweekday	18.7394	18.9453	19.3143	19.6958	19.9619	20.0613	20.0733	20.0730	20.0383	19.7777	19.2290	18.6705
Tweekend	20.3335	20.4283	20.5997	20.7839	20.9234	20.9867	20.9979	20.9974	20.9689	20.8214	20.5567	20.3017
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	19.9714	20.1157	20.3822	20.6625	20.8818	20.9795	20.9968	20.9961	20.9514	20.7244	20.3079	19.9223 (87)
Th 2	20.0743	20.0743	20.0743	20.0743	20.0743	20.0743	20.0743	20.0743	20.0743	20.0743	20.0743	20.0743 (88)
util rest of house	0.9259	0.9012	0.8482	0.7475	0.5826	0.3591	0.2027	0.2168	0.4621	0.7348	0.8800	0.9347 (89)
Tweekday	18.7394	18.9453	19.3143	19.6958	19.9619	20.0613	20.0733	20.0730	20.0383	19.7777	19.2290	18.6705
Tweekend	18.7394	18.9453	19.3143	19.6958	19.9619	20.0613	20.0733	20.0730	20.0383	19.7777	19.2290	18.6705
MIT 2	18.7394	18.9453	19.3143	19.6958	19.9619	20.0613	20.0733	20.0730	20.0383	19.7777	19.2290	18.6705 (90)
Living area fraction									fLA = Living area / (4) =			0.2070 (91)
MIT	18.9945	19.1876	19.5354	19.8959	20.1523	20.2514	20.2645	20.2641	20.2273	19.9737	19.4524	18.9296 (92)
Temperature adjustment												0.0000
adjusted MIT	18.9945	19.1876	19.5354	19.8959	20.1523	20.2514	20.2645	20.2641	20.2273	19.9737	19.4524	18.9296 (93)

8. Space heating requirement

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF HEAT DEMAND 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9102	0.8850	0.8336	0.7400	0.5876	0.3739	0.2203	0.2347	0.4750	0.7296	0.8645	0.9195	(94)
Useful gains	617.6898	650.1868	646.0259	600.1362	476.7994	301.7278	170.2669	177.3150	349.2282	507.7031	574.8402	595.1002	(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													
Month fracti	1003.3813	981.2215	876.3480	721.8497	516.5004	307.0107	170.7519	177.9440	363.0445	604.7026	827.0277	998.6991	(97)
Space heating kWh	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	286.9545	222.4554	171.3597	87.6338	29.5376	0.0000	0.0000	0.0000	0.0000	72.1677	181.5750	300.2776	(98)
RHI space heating demand												1351.9610	(98)
												1352	(98)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	35.7200 (1b)	x 2.3100 (2b)	= 82.5132 (1b) - (3b)
First floor	35.7200 (1c)	x 2.6100 (2c)	= 93.2292 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.4400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 175.7424 (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)
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)
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate												
	0.2365	0.2318	0.2272	0.2040	0.1994	0.1762	0.1762	0.1716	0.1855	0.1994	0.2086	0.2179 (22b)
Mechanical extract ventilation - decentralised												
If mechanical ventilation:												0.5000 (23a)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K					
Solid Door			1.9800	1.0000	1.9800		(26)					
Window (Uw = 1.20)			6.6200	1.1450	7.5802		(27)					
French Door (Uw = 1.40)			3.1500	1.3258	4.1761		(27)					
FP McCann System			35.7200	0.1100	3.9292	75.0000	2679.0000 (28a)					
100mm Knauf Supafil 34	83.1500	11.7500	71.4000	0.2500	17.8500	52.8000	3769.9200 (29a)					
Plane Ceiling-500mm Loft Roll	35.7200		35.7200	0.0900	3.2148	9.0000	321.4800 (30)					
Total net area of external elements Aum(A, m2)			154.5900				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	38.7303		(33)					
E-WM-30			41.9200	0.0000	0.0000	45.0000	1886.4000 (32)					
Timber GF			58.1700			9.0000	523.5300 (32c)					
Timber 1F			72.3200			9.0000	650.8800 (32c)					
Internal Floor			35.7200			12.6000	450.0720 (32d)					
Internal Ceiling			35.7200			9.0000	321.4800 (32e)					
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		10602.7620 (34)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							148.4149 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.4867 (36)					
Total fabric heat loss						(33) + (36) =	43.2170 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 28.9975	Feb 28.9975	Mar 28.9975	Apr 28.9975	May 28.9975	Jun 28.9975	Jul 28.9975	Aug 28.9975	Sep 28.9975	Oct 28.9975	Nov 28.9975	Dec 28.9975 (38)
Heat transfer coeff	72.2145	72.2145	72.2145	72.2145	72.2145	72.2145	72.2145	72.2145	72.2145	72.2145	72.2145	72.2145 (39)
Average = Sum(39)m / 12 =												72.2145 (39)
HLP	Jan 1.0108	Feb 1.0108	Mar 1.0108	Apr 1.0108	May 1.0108	Jun 1.0108	Jul 1.0108	Aug 1.0108	Sep 1.0108	Oct 1.0108	Nov 1.0108	Dec 1.0108 (40)
HLP (average)												1.0108 (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												2.2806 (42)
Average daily hot water use (litres/day)												88.3636 (43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS 09 Jan 2014

Daily hot water use	97.1999	93.6654	90.1308	86.5963	83.0617	79.5272	79.5272	83.0617	86.5963	90.1308	93.6654	97.1999 (44)
Energy conte	144.1447	126.0698	130.0928	113.4180	108.8273	93.9097	87.0211	99.8580	101.0506	117.7648	128.5495	139.5964 (45)
Energy content (annual)										Total = Sum (45)m =		1390.3028 (45)
Distribution loss (46)m = 0.15 x (45)m	21.6217	18.9105	19.5139	17.0127	16.3241	14.0865	13.0532	14.9787	15.1576	17.6647	19.2824	20.9395 (46)
Water storage loss:												
Store volume												200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5600 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.8424 (55)
Total storage loss	26.1144	23.5872	26.1144	25.2720	26.1144	25.2720	26.1144	26.1144	25.2720	26.1144	25.2720	26.1144 (56)
If cylinder contains dedicated solar storage	26.1144	23.5872	26.1144	25.2720	26.1144	25.2720	26.1144	26.1144	25.2720	26.1144	25.2720	26.1144 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Total heat required for water heating calculated for each month	193.5215	170.6682	179.4696	161.2020	158.2041	141.6937	136.3979	149.2348	148.8346	167.1416	176.3335	188.9732 (62)
WWHRS	-46.4201	-40.8406	-41.6849	-34.3185	-31.8766	-26.3044	-22.2765	-26.9669	-27.7472	-34.2857	-39.6943	-44.8624 eq. (G10)
Total of WWHRS savings												-417.2782
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	147.1013	129.8276	137.7847	126.8835	126.3275	115.3893	114.1214	122.2679	121.0874	132.8559	136.6392	144.1108 (64)
Heat gains from water heating, kWh/month	87.4295	77.5969	82.7573	75.9387	75.6865	69.4522	68.4360	72.7042	71.8265	78.6582	80.9699	85.9172 (65)
Total per year (kWh/year) = Sum (64)m =												1554.3966 (64)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	136.8342	136.8342	136.8342	136.8342	136.8342	136.8342	136.8342	136.8342	136.8342	136.8342	136.8342	136.8342 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	48.2190	42.8277	34.8298	26.3684	19.7107	16.6406	17.9807	23.3721	31.3699	39.8313	46.4890	49.5591 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	299.4542	302.5616	294.7311	278.0608	257.0175	237.2398	224.0271	220.9197	228.7502	245.4205	266.4638	286.2415 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.9640	50.9640	50.9640	50.9640	50.9640	50.9640	50.9640	50.9640	50.9640	50.9640	50.9640	50.9640 (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)	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228 (71)
Water heating gains (Table 5)	117.5128	115.4716	111.2329	105.4704	101.7292	96.4614	91.9838	97.7207	99.7591	105.7234	112.4582	115.4802 (72)
Total internal gains	561.7614	557.4363	537.3692	506.4750	475.0328	446.9172	430.5671	438.5879	456.4547	487.5507	521.9864	547.8562 (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					3.5600	10.6334	0.4600	0.0000	0.7700		13.4082 (74)	
East					0.6600	19.6403	0.4600	0.0000	0.7700		4.5913 (76)	
South					2.4000	46.7521	0.4600	0.0000	0.7700		39.7430 (78)	
South					3.1500	46.7521	0.4300	0.0000	0.7700		48.7608 (78)	
Solar gains	106.5033	179.5518	242.9684	300.1892	338.1070	337.1936	324.4009	295.4094	262.4276	197.4975	127.1727	91.4288 (83)
Total gains	668.2647	736.9881	780.3376	806.6642	813.1398	784.1107	754.9680	733.9973	718.8822	685.0482	649.1592	639.2850 (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	40.7842	40.7842	40.7842	40.7842	40.7842	40.7842	40.7842	40.7842	40.7842	40.7842	40.7842	40.7842
alpha	3.7189	3.7189	3.7189	3.7189	3.7189	3.7189	3.7189	3.7189	3.7189	3.7189	3.7189	3.7189
util living area	0.9471	0.9240	0.8863	0.8184	0.7072	0.5525	0.4109	0.4393	0.6270	0.8227	0.9199	0.9541 (86)
Tweekday	18.5650	18.8248	19.1806	19.5701	19.8726	20.0272	20.0661	20.0629	19.9907	19.6481	19.0439	18.4787
Tweekend	20.2547	20.3735	20.5376	20.7222	20.8744	20.9623	20.9903	20.9873	20.9381	20.7562	20.4712	20.2154
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	19.8497	20.0309	20.2863	20.5661	20.8062	20.9421	20.9850	20.9804	20.9034	20.6238	20.1742	19.7891 (87)
Th 2	20.0743	20.0743	20.0743	20.0743	20.0743	20.0743	20.0743	20.0743	20.0743	20.0743	20.0743	20.0743 (88)
util rest of house	0.9381	0.9115	0.8675	0.7882	0.6595	0.4838	0.3286	0.3562	0.5607	0.7876	0.9047	0.9462 (89)
Tweekday	18.5650	18.8248	19.1806	19.5701	19.8726	20.0272	20.0661	20.0629	19.9907	19.6481	19.0439	18.4787
Tweekend	18.5650	18.8248	19.1806	19.5701	19.8726	20.0272	20.0661	20.0629	19.9907	19.6481	19.0439	18.4787
MIT 2	18.5650	18.8248	19.1806	19.5701	19.8726	20.0272	20.0661	20.0629	19.9907	19.6481	19.0439	18.4787 (90)
Living area fraction									fLA = Living area / (4) =			0.2070 (91)
MIT	18.8309	19.0745	19.4095	19.7763	20.0659	20.2166	20.2563	20.2528	20.1796	19.8501	19.2779	18.7500 (92)
Temperature adjustment												0.0000
adjusted MIT	18.8309	19.0745	19.4095	19.7763	20.0659	20.2166	20.2563	20.2528	20.1796	19.8501	19.2779	18.7500 (93)

8. Space heating requirement

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9230	0.8952	0.8520	0.7775	0.6591	0.4948	0.3451	0.3726	0.5686	0.7780	0.8888	0.9318	(94)
Useful gains	616.8335	659.7865	664.8096	627.1413	535.9096	387.9433	260.5621	273.4960	408.7740	532.9952	576.9683	595.6579	(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	1049.3446	1023.6011	932.2529	785.4264	604.1359	405.6016	264.0375	278.2294	439.0378	667.9896	879.4235	1050.7205	(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	321.7883	244.4835	198.9778	113.9653	50.7604	0.0000	0.0000	0.0000	0.0000	100.4359	217.7678	338.5666	(98)
Space heating												1586.7454	(98)
Space heating per m2											(98) / (4) =	22.2109	(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 %)		215.0089	(206)
Efficiency of secondary/supplementary heating system, %		100.0000	(208)
Space heating requirement		737.9906	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	321.7883	244.4835	198.9778	113.9653	50.7604	0.0000	0.0000	0.0000	0.0000	100.4359	217.7678	338.5666	(98)
Space heating efficiency (main heating system 1)	215.0089	215.0089	215.0089	215.0089	215.0089	0.0000	0.0000	0.0000	0.0000	215.0089	215.0089	215.0089	(210)
Space heating fuel (main heating system)	149.6628	113.7085	92.5440	53.0049	23.6085	0.0000	0.0000	0.0000	0.0000	46.7124	101.2832	157.4663	(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	147.1013	129.8276	137.7847	126.8835	126.3275	115.3893	114.1214	122.2679	121.0874	132.8559	136.6392	144.1108	(64)
Efficiency of water heater												170.2800	(216)
(217)m	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	(217)
Fuel for water heating, kWh/month	86.3879	76.2436	80.9166	74.5146	74.1881	67.7644	67.0199	71.8040	71.1108	78.0220	80.2438	84.6317	(219)
Water heating fuel used												912.8474	(219)
Annual totals kWh/year													
Space heating fuel - main system												737.9906	(211)
Space heating fuel - secondary												0.0000	(215)

Electricity for pumps and fans:

(MEV)Decentralised, Database: total watage = 6.6170, total flow = 29.0000, SFP = 0.2282)			
mechanical ventilation fans (SFP = 0.2282)			48.9215 (230a)
Total electricity for the above, kWh/year			48.9215 (231)
Electricity for lighting (calculated in Appendix L)			340.6249 (232)

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

PV Unit 0 (0.80 * 1.20 * 1080 * 1.00) =		-1036.3436	-1036.3436 (233)
Total delivered energy for all uses			1004.0408 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	737.9906	13.1900	97.3410	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	912.8474	13.1900	120.4046	(247)
Mechanical ventilation fans	48.9215	13.1900	6.4527	(249)
Pumps and fans for heating	0.0000	0.0000	0.0000	(249)
Energy for lighting	340.6249	13.1900	44.9284	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-1036.3436	13.1900	-136.6937	(252)
Total energy cost			132.4330	(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] =	0.4777 (257)
SAP value			93.3363
SAP rating (Section 12)			93 (258)
SAP band			A

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	737.9906	0.5190	383.0171	(261)

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Space heating - secondary	0.0000	0.5190	0.0000 (263)
Water heating (other fuel)	912.8474	0.5190	473.7678 (264)
Space and water heating			856.7850 (265)
Pumps and fans	48.9215	0.5190	25.3902 (267)
Energy for lighting	340.6249	0.5190	176.7843 (268)
Energy saving/generation technologies			
PV Unit	-1036.3436	0.5190	-537.8623 (269)
Total kg/year			521.0972 (272)
CO2 emissions per m2			7.2900 (273)
EI value			94.0032
EI rating			94 (274)
EI band			A

----- Calculation of stars for heating and DHW

Main heating energy efficiency	$13.19 \times (1 + 0.29 \times 0.00) / 2.1501 = 6.135$, stars = 3
Main heating environmental impact	$0.519 \times (1 + 0.29 \times 0.00) / 2.1501 = 0.2414$, 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

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	35.7200 (1b)	x 2.3100 (2b)	= 82.5132 (1b) - (3b)
First floor	35.7200 (1c)	x 2.6100 (2c)	= 93.2292 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.4400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 175.7424 (5)

2. Ventilation rate

										main	secondary	other	total	m3 per hour			
										heating	heating						
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)
Infiltration due to chimneys, flues and fans										= (6a)+(6b)+(7a)+(7b)+(7c) =					Air changes per hour		
Pressure test															0.0000 / (5) =		0.0000 (8)
Measured/design AP50															Yes		
Infiltration rate															4.0100		
Number of sides sheltered															0.2005 (18)		
															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)		
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec					
	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000 (22)					
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500 (22a)					
Adj infilt rate																	
	0.1947	0.1855	0.1855	0.1716	0.1716	0.1530	0.1576	0.1484	0.1530	0.1623	0.1623	0.1762 (22b)					
Mechanical extract ventilation - decentralised																	
If mechanical ventilation:															0.5000 (23a)		
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (25)					

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K					
Solid Door			1.9800	1.0000	1.9800		(26)					
Window (Uw = 1.20)			6.6200	1.1450	7.5802		(27)					
French Door (Uw = 1.40)			3.1500	1.3258	4.1761		(27)					
FP McCann System			35.7200	0.1100	3.9292	75.0000	2679.0000 (28a)					
100mm Knauf Supafil 34	83.1500	11.7500	71.4000	0.2500	17.8500	52.8000	3769.9200 (29a)					
Plane Ceiling-500mm Loft Roll	35.7200		35.7200	0.0900	3.2148	9.0000	321.4800 (30)					
Total net area of external elements Aum(A, m2)			154.5900				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	38.7303		(33)					
E-WM-30			41.9200	0.0000	0.0000	45.0000	1886.4000 (32)					
Timber GF			58.1700			9.0000	523.5300 (32c)					
Timber 1F			72.3200			9.0000	650.8800 (32c)					
Internal Floor			35.7200			12.6000	450.0720 (32d)					
Internal Ceiling			35.7200			9.0000	321.4800 (32e)					
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		10602.7620 (34)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							148.4149 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.4867 (36)					
Total fabric heat loss						(33) + (36) =	43.2170 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 28.9975	Feb 28.9975	Mar 28.9975	Apr 28.9975	May 28.9975	Jun 28.9975	Jul 28.9975	Aug 28.9975	Sep 28.9975	Oct 28.9975	Nov 28.9975	Dec 28.9975 (38)
Heat transfer coeff	72.2145	72.2145	72.2145	72.2145	72.2145	72.2145	72.2145	72.2145	72.2145	72.2145	72.2145	72.2145 (39)
Average = Sum(39)m / 12 =												72.2145 (39)
HLP	Jan 1.0108	Feb 1.0108	Mar 1.0108	Apr 1.0108	May 1.0108	Jun 1.0108	Jul 1.0108	Aug 1.0108	Sep 1.0108	Oct 1.0108	Nov 1.0108	Dec 1.0108 (40)
HLP (average)												1.0108 (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												2.2806 (42)
Average daily hot water use (litres/day)												88.3636 (43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

Daily hot water use	97.1999	93.6654	90.1308	86.5963	83.0617	79.5272	79.5272	83.0617	86.5963	90.1308	93.6654	97.1999 (44)
Energy conte	144.1447	126.0698	130.0928	113.4180	108.8273	93.9097	87.0211	99.8580	101.0506	117.7648	128.5495	139.5964 (45)
Energy content (annual)												1390.3028 (45)
Distribution loss (46)m = 0.15 x (45)m												
	21.6217	18.9105	19.5139	17.0127	16.3241	14.0865	13.0532	14.9787	15.1576	17.6647	19.2824	20.9395 (46)
Water storage loss:												
Store volume												200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5600 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.8424 (55)
Total storage loss												
	26.1144	23.5872	26.1144	25.2720	26.1144	25.2720	26.1144	26.1144	25.2720	26.1144	25.2720	26.1144 (56)
If cylinder contains dedicated solar storage												
	26.1144	23.5872	26.1144	25.2720	26.1144	25.2720	26.1144	26.1144	25.2720	26.1144	25.2720	26.1144 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Total heat required for water heating calculated for each month												
	193.5215	170.6682	179.4696	161.2020	158.2041	141.6937	136.3979	149.2348	148.8346	167.1416	176.3335	188.9732 (62)
WWHRS	-46.4201	-40.8406	-41.6849	-34.3185	-31.8766	-26.3044	-22.2765	-26.9669	-27.7472	-34.2857	-39.6943	-44.8624 eq. (G10)
Total of WWHRS savings												-417.2782
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	147.1013	129.8276	137.7847	126.8835	126.3275	115.3893	114.1214	122.2679	121.0874	132.8559	136.6392	144.1108 (64)
Total per year (kWh/year) = Sum(64)m =												1554.3966 (64)
Heat gains from water heating, kWh/month	87.4295	77.5969	82.7573	75.9387	75.6865	69.4522	68.4360	72.7042	71.8265	78.6582	80.9699	85.9172 (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	136.8342	136.8342	136.8342	136.8342	136.8342	136.8342	136.8342	136.8342	136.8342	136.8342	136.8342	136.8342 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	48.2190	42.8277	34.8298	26.3684	19.7107	16.6406	17.9807	23.3721	31.3699	39.8313	46.4890	49.5591 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	299.4542	302.5616	294.7311	278.0608	257.0175	237.2398	224.0271	220.9197	228.7502	245.4205	266.4638	286.2415 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	50.9640	50.9640	50.9640	50.9640	50.9640	50.9640	50.9640	50.9640	50.9640	50.9640	50.9640	50.9640 (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)												
	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228 (71)
Water heating gains (Table 5)												
	117.5128	115.4716	111.2329	105.4704	101.7292	96.4614	91.9838	97.7207	99.7591	105.7234	112.4582	115.4802 (72)
Total internal gains	561.7614	557.4363	537.3692	506.4750	475.0328	446.9172	430.5671	438.5879	456.4547	487.5507	521.9864	547.8562 (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				3.5600	11.9814	0.4600	0.0000	0.7700	15.1080 (74)			
East				0.6600	22.3313	0.4600	0.0000	0.7700	5.2204 (76)			
South				2.4000	50.9848	0.4600	0.0000	0.7700	43.3412 (78)			
South				3.1500	50.9848	0.4300	0.0000	0.7700	53.1754 (78)			
Solar gains	116.8450	177.2551	237.5750	304.5394	336.3962	360.0933	342.2515	316.9748	278.7828	208.2919	142.9178	99.3597 (83)
Total gains	678.6064	734.6914	774.9442	811.0144	811.4289	807.0105	772.8186	755.5628	735.2375	695.8426	664.9042	647.2159 (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	40.7842	40.7842	40.7842	40.7842	40.7842	40.7842	40.7842	40.7842	40.7842	40.7842	40.7842	40.7842
alpha	3.7189	3.7189	3.7189	3.7189	3.7189	3.7189	3.7189	3.7189	3.7189	3.7189	3.7189	3.7189
util living area	0.9369	0.9154	0.8701	0.7835	0.6394	0.4347	0.2876	0.3032	0.5371	0.7782	0.8994	0.9445 (86)
Tweekday	18.7394	18.9453	19.3143	19.6958	19.9619	20.0613	20.0733	20.0730	20.0383	19.7777	19.2290	18.6705
Tweekend	20.3335	20.4283	20.5997	20.7839	20.9234	20.9867	20.9979	20.9974	20.9689	20.8214	20.5567	20.3017
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	19.9714	20.1157	20.3822	20.6625	20.8818	20.9795	20.9968	20.9961	20.9514	20.7244	20.3079	19.9223 (87)
Th 2	20.0743	20.0743	20.0743	20.0743	20.0743	20.0743	20.0743	20.0743	20.0743	20.0743	20.0743	20.0743 (88)
util rest of house												
	0.9259	0.9012	0.8482	0.7475	0.5826	0.3591	0.2027	0.2168	0.4621	0.7348	0.8800	0.9347 (89)
Tweekday	18.7394	18.9453	19.3143	19.6958	19.9619	20.0613	20.0733	20.0730	20.0383	19.7777	19.2290	18.6705
Tweekend	18.7394	18.9453	19.3143	19.6958	19.9619	20.0613	20.0733	20.0730	20.0383	19.7777	19.2290	18.6705
MIT 2	18.7394	18.9453	19.3143	19.6958	19.9619	20.0613	20.0733	20.0730	20.0383	19.7777	19.2290	18.6705 (90)
Living area fraction									fLA = Living area / (4) =			0.2070 (91)
MIT	18.9945	19.1876	19.5354	19.8959	20.1523	20.2514	20.2645	20.2641	20.2273	19.9737	19.4524	18.9296 (92)
Temperature adjustment												0.0000
adjusted MIT	18.9945	19.1876	19.5354	19.8959	20.1523	20.2514	20.2645	20.2641	20.2273	19.9737	19.4524	18.9296 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9102	0.8850	0.8336	0.7400	0.5876	0.3739	0.2203	0.2347	0.4750	0.7296	0.8645	0.9195 (94)
Useful gains	617.6898	650.1868	646.0259	600.1362	476.7994	301.7278	170.2669	177.3150	349.2282	507.7031	574.8402	595.1002 (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	1003.3813	981.2215	876.3480	721.8497	516.5004	307.0107	170.7519	177.9440	363.0445	604.7026	827.0277	998.6991 (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	286.9545	222.4554	171.3597	87.6338	29.5376	0.0000	0.0000	0.0000	0.0000	72.1677	181.5750	300.2776 (98)
Space heating												1351.9610 (98)
Space heating per m2										(98) / (4) =		18.9244 (99)

Not applicable

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	286.9545	222.4554	171.3597	87.6338	29.5376	0.0000	0.0000	0.0000	0.0000	72.1677	181.5750	300.2776	(98)
Space heating efficiency (main heating system 1)	215.0089	215.0089	215.0089	215.0089	215.0089	0.0000	0.0000	0.0000	0.0000	215.0089	215.0089	215.0089	(210)
Space heating fuel (main heating system)	133.4617	103.4633	79.6989	40.7582	13.7378	0.0000	0.0000	0.0000	0.0000	33.5650	84.4500	139.6582	(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 requirement	147.1013	129.8276	137.7847	126.8835	126.3275	115.3893	114.1214	122.2679	121.0874	132.8559	136.6392	144.1108	(64)
Efficiency of water heater (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	(216)
Fuel for water heating, kWh/month	86.3879	76.2436	80.9166	74.5146	74.1881	67.7644	67.0199	71.8040	71.1108	78.0220	80.2438	84.6317	(219)
Water heating fuel used												912.8474	(219)
Annual totals kWh/year													
Space heating fuel - main system												628.7931	(211)
Space heating fuel - secondary									0.0000				(212)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	628.7931	16.9600	106.6433 (240)
Space heating - secondary	0.0000	0.0000	0.0000 (242)
Water heating (other fuel)	912.8474	16.9600	154.8189 (247)
Mechanical ventilation fans	48.9215	16.9600	8.2971 (249)
Pumps and fans for heating	0.0000	0.0000	0.0000 (249)
Energy for lighting	340.6249	16.9600	57.7700 (250)
Additional standing charges			0.0000 (251)
Energy saving/generation technologies			
PV Unit	-1094.4958	16.9600	-185.6265 (252)
Total energy cost			141.9028 (255)

	Energy	Emission factor	Emissions
	kWh/year	kg CO2/kWh	kg CO2/year
Space heating - main system 1	628.7931	0.5190	326.3390 (261)
Space heating - secondary	0.0000	0.5190	0.0000 (263)
Water heating (other fuel)	912.8474	0.5190	473.7678 (264)
Space and water heating			800.1115 (265)
Pumps and fans	48.9215	0.5190	25.3902 (267)
Energy for lighting	340.6249	0.5190	176.7843 (268)
Energy saving/generation technologies			
PV Unit	-1094.4958	0.5190	-568.0433 (269)
Total kg/year			434.2427 (272)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

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	628.7931	3.0700	1930.3949 (261)
Space heating - secondary	0.0000	3.0700	0.0000 (263)
Water heating (other fuel)	912.8474	3.0700	2802.4417 (264)
Space and water heating			4732.8365 (265)
Pumps and fans	48.9215	3.0700	150.1889 (267)
Energy for lighting	340.6249	3.0700	1045.7184 (268)
Energy saving/generation technologies			
PV Unit	-1094.4958	3.0700	-3360.1021 (269)
Primary energy kWh/year			2568.6417 (272)
Primary energy kWh/m2/year			35.9552 (273)

SAP 2012 EPC IMPROVEMENTS

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

(For testing purposes):

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 2.4	-£ 62	-191 kg (44.0%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£62	2.67 kg/m²	A 96
Total Savings	£62	2.67 kg/m²	A 96

Potential energy efficiency rating: A 96
Potential environmental impact rating: A 96

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 £328	Potential £265	Saving £62
Electricity			
Space heating	£115	£115	-£0
Water heating	£155	£92	£63
Lighting	£58	£58	£0
Generated (PV)	-£186	-£186	£0
Total cost of fuels	£142	£79	£62
Total cost of uses	£142	£79	£63
Delivered energy	12 kWh/m²	7 kWh/m²	5 kWh/m²
Carbon dioxide emissions	0.4 tonnes	0.2 tonnes	0.2 tonnes
CO2 emissions per m²	6 kg/m²	3 kg/m²	3 kg/m²
Primary energy	36 kWh/m²	20 kWh/m²	16 kWh/m²

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



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

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m ²)	Storey height (m)	Volume (m ³)
Ground floor	35.7200 (1b)	x 2.3100 (2b)	= 82.5132 (1b) - (3b)
First floor	35.7200 (1c)	x 2.6100 (2c)	= 93.2292 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.4400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 175.7424 (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)
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)
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000 (22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750 (22a)
Adj infilt rate												
	0.2365	0.2318	0.2272	0.2040	0.1994	0.1762	0.1762	0.1716	0.1855	0.1994	0.2086	0.2179 (22b)
Mechanical extract ventilation - decentralised												
If mechanical ventilation:												0.5000 (23a)
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K					
Solid Door			1.9800	1.0000	1.9800		(26)					
Window (Uw = 1.20)			6.6200	1.1450	7.5802		(27)					
French Door (Uw = 1.40)			3.1500	1.3258	4.1761		(27)					
FP McCann System			35.7200	0.1100	3.9292	75.0000	2679.0000 (28a)					
100mm Knauf Supafil 34	83.1500	11.7500	71.4000	0.2500	17.8500	52.8000	3769.9200 (29a)					
Plane Ceiling-500mm Loft Roll	35.7200		35.7200	0.0900	3.2148	9.0000	321.4800 (30)					
Total net area of external elements Aum(A, m2)			154.5900				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	38.7303		(33)					
E-WM-30			41.9200	0.0000	0.0000	45.0000	1886.4000 (32)					
Timber GF			58.1700			9.0000	523.5300 (32c)					
Timber 1F			72.3200			9.0000	650.8800 (32c)					
Internal Floor			35.7200			12.6000	450.0720 (32d)					
Internal Ceiling			35.7200			9.0000	321.4800 (32e)					
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		10602.7620 (34)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							148.4149 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.4867 (36)					
Total fabric heat loss						(33) + (36) =	43.2170 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 28.9975	Feb 28.9975	Mar 28.9975	Apr 28.9975	May 28.9975	Jun 28.9975	Jul 28.9975	Aug 28.9975	Sep 28.9975	Oct 28.9975	Nov 28.9975	Dec 28.9975 (38)
Heat transfer coeff	72.2145	72.2145	72.2145	72.2145	72.2145	72.2145	72.2145	72.2145	72.2145	72.2145	72.2145	72.2145 (39)
Average = Sum(39)m / 12 =												72.2145 (39)
HLP	Jan 1.0108	Feb 1.0108	Mar 1.0108	Apr 1.0108	May 1.0108	Jun 1.0108	Jul 1.0108	Aug 1.0108	Sep 1.0108	Oct 1.0108	Nov 1.0108	Dec 1.0108 (40)
HLP (average)												1.0108 (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												2.2806 (42)
Average daily hot water use (litres/day)												88.3636 (43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Daily hot water use	97.1999	93.6654	90.1308	86.5963	83.0617	79.5272	79.5272	83.0617	86.5963	90.1308	93.6654	97.1999 (44)
Energy conte	144.1447	126.0698	130.0928	113.4180	108.8273	93.9097	87.0211	99.8580	101.0506	117.7648	128.5495	139.5964 (45)
Energy content (annual)												
Distribution loss (46)m = 0.15 x (45)m												1390.3028 (45)
	21.6217	18.9105	19.5139	17.0127	16.3241	14.0865	13.0532	14.9787	15.1576	17.6647	19.2824	20.9395 (46)
Water storage loss:												
Store volume												200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5600 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.8424 (55)
Total storage loss												
	26.1144	23.5872	26.1144	25.2720	26.1144	25.2720	26.1144	26.1144	25.2720	26.1144	25.2720	26.1144 (56)
If cylinder contains dedicated solar storage												
	26.1144	23.5872	26.1144	25.2720	26.1144	25.2720	26.1144	26.1144	25.2720	26.1144	25.2720	26.1144 (57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624 (59)
Total heat required for water heating calculated for each month												
	193.5215	170.6682	178.0738	154.4484	145.4098	129.0870	123.3710	137.1384	143.4318	165.7458	176.3335	188.9732 (62)
WWHRS	-46.4201	-40.8406	-41.6849	-34.3185	-31.8766	-26.3044	-22.2765	-26.9669	-27.7472	-34.2857	-39.6943	-44.8624 eq. (G10)
Total of WWHRS savings												-417.2782
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												1.8639 (H8)
Utilisation factor												0.4152 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												75.0000 (H13)
Daily hot water demand												88.3636 (H14)
Volume ratio Veff/V												0.8488 (H15)
Solar storage volume factor												0.9672 (H16)
Solar input												-640.4277 (H17)
Solar input	-18.5711	-30.9899	-52.7793	-70.7347	-87.3867	-85.9151	-84.7797	-74.0724	-58.0136	-39.6164	-22.0280	-15.5409 (63)
Output from w/h												
	128.5302	98.8378	83.6097	49.3953	26.1465	16.8675	16.3148	36.0990	57.6710	91.8437	114.6112	128.5700 (64)
Heat gains from water heating, kWh/month												
	87.4295	77.5969	81.6407	70.5358	65.4511	59.3668	58.0144	63.0271	67.5042	77.5416	80.9699	85.9172 (65)
Total per year (kWh/year) = Sum(64)m =												848.4966 (64)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
(66)m	136.8342	136.8342	136.8342	136.8342	136.8342	136.8342	136.8342	136.8342	136.8342	136.8342	136.8342	136.8342 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	48.2190	42.8277	34.8298	26.3684	19.7107	16.6406	17.9807	23.3721	31.3699	39.8313	46.4890	49.5591 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	299.4542	302.5616	294.7311	278.0608	257.0175	237.2398	224.0271	220.9197	228.7502	245.4205	266.4638	286.2415 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.9640	50.9640	50.9640	50.9640	50.9640	50.9640	50.9640	50.9640	50.9640	50.9640	50.9640	50.9640 (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)	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228 (71)
Water heating gains (Table 5)	117.5128	115.4716	109.7321	97.9664	87.9719	82.4539	77.9764	84.7138	93.7559	104.2226	112.4582	115.4802 (72)
Total internal gains	561.7614	557.4363	535.8684	498.9710	461.2755	432.9097	416.5596	425.5810	450.4515	486.0499	521.9864	547.8562 (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					3.5600	10.6334	0.4600	0.0000	0.7700		13.4082 (74)	
East					0.6600	19.6403	0.4600	0.0000	0.7700		4.5913 (76)	
South					2.4000	46.7521	0.4600	0.0000	0.7700		39.7430 (78)	
South					3.1500	46.7521	0.4300	0.0000	0.7700		48.7608 (78)	

Solar gains	106.5033	179.5518	242.9684	300.1892	338.1070	337.1936	324.4009	295.4094	262.4276	197.4975	127.1727	91.4288 (83)
Total gains	668.2647	736.9881	778.8368	799.1602	799.3824	770.1033	740.9606	720.9904	712.8790	683.5474	649.1592	639.2850 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
tau	40.7842	40.7842	40.7842	40.7842	40.7842	40.7842	40.7842	40.7842	40.7842	40.7842	40.7842	40.7842
alpha	3.7189	3.7189	3.7189	3.7189	3.7189	3.7189	3.7189	3.7189	3.7189	3.7189	3.7189	3.7189
util living area	0.9471	0.9240	0.8868	0.8218	0.7148	0.5607	0.4181	0.4464	0.6309	0.8235	0.9199	0.9541 (86)
Tweekday	18.5650	18.8248	19.1781	19.5613	19.8643	20.0247	20.0655	20.0622	19.9888	19.6463	19.0439	18.4787
Tweekend	20.2547	20.3735	20.5364	20.7177	20.8696	20.9605	20.9897	20.9866	20.9369	20.7553	20.4712	20.2154

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)



CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

24 / 16	0	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	0
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	0
MIT	19.8497	20.0309	20.2845	20.5592	20.7988	20.9393	20.9841	20.9793	20.9014	20.6224	20.1742	19.7891	(87)
Th 2	20.0743	20.0743	20.0743	20.0743	20.0743	20.0743	20.0743	20.0743	20.0743	20.0743	20.0743	20.0743	(88)
util rest of house													
	0.9381	0.9115	0.8681	0.7919	0.6674	0.4915	0.3346	0.3623	0.5645	0.7885	0.9047	0.9462	(89)
Tweekday	18.5650	18.8248	19.1781	19.5613	19.8643	20.0247	20.0655	20.0622	19.9888	19.6463	19.0439	18.4787	
Tweekend	18.5650	18.8248	19.1781	19.5613	19.8643	20.0247	20.0655	20.0622	19.9888	19.6463	19.0439	18.4787	
MIT 2	18.5650	18.8248	19.1781	19.5613	19.8643	20.0247	20.0655	20.0622	19.9888	19.6463	19.0439	18.4787	(90)
Living area fraction									fLA = Living area / (4) =				0.2070 (91)
MIT	18.8309	19.0745	19.4071	19.7679	20.0578	20.2140	20.2557	20.2521	20.1777	19.8484	19.2779	18.7500	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8309	19.0745	19.4071	19.7679	20.0578	20.2140	20.2557	20.2521	20.1777	19.8484	19.2779	18.7500	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9230	0.8952	0.8525	0.7809	0.6665	0.5023	0.3513	0.3789	0.5723	0.7789	0.8888	0.9318	(94)
Useful gains	616.8335	659.7865	663.9662	624.0600	532.7577	386.8559	260.3066	273.1712	407.9895	532.3811	576.9683	595.6579	(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													
	1049.3446	1023.6011	932.0809	784.8182	603.5528	405.4145	263.9947	278.1749	438.8988	667.8689	879.4235	1050.7205	(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													
	321.7883	244.4835	199.4773	115.7459	52.6715	0.0000	0.0000	0.0000	0.0000	100.8029	217.7678	338.5666	(98)
Space heating													1591.3037 (98)
Space heating per m2											(98) / (4) =		22.2747 (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 %)													215.0089 (206)
Efficiency of secondary/supplementary heating system, %													100.0000 (208)
Space heating requirement													740.1107 (211)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating requirement	321.7883	244.4835	199.4773	115.7459	52.6715	0.0000	0.0000	0.0000	0.0000	100.8029	217.7678	338.5666	(98)
Space heating efficiency (main heating system 1)	215.0089	215.0089	215.0089	215.0089	215.0089	0.0000	0.0000	0.0000	0.0000	215.0089	215.0089	215.0089	(210)
Space heating fuel (main heating system)	149.6628	113.7085	92.7763	53.8331	24.4974	0.0000	0.0000	0.0000	0.0000	46.8831	101.2832	157.4663	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	128.5302	98.8378	83.6097	49.3953	26.1465	16.8675	16.3148	36.0990	57.6710	91.8437	114.6112	128.5700	(64)
Efficiency of water heater	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	(216)
(217)m	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	(217)
Fuel for water heating, kWh/month	75.4817	58.0443	49.1013	29.0083	15.3550	9.9057	9.5812	21.1998	33.8683	53.9369	67.3075	75.5050	(219)
Water heating fuel used												498.2949	(219)
Annual totals kWh/year													
Space heating fuel - main system												740.1107	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(MEV)Decentralised, Database: total watage = 6.6170, total flow = 29.0000, SFP = 0.2282)													
mechanical ventilation fans (SFP = 0.2282)													48.9215 (230a)
pump for solar water heating													50.0000 (230g)
Total electricity for the above, kWh/year													98.9215 (231)
Electricity for lighting (calculated in Appendix L)													340.6249 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.20 * 1080 * 1.00) =									-1036.3436			-1036.3436	(233)
Total delivered energy for all uses												641.6083	(238)

10a. Fuel costs - using Table 12 prices

	Fuel	Fuel price	Fuel cost	
	kWh/year	p/kWh	£/year	
Space heating - main system 1	740.1107	13.1900	97.6206	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	498.2949	13.1900	65.7251	(247)
Mechanical ventilation fans	48.9215	13.1900	6.4527	(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	340.6249	13.1900	44.9284	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-1036.3436	13.1900	-136.6937	(252)
Total energy cost			84.6281	(255)

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	0.3053 (257)
SAP value		95.7417
SAP rating (Section 12)		96 (258)
SAP band		A

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

	Energy kWh/year	Emission factor kg CO ₂ /kWh	Emissions kg CO ₂ /year
Space heating - main system 1	740.1107	0.5190	384.1174 (261)
Space heating - secondary	0.0000	0.5190	0.0000 (263)
Water heating (other fuel)	498.2949	0.5190	258.6151 (264)
Space and water heating			642.7325 (265)
Pumps and fans	98.9215	0.5190	51.3402 (267)
Energy for lighting	340.6249	0.5190	176.7843 (268)
Energy saving/generation technologies			
PV Unit	-1036.3436	0.5190	-537.8623 (269)
Total kg/year			332.9947 (272)
CO ₂ emissions per m ²			4.6600 (273)
EI value			96.1679
EI rating			96 (274)
EI band			A

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

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 (m ²)	Storey height (m)	Volume (m ³)
Ground floor	35.7200 (1b)	x 2.3100 (2b)	= 82.5132 (1b) - (3b)
First floor	35.7200 (1c)	x 2.6100 (2c)	= 93.2292 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.4400		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 175.7424 (5)

2. Ventilation rate

										main	secondary	other	total	m3 per hour			
										heating	heating						
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)
Infiltration due to chimneys, flues and fans										= (6a)+(6b)+(7a)+(7b)+(7c) =					Air changes per hour		
Pressure test															0.0000 / (5) =		0.0000 (8)
Measured/design AP50															Yes		
Infiltration rate															4.0100		
Number of sides sheltered															0.2005 (18)		
															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)		
Wind speed	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec					
	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000 (22)					
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500 (22a)					
Adj infilt rate																	
	0.1947	0.1855	0.1855	0.1716	0.1716	0.1530	0.1576	0.1484	0.1530	0.1623	0.1623	0.1762 (22b)					
Mechanical extract ventilation - decentralised																	
If mechanical ventilation:															0.5000 (23a)		
Effective ac	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000 (25)					

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K					
Solid Door			1.9800	1.0000	1.9800		(26)					
Window (Uw = 1.20)			6.6200	1.1450	7.5802		(27)					
French Door (Uw = 1.40)			3.1500	1.3258	4.1761		(27)					
FP McCann System			35.7200	0.1100	3.9292	75.0000	2679.0000 (28a)					
100mm Knauf Supafil 34	83.1500	11.7500	71.4000	0.2500	17.8500	52.8000	3769.9200 (29a)					
Plane Ceiling-500mm Loft Roll	35.7200		35.7200	0.0900	3.2148	9.0000	321.4800 (30)					
Total net area of external elements Aum(A, m2)			154.5900				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	38.7303		(33)					
E-WM-30			41.9200	0.0000	0.0000	45.0000	1886.4000 (32)					
Timber GF			58.1700			9.0000	523.5300 (32c)					
Timber 1F			72.3200			9.0000	650.8800 (32c)					
Internal Floor			35.7200			12.6000	450.0720 (32d)					
Internal Ceiling			35.7200			9.0000	321.4800 (32e)					
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		10602.7620 (34)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							148.4149 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							4.4867 (36)					
Total fabric heat loss						(33) + (36) =	43.2170 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 28.9975	Feb 28.9975	Mar 28.9975	Apr 28.9975	May 28.9975	Jun 28.9975	Jul 28.9975	Aug 28.9975	Sep 28.9975	Oct 28.9975	Nov 28.9975	Dec 28.9975 (38)
Heat transfer coeff	72.2145	72.2145	72.2145	72.2145	72.2145	72.2145	72.2145	72.2145	72.2145	72.2145	72.2145	72.2145 (39)
Average = Sum(39)m / 12 =												72.2145 (39)
HLP	Jan 1.0108	Feb 1.0108	Mar 1.0108	Apr 1.0108	May 1.0108	Jun 1.0108	Jul 1.0108	Aug 1.0108	Sep 1.0108	Oct 1.0108	Nov 1.0108	Dec 1.0108 (40)
HLP (average)												1.0108 (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												2.2806 (42)
Average daily hot water use (litres/day)												88.3636 (43)
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

Daily hot water use	97.1999	93.6654	90.1308	86.5963	83.0617	79.5272	79.5272	83.0617	86.5963	90.1308	93.6654	97.1999 (44)
Energy conte	144.1447	126.0698	130.0928	113.4180	108.8273	93.9097	87.0211	99.8580	101.0506	117.7648	128.5495	139.5964 (45)
Energy content (annual)												
Distribution loss (46)m = 0.15 x (45)m												1390.3028 (45)
	21.6217	18.9105	19.5139	17.0127	16.3241	14.0865	13.0532	14.9787	15.1576	17.6647	19.2824	20.9395 (46)
Water storage loss:												
Store volume												200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.5600 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.8424 (55)
Total storage loss												
	26.1144	23.5872	26.1144	25.2720	26.1144	25.2720	26.1144	26.1144	25.2720	26.1144	25.2720	26.1144 (56)
If cylinder contains dedicated solar storage												
	26.1144	23.5872	26.1144	25.2720	26.1144	25.2720	26.1144	26.1144	25.2720	26.1144	25.2720	26.1144 (57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624 (59)
Total heat required for water heating calculated for each month												
	193.5215	170.6682	178.0738	154.4484	145.4098	129.0870	123.3710	137.1384	143.4318	165.7458	176.3335	188.9732 (62)
WWHRS	-46.4201	-40.8406	-41.6849	-34.3185	-31.8766	-26.3044	-22.2765	-26.9669	-27.7472	-34.2857	-39.6943	-44.8624 eq. (G10)
Total of WWHRS savings												-417.2782
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												1.9685 (H8)
Utilisation factor												0.3983 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												75.0000 (H13)
Daily hot water demand												88.3636 (H14)
Volume ratio Veff/V												0.8488 (H15)
Solar storage volume factor												0.9672 (H16)
Solar input												-648.8192 (H17)
Solar input	-19.9703	-30.0154	-50.5497	-69.8751	-84.1531	-88.5675	-86.4409	-77.1922	-60.2488	-40.9861	-24.2745	-16.5455 (63)
Solar input (sum of months) = Sum(63)m =												-648.8192 (63)
Output from w/h												
	127.1310	99.8123	85.8393	50.2548	29.3801	14.2150	14.6536	32.9792	55.4358	90.4740	112.3647	127.5653 (64)
Total per year (kWh/year) = Sum(64)m =												840.1051 (64)
Heat gains from water heating, kWh/month												
	87.4295	77.5969	81.6407	70.5358	65.4511	59.3668	58.0144	63.0271	67.5042	77.5416	80.9699	85.9172 (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	136.8342	136.8342	136.8342	136.8342	136.8342	136.8342	136.8342	136.8342	136.8342	136.8342	136.8342	136.8342 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	48.2190	42.8277	34.8298	26.3684	19.7107	16.6406	17.9807	23.3721	31.3699	39.8313	46.4890	49.5591 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	299.4542	302.5616	294.7311	278.0608	257.0175	237.2398	224.0271	220.9197	228.7502	245.4205	266.4638	286.2415 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.9640	50.9640	50.9640	50.9640	50.9640	50.9640	50.9640	50.9640	50.9640	50.9640	50.9640	50.9640 (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)	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228	-91.2228 (71)
Water heating gains (Table 5)	117.5128	115.4716	109.7321	97.9664	87.9719	82.4539	77.9764	84.7138	93.7559	104.2226	112.4582	115.4802 (72)
Total internal gains	561.7614	557.4363	535.8684	498.9710	461.2755	432.9097	416.5596	425.5810	450.4515	486.0499	521.9864	547.8562 (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					3.5600	11.9814	0.4600	0.0000			0.7700			15.1080 (74)
East					0.6600	22.3313	0.4600	0.0000			0.7700			5.2204 (76)
South					2.4000	50.9848	0.4600	0.0000			0.7700			43.3412 (78)
South					3.1500	50.9848	0.4300	0.0000			0.7700			53.1754 (78)
Solar gains	116.8450	177.2551	237.5750	304.5394	336.3962	360.0933	342.2515	316.9748	278.7828	208.2919	142.9178			99.3597 (83)
Total gains	678.6064	734.6914	773.4434	803.5104	797.6716	793.0030	758.8111	742.5558	729.2343	694.3418	664.9042			647.2159 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
tau	40.7842	40.7842	40.7842	40.7842	40.7842	40.7842	40.7842	40.7842	40.7842	40.7842	40.7842	40.7842
alpha	3.7189	3.7189	3.7189	3.7189	3.7189	3.7189	3.7189	3.7189	3.7189	3.7189	3.7189	3.7189
util living area	0.9369	0.9154	0.8707	0.7871	0.6473	0.4417	0.2928	0.3084	0.5408	0.7791	0.8994	0.9445 (86)
Tweekday	18.7394	18.9453	19.3120	19.6886	19.9567	20.0605	20.0733	20.0729	20.0374	19.7764	19.2290	18.6705
Tweekend	20.3335	20.4283	20.5985	20.7801	20.9202	20.9859	20.9978	20.9973	20.9682	20.8207	20.5567	20.3017

FULL SAP CALCULATION PRINTOUT

Calculation Type: New Build (As Designed)

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

24 / 16	0	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	0
16 / 9	0	0	0	0	0	0	0	0	0	0	0	0	0
MIT	19.9714	20.1157	20.3804	20.6566	20.8768	20.9784	20.9966	20.9958	20.9503	20.7233	20.3079	19.9223 (87)	
Th 2	20.0743	20.0743	20.0743	20.0743	20.0743	20.0743	20.0743	20.0743	20.0743	20.0743	20.0743	20.0743 (88)	
util rest of house													
	0.9259	0.9012	0.8489	0.7515	0.5904	0.3651	0.2065	0.2205	0.4655	0.7357	0.8800	0.9347 (89)	
Tuesday	18.7394	18.9453	19.3120	19.6886	19.9567	20.0605	20.0733	20.0729	20.0374	19.7764	19.2290	18.6705	
Tuesday	18.7394	18.9453	19.3120	19.6886	19.9567	20.0605	20.0733	20.0729	20.0374	19.7764	19.2290	18.6705	
MIT 2	18.7394	18.9453	19.3120	19.6886	19.9567	20.0605	20.0733	20.0729	20.0374	19.7764	19.2290	18.6705 (90)	
Living area fraction									fLA = Living area / (4) =				0.2070 (91)
MIT	18.9945	19.1876	19.5332	19.8890	20.1472	20.2506	20.2644	20.2640	20.2264	19.9724	19.4524	18.9296 (92)	
Temperature adjustment												0.0000	
adjusted MIT	18.9945	19.1876	19.5332	19.8890	20.1472	20.2506	20.2644	20.2640	20.2264	19.9724	19.4524	18.9296 (93)	

8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.9102	0.8850	0.8342	0.7437	0.5952	0.3800	0.2243	0.2387	0.4784	0.7305	0.8645	0.9195 (94)	
Useful gains	617.6898	650.1868	645.2438	597.5483	474.7386	301.3736	170.2289	177.2687	348.8373	507.2145	574.8402	595.1002 (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													
	1003.3813	981.2215	876.1898	721.3491	516.1322	306.9514	170.7452	177.9360	362.9775	604.6091	827.0277	998.6991 (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													
	286.9545	222.4554	171.8238	89.1365	30.7968	0.0000	0.0000	0.0000	0.0000	72.4615	181.5750	300.2776 (98)	
Space heating												1355.4811 (98)	
Space heating per m2										(98) / (4) =		18.9737 (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 %)													215.0089 (206)
Efficiency of secondary/supplementary heating system, %													100.0000 (208)
Space heating requirement													630.4303 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	286.9545	222.4554	171.8238	89.1365	30.7968	0.0000	0.0000	0.0000	0.0000	72.4615	181.5750	300.2776 (98)	
Space heating efficiency (main heating system 1)	215.0089	215.0089	215.0089	215.0089	215.0089	0.0000	0.0000	0.0000	0.0000	215.0089	215.0089	215.0089 (210)	
Space heating fuel (main heating system)	133.4617	103.4633	79.9147	41.4571	14.3235	0.0000	0.0000	0.0000	0.0000	33.7016	84.4500	139.6582 (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	127.1310	99.8123	85.8393	50.2548	29.3801	14.2150	14.6536	32.9792	55.4358	90.4740	112.3647	127.5653 (64)	
Efficiency of water heater	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800	170.2800 (216)	
Fuel for water heating, kWh/month	74.6600	58.6165	50.4107	29.5130	17.2540	8.3480	8.6056	19.3677	32.5557	53.1325	65.9882	74.9150 (219)	
Water heating fuel used												493.3668 (219)	
Annual totals kWh/year													
Space heating fuel - main system												630.4303 (211)	
Space heating fuel - secondary												0.0000 (215)	
Electricity for pumps and fans:													
(MEV)Decentralised, Database: total watage = 6.6170, total flow = 29.0000, SFP = 0.2282)													
mechanical ventilation fans (SFP = 0.2282)													48.9215 (230a)
pump for solar water heating													50.0000 (230g)
Total electricity for the above, kWh/year													98.9215 (231)
Electricity for lighting (calculated in Appendix L)													340.6249 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.20 * 1140 * 1.00) =									-1094.4958				-1094.4958 (233)
Total delivered energy for all uses													468.8477 (238)

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

	Fuel	Fuel price	Fuel cost	
	kWh/year	p/kWh	£/year	
Space heating - main system 1	630.4303	16.9600	106.9210 (240)	
Space heating - secondary	0.0000	0.0000	0.0000 (242)	
Water heating (other fuel)	493.3668	16.9600	83.6750 (247)	
Mechanical ventilation fans	48.9215	16.9600	8.2971 (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	340.6249	16.9600	57.7700 (250)	
Additional standing charges			0.0000 (251)	
Energy saving/generation technologies				
PV Unit	-1094.4958	16.9600	-185.6265 (252)	
Total energy cost			79.5166 (255)	

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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	630.4303	0.5190	327.1933 (261)
Space heating - secondary	0.0000	0.5190	0.0000 (263)
Water heating (other fuel)	493.3668	0.5190	256.0574 (264)
Space and water heating			583.2507 (265)
Pumps and fans	98.9215	0.5190	51.3402 (267)
Energy for lighting	340.6249	0.5190	176.7843 (268)
Energy saving/generation technologies			
PV Unit	-1094.4958	0.5190	-568.0433 (269)
Total kg/year			243.3319 (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	630.4303	3.0700	1935.4209 (261)
Space heating - secondary	0.0000	3.0700	0.0000 (263)
Water heating (other fuel)	493.3668	3.0700	1514.6362 (264)
Space and water heating			3450.0571 (265)
Pumps and fans	98.9215	3.0700	303.6889 (267)
Energy for lighting	340.6249	3.0700	1045.7184 (268)
Energy saving/generation technologies			
PV Unit	-1094.4958	3.0700	-3360.1021 (269)
Primary energy kWh/year			1439.3623 (272)
Primary energy kWh/m2/year			20.1478 (273)

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

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	North
Overshading	Average or unknown
Thermal mass parameter	148.4 (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	231.98 (P1)
Transmission heat loss coefficient	43.22 (37)
Summer heat loss coefficient	275.20 (P2)

Overhangs

Orientation	Ratio	Z_overhangs	Overhang type
North	0.000	1.000	None
East	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)
East	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	Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	3.5600	81.1852	0.4600	0.0000	0.9000	119.6540
East	0.6600	117.5071	0.4600	0.0000	0.9000	32.1076
South	2.4000	112.2060	0.4600	0.0000	0.9000	111.4879
South	3.1500	112.2060	0.4300	0.0000	0.9000	136.7847
total:						400.0342
Solar gains		Jun	Jul	Aug		(P3/P4)
Internal gains		421	400	370		
Total summer gains		447	431	439		(P5)
Summer gain/loss ratio		868	831	809		(P6)
Summer external temperature		3.15	3.02	2.94		
		16.00	17.90	17.80		

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

Thermal mass temperature increment (TMP = 148.4)	0.96	0.96	0.96	
Threshold temperature	20.11	21.88	21.70	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	
Assessment of likelihood of high internal temperature:	Slight			