elmhurst energy



SAP Report Submission for Building Regulations Compliance

Client: Imperial Homes Southern

Project: Little Oaks, Winchester Road
Botley, SOUTHAMPTON, SO32 2SZ

Contact: Mark Rogers
Surecalc Limited
mark@surecalc.co.uk

Report Issue Date: 05/09/2019

EXCELLENCE IN ENERGY ASSESSMENT

CODE FOR SUSTAINABLE HOMES
Calculation Type: New Build (As Built)

Property Reference	sc120823	**Issued on Date**	05/09/2019
Assessment Reference	002 As Built	**Prop Type Ref**	New Dwelling
Property	Little Oaks, Winchester Road, Botley, SOUTHAMPTON, SO32 2SZ		

SAP Rating	88 B	**DER**	13.24	**TER**	16.76
Environmental	89 B	**% DER<TER**	21.02		
CO_2 Emissions (t/year)	0.96	**DFEE**	38.63	**TFEE**	49.48
General Requirements Compliance	Pass	**% DFEE<TFEE**	21.94		

Assessor Details	Mr. Mark Rogers, Surecalc Limited, Tel: 01243572695, mark@surecalc.co.uk	**Assessor ID**	A320-0001
Client	Imperial Homes Southern, Imperial Homes Southern		

ENE 1 - Dwelling Emission Rate calculation

Total floor area	98	m^2	
DER	13.24	$kgCO_2/yr/m^2$	
TER	16.76	$kgCO_2/yr/m^2$	
CO_2 emissions offset from additional allowable electricity generation	0.00	$kgCO_2/yr/m^2$	(ZC7)
Residual CO_2 emissions offset from biofuel CHP	0.00	$kgCO_2/yr/m^2$	(ZC5)
Total CO_2 emissions offset from SAP Section 16 allowances	0.00	$kgCO_2/yr/m^2$	
DER accounting for SAP Section 16 allowances	13.24	$kgCO_2/yr/m^2$	
Reduction DER/TER	21.02	%	
CfSH ENE1 credits achieved	3.1		
CfSH ENE1 level achieved	4		

ENE 2 – Fabric Energy Efficiency calculation

Dwelling type	House, Semi-Detached		
Fabric energy efficiency (F.E.E.)	38.63	$kWh/m^2/yr$	
CfSH ENE2 credits achieved	8.8		
CfSH ENE1 and 2 overall level achieved	4		

ENE 7 – Low and Zero Carbon Technologies calculation

Standard case CO_2 emissions

Total floor area	98	m^2	
DER	17.08	$kgCO_2/yr/m^2$	
CO_2 emissions from electrical appliances	15.30	$kgCO_2/yr/m^2$	(ZC2)
CO_2 emissions from cooking	1.88	$kgCO_2/yr/m^2$	(ZC3)
Standard case total CO_2 emissions	34.26	$kgCO_2/yr/m^2$	(ZC4)
Net Standard case CO_2 emissions	34.26	$kgCO_2/yr/m^2$	(ZC8)

Actual case CO_2 emissions

DER	14.05	$kgCO_2/yr/m^2$	
CO_2 emissions from electrical appliances	15.30	$kgCO_2/yr/m^2$	(ZC2)
CO_2 emissions from cooking	1.88	$kgCO_2/yr/m^2$	(ZC3)
Actual case total CO_2 emissions	31.23	$kgCO_2/yr/m^2$	(ZC4)
CO_2 emissions from Biomass	0.00	$kgCO_2/yr/m^2$	(ZC5)
CO_2 reduction from additional allowable electricity generation	0.00	$kgCO_2/yr/m^2$	(ZC7)
Net Actual case CO_2 emissions	31.23	$kgCO_2/yr/m^2$	(ZC8)
Improvement in net actual/net standard case CO_2 emissions	9	%	

Regs Region: England
Elmhurst Energy Systems SAP2012 Calculator (Design System) version 4.10r08

ENE7 credits achieved	0

BASIC COMPLIANCE REPORT
Calculation Type: New Build (As Built)

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General Requirements Compliance	Pass	**% DFEE<TFEE**	21.94		

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SUMARY FOR INPUT DATA FOR New Build (As Built)

Criterion 1 – Achieving the TER and TFEE rate

1a TER and DER

Fuel for main heating	Mains gas		
Fuel factor	1.00 (mains gas)		
Target Carbon Dioxide Emission Rate (TER)	16.76	$kgCO_2/m^2$	
Dwelling Carbon Dioxide Emission Rate (DER)	13.24	$kgCO_2/m^2$	Pass
	-3.52 (-21.0%)	$kgCO_2/m^2$	

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	49.48	$kWh/m^2/yr$	
Dwelling Fabric Energy Efficiency (DFEE)	38.63	$kWh/m^2/yr$	
	-10.9 (-22.0%)	$kWh/m^2/yr$	Pass

Criterion 2 – Limits on design flexibility

Limiting Fabric Standards

2 Fabric U-values

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

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	4.33 (measured in this dwelling)	
Maximum	10.0	Pass

Limiting System Efficiencies

4 Heating efficiency

Main heating system	Boiler system with radiators or underfloor - Mains gas Data from database Glow-worm ENERGY 25s Efficiency: 89.3% SEDBUK2009 Minimum: 88.0%		Pass
Secondary heating system	None		

5 Cylinder insulation

Hot water storage	Nominal cylinder loss: 1.79 kWh/day Permitted by DBSCG 2.30		Pass
Primary pipework insulated	Yes		Pass

6 Controls

Space heating controls	Time and temperature zone control		Pass
Hot water controls	Cylinderstat		Pass
	Independent timer for DHW		Pass
Boiler interlock	Yes		Pass

7 Low energy lights

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

8 Mechanical ventilation

Not applicable

Criterion 3 – Limiting the effects of heat gains in summer

9 Summertime temperature

Overheating risk (Southern England)	Not significant	Pass

Based on:

Overshading	Average	
Windows facing North Windows facing East Windows facing South	3.60 m², No overhang 2.00 m², No overhang 8.12 m², No overhang	
Air change rate	4.00 ach	
Blinds/curtains	None	

Criterion 4 – Building performance consistent with DER and DFEE rate

Party Walls

Type	U-value		
Filled Cavity with Edge Sealing	0.00	W/m²K	Pass

Air permeability and pressure testing

3 Air permeability

Air permeability at 50 pascals	4.33 (measured in this dwelling)		
Maximum	10.0		Pass

10 Key features

Party wall U-value	0.00	W/m²K
Roof U-value	0.11	W/m²K
Floor U-value	0.11	W/m²K
Thermal bridging y-value	0.029	W/m²K
Photovoltaic array	1.20	kW

This report has not been submitted through the Elmhurst Energy members' portal, therefore results are subject to change when the dwelling is completed.

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

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General Requirements Compliance	Pass	**% DFEE<TFEE**	21.94		

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

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DWELLING AS BUILT

Semi-Detached House, total floor area 98 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:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 16.76 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 13.24 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)49.5 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)38.6 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.20 (max. 0.30)	0.20 (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	0.11 (max. 0.20)	0.11 (max. 0.35)	OK
Openings	1.40 (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: 4.33 (measured in this dwelling)
Maximum 10.0 OK

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Glow-worm ENERGY 25s

Efficiency: 89.3% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage: Nominal cylinder loss: 1.79 kWh/day
Permitted by DBSCG 2.30 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

Boiler interlock: Yes OK

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

8 Mechanical ventilation
Not applicable

9 Summertime temperature
Overheating risk (Southern England): Not significant OK
Based on:
Overshading: Average
Windows facing North: 3.60 m², No overhang
Windows facing East: 2.00 m², No overhang
Windows facing South: 8.12 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 0.11 W/m²K
Floor U-value 0.11 W/m²K
Thermal bridging y-value 0.029 W/m²K
Photovoltaic array 1.20 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.0000	(1b)	x 2.3900	(2b) =	117.1100	(1b) - (3b)
First floor	49.0000	(1c)	x 2.7500	(2c) =	134.7500	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	98.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		251.8600	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1588	(8)
Pressure test			Yes	
Measured/design AP50			4.3300	
Infiltration rate			0.3753	(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) =		0.3472	(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	0.4426	0.4340	0.4253	0.3819	0.3732	0.3298	0.3298	0.3211	0.3472	0.3732	0.3906	0.4079	(22b)
Effective ac	0.5980	0.5942	0.5904	0.5729	0.5696	0.5544	0.5544	0.5516	0.5603	0.5696	0.5763	0.5832	(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	
New Dwelling DG Door			2.1000	1.4000	2.9400			(26a)
New Dwelling DG Window (Uw = 1.40)			13.7200	1.3258	18.1894			(27)
Ground Floor			49.0000	0.1100	5.3900			(28a)
External Wall	102.5400	15.8200	86.7200	0.2000	17.3440			(29a)
External Roof	49.0000		49.0000	0.1100	5.3900			(30)
Total net area of external elements Aum(A, m2)			200.5400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		49.2534			(33)
Party Wall			49.3400	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	5.7336	(36)
Total fabric heat loss (33) + (36) =	54.9869	(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	49.6992	49.3830	49.0731	47.6174	47.3451	46.0773	46.0773	45.8425	46.5656	47.3451	47.8961	48.4721	(38)
Heat transfer coeff	104.6861	104.3700	104.0600	102.6044	102.3320	101.0642	101.0642	100.8294	101.5526	102.3320	102.8830	103.4590	(39)
Average = Sum(39)m / 12 =												102.6031	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0682	1.0650	1.0618	1.0470	1.0442	1.0313	1.0313	1.0289	1.0363	1.0442	1.0498	1.0557	(40)
HLP (average)												1.0470	(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	2.7202 (42)
Average daily hot water use (litres/day)	98.8053 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.6858	104.7336	100.7814	96.8292	92.8770	88.9248	88.9248	92.8770	96.8292	100.7814	104.7336	108.6858	(44)
Energy conte	161.1780	140.9673	145.4656	126.8204	121.6872	105.0068	97.3043	111.6581	112.9916	131.6808	143.7399	156.0923	(45)
Energy content (annual)										Total = Sum(45)m =		1554.5924	(45)
Distribution loss (46)m = 0.15 x (45)m	24.1767	21.1451	21.8198	19.0231	18.2531	15.7510	14.5956	16.7487	16.9487	19.7521	21.5610	23.4138	(46)
Water storage loss:													
Store volume												210.0000	(47)

b) If manufacturer declared loss factor is not known :

Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0103	(51)
Volume factor from Table 2a												0.8298	(52)
Temperature factor from Table 2b												0.5400	(53)
Enter (49) or (54) in (55)												0.9682	(55)
Total storage loss													
	30.0132	27.1087	30.0132	29.0450	30.0132	29.0450	30.0132	30.0132	29.0450	30.0132	29.0450	30.0132	(56)
If cylinder contains dedicated solar storage													
	30.0132	27.1087	30.0132	29.0450	30.0132	29.0450	30.0132	30.0132	29.0450	30.0132	29.0450	30.0132	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	214.4536	189.0872	198.7412	178.3775	174.9628	156.5639	150.5799	164.9337	164.5487	184.9565	195.2970	209.3679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
Output from w/h													
	214.4536	189.0872	198.7412	178.3775	174.9628	156.5639	150.5799	164.9337	164.5487	184.9565	195.2970	209.3679	(64)
Total per year (kWh/year) = Sum(64)m =												2181.8698	(64)
Heat gains from water heating, kWh/month													
	96.2122	85.3675	90.9878	83.4134	83.0815	76.1604	74.9742	79.7468	78.8154	86.4044	89.0392	94.5212	(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	136.0112	136.0112	136.0112	136.0112	136.0112	136.0112	136.0112	136.0112	136.0112	136.0112	136.0112	136.0112	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.2026	21.4965	17.4822	13.2351	9.8934	8.3524	9.0251	11.7312	15.7455	19.9926	23.3343	24.8753	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	253.0533	255.6792	249.0621	234.9748	217.1923	200.4792	189.3138	186.6879	193.3051	207.3923	225.1748	241.8880	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.6011	36.6011	36.6011	36.6011	36.6011	36.6011	36.6011	36.6011	36.6011	36.6011	36.6011	36.6011	(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)													
	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	(71)
Water heating gains (Table 5)													
	129.3174	127.0350	122.2954	115.8520	111.6687	105.7783	100.7717	107.1866	109.4658	116.1349	123.6655	127.0446	(72)
Total internal gains													
	473.3767	471.0142	455.6430	430.8653	405.5577	381.4133	365.9140	372.4090	385.3197	410.3231	438.9780	460.6112	(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	3.6000	10.6334	0.7100	0.7000	0.7700	13.1845	(74)
East	2.0000	19.6403	0.7100	0.7000	0.7700	13.5290	(76)
South	8.1200	46.7521	0.7100	0.7000	0.7700	130.7514	(78)

Solar gains	157.4650	265.7991	359.1726	440.6301	491.8040	488.0915	470.5924	432.0355	387.1118	292.3636	188.1189	135.0982	(83)
Total gains	630.8417	736.8133	814.8156	871.4954	897.3617	869.5048	836.5063	804.4445	772.4315	702.6867	627.0970	595.7093	(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	65.0091	65.2061	65.4003	66.3281	66.5046	67.3389	67.3389	67.4957	67.0151	66.5046	66.1485	65.7802	
alpha	5.3339	5.3471	5.3600	5.4219	5.4336	5.4893	5.4893	5.4997	5.4677	5.4336	5.4099	5.3853	
util living area													
	0.9972	0.9931	0.9827	0.9512	0.8683	0.6999	0.5237	0.5644	0.8014	0.9617	0.9935	0.9979	(86)
MIT	20.1325	20.2567	20.4321	20.6477	20.8236	20.9224	20.9457	20.9434	20.8904	20.6653	20.3589	20.1132	(87)
Th 2	20.0269	20.0295	20.0321	20.0444	20.0467	20.0574	20.0574	20.0593	20.0532	20.0467	20.0420	20.0372	(88)
util rest of house													
	0.9963	0.9909	0.9768	0.9339	0.8230	0.6142	0.4157	0.4552	0.7266	0.9446	0.9909	0.9973	(89)
MIT 2	18.8646	19.0473	19.3029	19.6174	19.8493	19.9660	19.9830	19.9840	19.9339	19.6483	19.2070	18.8446	(90)
Living area fraction									fLA = Living area / (4) =			0.1919	(91)
MIT	19.1079	19.2795	19.5196	19.8152	20.0363	20.1496	20.1678	20.1682	20.1175	19.8435	19.4281	19.0881	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.9579	19.1295	19.3696	19.6652	19.8863	19.9996	20.0178	20.0182	19.9675	19.6935	19.2781	18.9381	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9948	0.9880	0.9715	0.9253	0.8141	0.6086	0.4110	0.4503	0.7190	0.9363	0.9880	0.9961	(94)
Useful gains	627.5879	727.9600	791.5854	806.4115	730.5589	529.1464	343.8332	362.2254	555.3441	657.9387	619.6002	593.4037	(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													
	1534.4815	1485.1279	1339.2145	1104.5530	837.7228	545.7070	345.4176	364.8165	595.8601	930.5551	1252.9231	1524.7897	(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													
	674.7289	508.8168	407.4361	214.6619	79.7299	0.0000	0.0000	0.0000	0.0000	202.8266	455.9925	692.9512	(98)
Space heating												3237.1439	(98)
Space heating per m2											(98) / (4) =	33.0321	(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 %)												90.3000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3584.8770	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	674.7289	508.8168	407.4361	214.6619	79.7299	0.0000	0.0000	0.0000	0.0000	202.8266	455.9925	692.9512	(98)
Space heating efficiency (main heating system 1)													
	90.3000	90.3000	90.3000	90.3000	90.3000	0.0000	0.0000	0.0000	0.0000	90.3000	90.3000	90.3000	(210)
Space heating fuel (main heating system)													
	747.2081	563.4737	451.2028	237.7208	88.2945	0.0000	0.0000	0.0000	0.0000	224.6142	504.9751	767.3878	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	214.4536	189.0872	198.7412	178.3775	174.9628	156.5639	150.5799	164.9337	164.5487	184.9565	195.2970	209.3679	(64)
Efficiency of water heater												79.6000	(216)
(217)m	87.4644	87.1269	86.4883	85.1079	82.6664	79.6000	79.6000	79.6000	79.6000	84.8593	86.8012	87.5687	(217)
Fuel for water heating, kWh/month													
	245.1896	217.0251	229.7897	209.5899	211.6493	196.6883	189.1707	207.2031	206.7194	217.9565	224.9934	239.0899	(219)
Water heating fuel used												2595.0648	(219)
Annual totals kWh/year													
Space heating fuel - main system												3584.8770	(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)												427.4256	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.20 * 597 * 1.00) =										-573.4671		-573.4671	(233)
Total delivered energy for all uses												6108.9003	(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	3584.8770	0.2160	774.3334	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2595.0648	0.2160	560.5340	(264)
Space and water heating			1334.8674	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	427.4256	0.5190	221.8339	(268)
Energy saving/generation technologies				
PV Unit	-573.4671	0.5190	-297.6294	(269)
Total CO2, kg/year			1297.9969	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			13.2400	(273)

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

DER		13.2400	ZC1
Total Floor Area	TFA	98.0000	
Assumed number of occupants	N	2.7202	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.3014	ZC2
CO2 emissions from cooking, equation (L16)		1.8805	ZC3
Total CO2 emissions		30.4219	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		30.4219	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Built) (Version 9.92, January 2014)
CALCULATION OF TARGET EMISSIONS 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.0000 (1b)	x	2.3900 (2b)	=	117.1100	(1b) - (3b)
First floor	49.0000 (1c)	x	2.7500 (2c)	=	134.7500	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	98.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	251.8600	(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) =	0.1191	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3691	(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) =	0.3414	(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	0.4353	0.4268	0.4183	0.3756	0.3670	0.3244	0.3244	0.3158	0.3414	0.3670	0.3841	0.4012	(22b)
Effective ac	0.5948	0.5911	0.5875	0.5705	0.5674	0.5526	0.5526	0.5499	0.5583	0.5674	0.5738	0.5805	(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 Semi-glazed door			2.1000	1.2000	2.5200			(26a)
TER Opening Type (Uw = 1.40)			13.7200	1.3258	18.1894			(27)
Ground Floor			49.0000	0.1300	6.3700			(28a)
External Wall	102.5400	15.8200	86.7200	0.1800	15.6096			(29a)
External Roof	49.0000		49.0000	0.1300	6.3700			(30)
Total net area of external elements Aum(A, m2)			200.5400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		49.0590			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	10.2518	(36)
Total fabric heat loss (33) + (36) =	59.3108	(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	49.4322	49.1264	48.8266	47.4187	47.1553	45.9290	45.9290	45.7020	46.4014	47.1553	47.6882	48.2453	(38)
Heat transfer coeff	108.7430	108.4372	108.1374	106.7295	106.4661	105.2398	105.2398	105.0128	105.7122	106.4661	106.9990	107.5561	(39)
Average = Sum(39)m / 12 =												106.7283	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1096	1.1065	1.1034	1.0891	1.0864	1.0739	1.0739	1.0716	1.0787	1.0864	1.0918	1.0975	(40)
HLP (average)												1.0891	(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	2.7202 (42)
Average daily hot water use (litres/day)	98.8053 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.6858	104.7336	100.7814	96.8292	92.8770	88.9248	88.9248	92.8770	96.8292	100.7814	104.7336	108.6858	(44)
Energy conte	161.1780	140.9673	145.4656	126.8204	121.6872	105.0068	97.3043	111.6581	112.9916	131.6808	143.7399	156.0923	(45)
Energy content (annual)										Total = Sum(45)m =		1554.5924	(45)
Distribution loss (46)m = 0.15 x (45)m	24.1767	21.1451	21.8198	19.0231	18.2531	15.7510	14.5956	16.7487	16.9487	19.7521	21.5610	23.4138	(46)

Water storage loss:	
Store volume	210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):	1.7016 (48)
Temperature factor from Table 2b	0.5400 (49)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Enter (49) or (54) in (55)												0.9188	(55)
Total storage loss													
	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(56)
If cylinder contains dedicated solar storage													
	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842	(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													
	212.9246	187.7061	197.2122	176.8978	173.4338	155.0842	149.0509	163.4047	163.0690	183.4274	193.8173	207.8389	(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													
	212.9246	187.7061	197.2122	176.8978	173.4338	155.0842	149.0509	163.4047	163.0690	183.4274	193.8173	207.8389	(64)
									Total per year (kWh/year) = Sum(64)m =			2163.8667	(64)
Heat gains from water heating, kWh/month													
	94.9889	84.2627	89.7646	82.2297	81.8583	74.9766	73.7509	78.5236	77.6316	85.1812	87.8554	93.2979	(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	136.0112	136.0112	136.0112	136.0112	136.0112	136.0112	136.0112	136.0112	136.0112	136.0112	136.0112	136.0112	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.2026	21.4965	17.4822	13.2351	9.8934	8.3524	9.0251	11.7312	15.7455	19.9926	23.3343	24.8753	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	253.0533	255.6792	249.0621	234.9748	217.1923	200.4792	189.3138	186.6879	193.3051	207.3923	225.1748	241.8880	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.6011	36.6011	36.6011	36.6011	36.6011	36.6011	36.6011	36.6011	36.6011	36.6011	36.6011	36.6011	(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)													
	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	(71)
Water heating gains (Table 5)													
	127.6733	125.3909	120.6513	114.2079	110.0246	104.1342	99.1276	105.5424	107.8217	114.4908	122.0214	125.4005	(72)
Total internal gains													
	471.7326	469.3701	453.9989	429.2212	403.9136	379.7692	364.2698	370.7648	383.6756	408.6790	437.3339	458.9671	(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	3.6000	10.6334	0.6300	0.7000	0.7700	11.6989	(74)
East	2.0000	19.6403	0.6300	0.7000	0.7700	12.0046	(76)
South	8.1200	46.7521	0.6300	0.7000	0.7700	116.0189	(78)

Solar gains	139.7224	235.8499	318.7024	390.9816	436.3894	433.0953	417.5679	383.3555	343.4935	259.4212	166.9224	119.8758	(83)
Total gains	611.4551	705.2200	772.7013	820.2028	840.3030	812.8645	781.8377	754.1203	727.1692	668.1003	604.2563	578.8429	(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	62.5838	62.7603	62.9343	63.7645	63.9223	64.6671	64.6671	64.8069	64.3782	63.9223	63.6039	63.2745	
alpha	5.1723	5.1840	5.1956	5.2510	5.2615	5.3111	5.3111	5.3205	5.2919	5.2615	5.2403	5.2183	
util living area													
	0.9976	0.9946	0.9870	0.9643	0.9006	0.7533	0.5767	0.6177	0.8424	0.9710	0.9947	0.9982	(86)
MIT	19.8357	19.9911	20.2216	20.5149	20.7737	20.9405	20.9882	20.9832	20.8865	20.5554	20.1416	19.8107	(87)
Th 2	19.9930	19.9955	19.9980	20.0098	20.0120	20.0222	20.0222	20.0241	20.0183	20.0120	20.0075	20.0029	(88)
util rest of house													
	0.9968	0.9927	0.9824	0.9506	0.8612	0.6662	0.4566	0.4980	0.7718	0.9571	0.9926	0.9976	(89)
MIT 2	18.4418	18.6701	19.0063	19.4334	19.7830	19.9808	20.0177	20.0170	19.9267	19.4970	18.8991	18.4125	(90)
Living area fraction										fLA = Living area / (4) =		0.1919	(91)
MIT	18.7094	18.9236	19.2396	19.6410	19.9731	20.1650	20.2040	20.2024	20.1109	19.7002	19.1376	18.6809	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7094	18.9236	19.2396	19.6410	19.9731	20.1650	20.2040	20.2024	20.1109	19.7002	19.1376	18.6809	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9953	0.9899	0.9776	0.9441	0.8594	0.6801	0.4797	0.5209	0.7794	0.9513	0.9899	0.9964	(94)
Useful gains	608.5775	698.1164	755.3988	774.3166	722.1512	552.8121	375.0474	392.8091	566.7675	635.5860	598.1241	576.7608	(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													
	1566.9172	1520.6836	1377.6250	1146.3783	880.8084	585.6623	379.2808	399.3040	635.4242	968.8616	1288.0084	1557.5045	(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													
	713.0048	552.7651	462.9362	267.8844	118.0410	0.0000	0.0000	0.0000	0.0000	247.9570	496.7167	729.6733	(98)
Space heating												3588.9786	(98)
Space heating per m2											(98) / (4) =	36.6222	(99)

8c. Space cooling requirement

Not applicable

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												3838.4798	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	713.0048	552.7651	462.9362	267.8844	118.0410	0.0000	0.0000	0.0000	0.0000	247.9570	496.7167	729.6733	(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)													
	762.5720	591.1927	495.1190	286.5074	126.2470	0.0000	0.0000	0.0000	0.0000	265.1947	531.2478	780.3993	(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													
	212.9246	187.7061	197.2122	176.8978	173.4338	155.0842	149.0509	163.4047	163.0690	183.4274	193.8173	207.8389	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.7930	87.5250	87.0145	85.9182	83.8131	79.8000	79.8000	79.8000	79.8000	85.6186	87.2176	87.8875	(217)
Fuel for water heating, kWh/month													
	242.5302	214.4600	226.6429	205.8911	206.9293	194.3411	186.7805	204.7677	204.3471	214.2379	222.2227	236.4829	(219)
Water heating fuel used												2559.6334	(219)
Annual totals kWh/year													
Space heating fuel - main system												3838.4798	(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)												427.4256	(232)
Total delivered energy for all uses												6900.5388	(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	3838.4798	0.2160	829.1116	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2559.6334	0.2160	552.8808	(264)
Space and water heating			1381.9924	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	427.4256	0.5190	221.8339	(268)
Total CO2, kg/m2/year			1642.7513	(272)
Emissions per m2 for space and water heating			14.1020	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2636	(272b)
Emissions per m2 for pumps and fans			0.3972	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.1020 * 1.00) + 2.2636 + 0.3972, rounded to 2 d.p.			16.7600	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.0000 (1b)	x	2.3900 (2b)	=	117.1100	(1b) - (3b)
First floor	49.0000 (1c)	x	2.7500 (2c)	=	134.7500	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	98.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	251.8600	(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) =	0.1191	(8)
Pressure test		Yes	
Measured/design AP50		4.3300	
Infiltration rate		0.3356	(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) =	0.3104	(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	0.3958	0.3881	0.3803	0.3415	0.3337	0.2949	0.2949	0.2872	0.3104	0.3337	0.3492	0.3648	(22b)
Effective ac	0.5783	0.5753	0.5723	0.5583	0.5557	0.5435	0.5435	0.5412	0.5482	0.5557	0.5610	0.5665	(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	
New Dwelling DG Door			2.1000	1.4000	2.9400			(26a)
New Dwelling DG Window (Uw = 1.40)			13.7200	1.3258	18.1894			(27)
Ground Floor			49.0000	0.1100	5.3900			(28a)
External Wall	102.5400	15.8200	86.7200	0.2000	17.3440			(29a)
External Roof	49.0000		49.0000	0.1100	5.3900			(30)
Total net area of external elements Aum(A, m2)			200.5400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		49.2534			(33)
Party Wall			49.3400	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	5.7336	(36)
Total fabric heat loss (33) + (36) =	54.9869	(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	48.0676	47.8148	47.5670	46.4030	46.1852	45.1714	45.1714	44.9837	45.5619	46.1852	46.6258	47.0864	(38)
Heat transfer coeff	103.0545	102.8017	102.5539	101.3899	101.1722	100.1584	100.1584	99.9707	100.5489	101.1722	101.6127	102.0733	(39)
Average = Sum(39)m / 12 =												101.3889	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0516	1.0490	1.0465	1.0346	1.0324	1.0220	1.0220	1.0201	1.0260	1.0324	1.0369	1.0416	(40)
HLP (average)												1.0346	(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	2.7202 (42)
Average daily hot water use (litres/day)	98.8053 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.6858	104.7336	100.7814	96.8292	92.8770	88.9248	88.9248	92.8770	96.8292	100.7814	104.7336	108.6858	(44)
Energy conte	161.1780	140.9673	145.4656	126.8204	121.6872	105.0068	97.3043	111.6581	112.9916	131.6808	143.7399	156.0923	(45)
Energy content (annual)										Total = Sum(45)m =		1554.5924	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	34.2503	29.9555	30.9114	26.9493	25.8585	22.3140	20.6772	23.7273	24.0107	27.9822	30.5447	33.1696	(65)

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

Metabolic gains (Table 5), Watts													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	136.0112	136.0112	136.0112	136.0112	136.0112	136.0112	136.0112	136.0112	136.0112	136.0112	136.0112	136.0112	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.2026	21.4965	17.4822	13.2351	9.8934	8.3524	9.0251	11.7312	15.7455	19.9926	23.3343	24.8753	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	253.0533	255.6792	249.0621	234.9748	217.1923	200.4792	189.3138	186.6879	193.3051	207.3923	225.1748	241.8880	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.6011	36.6011	36.6011	36.6011	36.6011	36.6011	36.6011	36.6011	36.6011	36.6011	36.6011	36.6011	(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)													
	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	(71)
Water heating gains (Table 5)													
	46.0354	44.5767	41.5476	37.4296	34.7561	30.9916	27.7919	31.8916	33.3482	37.6105	42.4232	44.5828	(72)
Total internal gains													
	387.0947	385.5559	371.8952	349.4430	325.6451	303.6266	289.9341	294.1140	306.2022	328.7987	354.7357	375.1494	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	3.6000	10.6334	0.7100	0.7000	0.7700	13.1845	(74)
East	2.0000	19.6403	0.7100	0.7000	0.7700	13.5290	(76)
South	8.1200	46.7521	0.7100	0.7000	0.7700	130.7514	(78)

Solar gains	157.4650	265.7991	359.1726	440.6301	491.8040	488.0915	470.5924	432.0355	387.1118	292.3636	188.1189	135.0982	(83)
Total gains	544.5597	651.3549	731.0678	790.0730	817.4491	791.7181	760.5265	726.1495	693.3140	621.1623	542.8547	510.2475	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	66.0384	66.2008	66.3608	67.1226	67.2671	67.9479	67.9479	68.0755	67.6841	67.2671	66.9754	66.6732	
alpha	5.4026	5.4134	5.4241	5.4748	5.4845	5.5299	5.5299	5.5384	5.5123	5.4845	5.4650	5.4449	
util living area													
	0.9986	0.9961	0.9891	0.9660	0.8986	0.7456	0.5672	0.6138	0.8467	0.9765	0.9967	0.9990	(86)
MIT	19.8513	20.0176	20.2538	20.5462	20.7979	20.9502	20.9908	20.9861	20.8953	20.5636	20.1474	19.8219	(87)
Th 2	20.0406	20.0427	20.0448	20.0546	20.0564	20.0650	20.0650	20.0666	20.0617	20.0564	20.0527	20.0488	(88)
util rest of house													
	0.9982	0.9948	0.9852	0.9531	0.8597	0.6609	0.4531	0.4991	0.7789	0.9651	0.9953	0.9987	(89)
MIT 2	18.9881	19.1555	19.3915	19.6846	19.9167	20.0414	20.0626	20.0625	20.0034	19.7066	19.2936	18.9655	(90)
Living area fraction									fLA = Living area / (4) =			0.1919	(91)
MIT	19.1538	19.3210	19.5570	19.8500	20.0858	20.2158	20.2408	20.2398	20.1746	19.8711	19.4575	19.1299	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.1538	19.3210	19.5570	19.8500	20.0858	20.2158	20.2408	20.2398	20.1746	19.8711	19.4575	19.1299	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9976	0.9934	0.9826	0.9497	0.8611	0.6756	0.4752	0.5212	0.7882	0.9622	0.9942	0.9983	(94)
Useful gains	543.2393	647.0774	718.3506	750.2988	703.8741	534.9220	361.3669	378.4835	546.4505	597.6517	539.6896	509.3690	(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													
	1530.7473	1482.5005	1339.0486	1110.2205	848.4127	562.4702	364.6523	383.8668	610.7965	937.9730	1255.6746	1523.9392	(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													
	734.7060	561.4043	461.7993	259.1437	107.5367	0.0000	0.0000	0.0000	0.0000	253.1991	515.5092	754.8402	(98)
Space heating												3648.1384	(98)
Space heating per m2											(98) / (4) =	37.2259	(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	941.4888	741.1721	759.7769	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8822	0.9406	0.9253	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	830.5961	697.1348	703.0002	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1030.0380	991.4016	953.2808	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	143.5982	218.9345	186.2088	0.0000	0.0000	0.0000	0.0000	(104)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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Space cooling                                                                                                                                  548.7414 (104)
Cooled fraction                                                                                                  fC = cooled area / (4) =        1.0000 (105)
Intermittency factor (Table 10b)
                 0.0000     0.0000     0.0000     0.0000     0.0000     0.2500     0.2500     0.2500     0.0000     0.0000     0.0000     0.0000 (106)
Space cooling kWh
                 0.0000     0.0000     0.0000     0.0000     0.0000    35.8995    54.7336    46.5522     0.0000     0.0000     0.0000     0.0000 (107)
Space cooling                                                                                                                                  137.1854 (107)
Space cooling per m2                                                                                                                             1.3999 (108)
Energy for space heating                                                                                                                        37.2259 (99)
Energy for space cooling                                                                                                                         1.3999 (108)
Total                                                                                                                                           38.6258 (109)
Dwelling Fabric Energy Efficiency (DFEE)                                                                                                           38.6 (109)


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CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.0000 (1b)	x	2.3900 (2b)	=	117.1100	(1b) - (3b)
First floor	49.0000 (1c)	x	2.7500 (2c)	=	134.7500	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	98.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	251.8600	(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) =	0.1191	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3691	(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) =	0.3414	(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	0.4353	0.4268	0.4183	0.3756	0.3670	0.3244	0.3244	0.3158	0.3414	0.3670	0.3841	0.4012	(22b)
Effective ac	0.5948	0.5911	0.5875	0.5705	0.5674	0.5526	0.5526	0.5499	0.5583	0.5674	0.5738	0.5805	(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 Semi-glazed door			2.1000	1.2000	2.5200			(26a)
TER Opening Type (Uw = 1.40)			13.7200	1.3258	18.1894			(27)
Ground Floor			49.0000	0.1300	6.3700			(28a)
External Wall	102.5400	15.8200	86.7200	0.1800	15.6096			(29a)
External Roof	49.0000		49.0000	0.1300	6.3700			(30)
Total net area of external elements Aum(A, m2)			200.5400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		49.0590			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							10.2518	(36)
Total fabric heat loss					(33) + (36) =		59.3108	(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	49.4322	49.1264	48.8266	47.4187	47.1553	45.9290	45.9290	45.7020	46.4014	47.1553	47.6882	48.2453	(38)
Heat transfer coeff	108.7430	108.4372	108.1374	106.7295	106.4661	105.2398	105.2398	105.0128	105.7122	106.4661	106.9990	107.5561	(39)
Average = Sum(39)m / 12 =												106.7283	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1096	1.1065	1.1034	1.0891	1.0864	1.0739	1.0739	1.0716	1.0787	1.0864	1.0918	1.0975	(40)
HLP (average)												1.0891	(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												2.7202	(42)
Average daily hot water use (litres/day)												98.8053	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.6858	104.7336	100.7814	96.8292	92.8770	88.9248	88.9248	92.8770	96.8292	100.7814	104.7336	108.6858	(44)
Energy conte	161.1780	140.9673	145.4656	126.8204	121.6872	105.0068	97.3043	111.6581	112.9916	131.6808	143.7399	156.0923	(45)
Energy content (annual)										Total = Sum(45)m =		1554.5924	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	34.2503	29.9555	30.9114	26.9493	25.8585	22.3140	20.6772	23.7273	24.0107	27.9822	30.5447	33.1696	(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	136.0112	136.0112	136.0112	136.0112	136.0112	136.0112	136.0112	136.0112	136.0112	136.0112	136.0112	136.0112	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.2026	21.4965	17.4822	13.2351	9.8934	8.3524	9.0251	11.7312	15.7455	19.9926	23.3343	24.8753	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	253.0533	255.6792	249.0621	234.9748	217.1923	200.4792	189.3138	186.6879	193.3051	207.3923	225.1748	241.8880	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.6011	36.6011	36.6011	36.6011	36.6011	36.6011	36.6011	36.6011	36.6011	36.6011	36.6011	36.6011	(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)													
	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	(71)
Water heating gains (Table 5)													
	46.0354	44.5767	41.5476	37.4296	34.7561	30.9916	27.7919	31.8916	33.3482	37.6105	42.4232	44.5828	(72)
Total internal gains													
	387.0947	385.5559	371.8952	349.4430	325.6451	303.6266	289.9341	294.1140	306.2022	328.7987	354.7357	375.1494	(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	3.6000	10.6334	0.6300	0.7000	0.7700	11.6989	(74)
East	2.0000	19.6403	0.6300	0.7000	0.7700	12.0046	(76)
South	8.1200	46.7521	0.6300	0.7000	0.7700	116.0189	(78)

Solar gains	139.7224	235.8499	318.7024	390.9816	436.3894	433.0953	417.5679	383.3555	343.4935	259.4212	166.9224	119.8758	(83)
Total gains	526.8171	621.4057	690.5976	740.4246	762.0346	736.7219	707.5020	677.4695	649.6957	588.2199	521.6582	495.0252	(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	62.5838	62.7603	62.9343	63.7645	63.9223	64.6671	64.6671	64.8069	64.3782	63.9223	63.6039	63.2745	
alpha	5.1723	5.1840	5.1956	5.2510	5.2615	5.3111	5.3111	5.3205	5.2919	5.2615	5.2403	5.2183	
util living area													
	0.9988	0.9970	0.9921	0.9763	0.9279	0.8015	0.6289	0.6747	0.8855	0.9829	0.9973	0.9992	(86)
MIT	19.7548	19.9120	20.1467	20.4490	20.7256	20.9193	20.9824	20.9747	20.8504	20.4870	20.0633	19.7302	(87)
Th 2	19.9930	19.9955	19.9980	20.0098	20.0120	20.0222	20.0222	20.0241	20.0183	20.0120	20.0075	20.0029	(88)
util rest of house													
	0.9984	0.9959	0.9891	0.9666	0.8960	0.7184	0.5020	0.5500	0.8248	0.9740	0.9962	0.9989	(89)
MIT 2	18.8533	19.0121	19.2475	19.5542	19.8159	19.9820	20.0174	20.0164	19.9311	19.5959	19.1732	18.8367	(90)
Living area fraction										fLA = Living area / (4) =		0.1919	(91)
MIT	19.0263	19.1848	19.4200	19.7260	19.9905	20.1619	20.2026	20.2003	20.1075	19.7670	19.3440	19.0082	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.0263	19.1848	19.4200	19.7260	19.9905	20.1619	20.2026	20.2003	20.1075	19.7670	19.3440	19.0082	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9979	0.9947	0.9868	0.9630	0.8951	0.7317	0.5267	0.5741	0.8313	0.9711	0.9952	0.9985	(94)
Useful gains	525.6912	618.1261	681.5040	713.0271	682.1281	539.0466	372.6075	388.9057	540.1156	571.2257	519.1314	494.2580	(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													
	1601.3833	1549.0063	1397.1408	1155.4502	882.6612	585.3356	379.1394	399.0830	635.0701	975.9694	1310.0978	1592.7134	(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													
	800.3149	625.5515	532.4338	318.5446	149.1966	0.0000	0.0000	0.0000	0.0000	301.1293	569.4958	817.2508	(98)
Space heating												4113.9174	(98)
Space heating per m2											(98) / (4) =	41.9787	(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	989.2545	778.7748	798.0969	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8313	0.9058	0.8863	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	822.3303	705.3903	707.3841	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	965.7567	929.4249	896.3820	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)
Space cooling kWh													
	0.0000	0.0000	0.0000	0.0000	0.0000	103.2670	166.6817	140.6144	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												410.5631	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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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   25.8167   41.6704   35.1536    0.0000    0.0000    0.0000    0.0000 (107)
Space cooling                                                                                                        102.6408 (107)
Space cooling per m2                                                                                                   1.0474 (108)
Energy for space heating                                                                                              41.9787 (99)
Energy for space cooling                                                                                               1.0474 (108)
Total                                                                                                                 43.0261 (109)
Target Fabric Energy Efficiency (TFEE)                                                                                   49.5 (109)


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CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.0000	(1b)	x 2.3900	(2b) =	117.1100	(1b) - (3b)
First floor	49.0000	(1c)	x 2.7500	(2c) =	134.7500	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	98.0000					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	251.8600	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1588	(8)
Pressure test			Yes	
Measured/design AP50			4.3300	
Infiltration rate			0.3753	(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) =		0.3472	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3645	0.3385	0.3472	0.3298	0.3298	0.3211	0.3125	0.3038	0.2951	0.3211	0.3038	0.3211	(22b)
Effective ac	0.5664	0.5573	0.5603	0.5544	0.5544	0.5516	0.5488	0.5461	0.5435	0.5516	0.5461	0.5516	(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	
New Dwelling DG Door			2.1000	1.4000	2.9400			(26a)
New Dwelling DG Window (Uw = 1.40)			13.7200	1.3258	18.1894			(27)
Ground Floor			49.0000	0.1100	5.3900			(28a)
External Wall	102.5400	15.8200	86.7200	0.2000	17.3440			(29a)
External Roof	49.0000		49.0000	0.1100	5.3900			(30)
Total net area of external elements Aum(A, m2)			200.5400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		49.2534			(33)
Party Wall			49.3400	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	5.7336	(36)
Total fabric heat loss (33) + (36) =	54.9869	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	47.0790	46.3183	46.5656	46.0773	46.0773	45.8425	45.6140	45.3917	45.1757	45.8425	45.3917	45.8425	(38)
Heat transfer coeff	102.0660	101.3053	101.5526	101.0642	101.0642	100.8294	100.6009	100.3786	100.1626	100.8294	100.3786	100.8294	(39)
Average = Sum(39)m / 12 =												100.9218	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0415	1.0337	1.0363	1.0313	1.0313	1.0289	1.0265	1.0243	1.0221	1.0289	1.0243	1.0289	(40)
HLP (average)												1.0298	(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	2.7202 (42)
Average daily hot water use (litres/day)	98.8053 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.6858	104.7336	100.7814	96.8292	92.8770	88.9248	88.9248	92.8770	96.8292	100.7814	104.7336	108.6858	(44)
Energy conte	161.1780	140.9673	145.4656	126.8204	121.6872	105.0068	97.3043	111.6581	112.9916	131.6808	143.7399	156.0923	(45)
Energy content (annual)										Total = Sum(45)m =		1554.5924	(45)
Distribution loss (46)m = 0.15 x (45)m	24.1767	21.1451	21.8198	19.0231	18.2531	15.7510	14.5956	16.7487	16.9487	19.7521	21.5610	23.4138	(46)
Water storage loss:													
Store volume												210.0000	(47)

b) If manufacturer declared loss factor is not known :

CALCULATION OF HEAT DEMAND 09 Jan 2014

Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0103	(51)
Volume factor from Table 2a												0.8298	(52)
Temperature factor from Table 2b												0.5400	(53)
Enter (49) or (54) in (55)												0.9682	(55)
Total storage loss													
	30.0132	27.1087	30.0132	29.0450	30.0132	29.0450	30.0132	30.0132	29.0450	30.0132	29.0450	30.0132	(56)
If cylinder contains dedicated solar storage													
	30.0132	27.1087	30.0132	29.0450	30.0132	29.0450	30.0132	30.0132	29.0450	30.0132	29.0450	30.0132	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	214.4536	189.0872	198.7412	178.3775	174.9628	156.5639	150.5799	164.9337	164.5487	184.9565	195.2970	209.3679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
Output from w/h													
	214.4536	189.0872	198.7412	178.3775	174.9628	156.5639	150.5799	164.9337	164.5487	184.9565	195.2970	209.3679	(64)
Total per year (kWh/year) = Sum(64)m =												2181.8698	(64)
RHI water heating demand												2182	(64)
Heat gains from water heating, kWh/month													
	96.2122	85.3675	90.9878	83.4134	83.0815	76.1604	74.9742	79.7468	78.8154	86.4044	89.0392	94.5212	(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	163.2134	163.2134	163.2134	163.2134	163.2134	163.2134	163.2134	163.2134	163.2134	163.2134	163.2134	163.2134	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	60.5065	53.7414	43.7054	33.0878	24.7335	20.8811	22.5627	29.3279	39.3639	49.9815	58.3357	62.1882	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	377.6916	381.6108	371.7344	350.7087	324.1676	299.2226	282.5579	278.6386	288.5150	309.5407	336.0819	361.0268	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.0416	54.0416	54.0416	54.0416	54.0416	54.0416	54.0416	54.0416	54.0416	54.0416	54.0416	54.0416	(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)													
	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	(71)
Water heating gains (Table 5)													
	129.3174	127.0350	122.2954	115.8520	111.6687	105.7783	100.7717	107.1866	109.4658	116.1349	123.6655	127.0446	(72)
Total internal gains													
	678.9615	673.8333	649.1813	611.0946	572.0158	537.3281	517.3384	526.5991	548.7907	587.1031	629.5292	661.7056	(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	3.6000	13.4839	0.7100	0.7000	0.7700	16.7189	(74)
East	2.0000	25.1925	0.7100	0.7000	0.7700	17.3537	(76)
South	8.1200	56.7559	0.7100	0.7000	0.7700	158.7290	(78)

Solar gains	192.8016	276.8577	378.0160	469.9702	502.4045	543.5973	519.1805	485.2438	431.3244	328.6820	229.5245	162.6634	(83)
Total gains	871.7632	950.6910	1027.1973	1081.0647	1074.4203	1080.9254	1036.5188	1011.8429	980.1151	915.7851	859.0537	824.3690	(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	66.6780	67.1787	67.0151	67.3389	67.3389	67.4957	67.6491	67.7988	67.9450	67.4957	67.7988	67.4957	
alpha	5.4452	5.4786	5.4677	5.4893	5.4893	5.4997	5.5099	5.5199	5.5297	5.4997	5.5199	5.4997	
util living area													
	0.9849	0.9751	0.9465	0.8748	0.7383	0.5239	0.3774	0.3856	0.6225	0.8686	0.9647	0.9877	(86)
MIT	20.3747	20.4632	20.6204	20.7914	20.9021	20.9444	20.9498	20.9498	20.9355	20.8238	20.5931	20.3633	(87)
Th 2	20.0489	20.0553	20.0532	20.0574	20.0574	20.0593	20.0613	20.0632	20.0650	20.0593	20.0632	20.0593	(88)
util rest of house													
	0.9803	0.9678	0.9309	0.8403	0.6754	0.4411	0.2872	0.2937	0.5392	0.8253	0.9526	0.9838	(89)
MIT 2	19.2331	19.3646	19.5834	19.8143	19.9439	19.9837	19.9888	19.9908	19.9834	19.8607	19.5574	19.2255	(90)
Living area fraction									fLA = Living area / (4) =			0.1919	(91)
MIT	19.4522	19.5754	19.7824	20.0018	20.1278	20.1681	20.1733	20.1749	20.1661	20.0455	19.7562	19.4439	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.3022	19.4254	19.6324	19.8518	19.9778	20.0181	20.0233	20.0249	20.0161	19.8955	19.6062	19.2939	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9755	0.9616	0.9225	0.8317	0.6697	0.4374	0.2835	0.2899	0.5346	0.8165	0.9452	0.9796	(94)
Useful gains	850.4030	914.1494	947.5539	899.1221	719.5575	472.7870	293.8798	293.3695	523.9891	747.7642	811.9464	807.5840	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1469.9731	1430.9822	1282.8564	1046.1982	755.7390	475.7194	294.0836	293.5948	532.4787	856.5985	1175.0486	1441.2441	(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													
	460.9602	347.3116	249.4651	105.8948	26.9190	0.0000	0.0000	0.0000	0.0000	80.9728	261.4336	471.4431	(98)
Space heating												2004.4001	(98)
RHI space heating demand												2004	(98)

CALCULATION OF HEAT DEMAND 09 Jan 2014

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.0000 (1b)	x	2.3900 (2b)	=	117.1100	(1b) - (3b)
First floor	49.0000 (1c)	x	2.7500 (2c)	=	134.7500	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	98.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	251.8600	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1588	(8)
Pressure test		Yes	
Measured/design AP50		4.3300	
Infiltration rate		0.3753	(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) =	0.3472	(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	0.4426	0.4340	0.4253	0.3819	0.3732	0.3298	0.3298	0.3211	0.3472	0.3732	0.3906	0.4079	(22b)
Effective ac	0.5980	0.5942	0.5904	0.5729	0.5696	0.5544	0.5544	0.5516	0.5603	0.5696	0.5763	0.5832	(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	
New Dwelling DG Door			2.1000	1.4000	2.9400			(26a)
New Dwelling DG Window (Uw = 1.40)			13.7200	1.3258	18.1894			(27)
Ground Floor			49.0000	0.1100	5.3900			(28a)
External Wall	102.5400	15.8200	86.7200	0.2000	17.3440			(29a)
External Roof	49.0000		49.0000	0.1100	5.3900			(30)
Total net area of external elements Aum(A, m2)			200.5400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		49.2534			(33)
Party Wall			49.3400	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	5.7336	(36)
Total fabric heat loss (33) + (36) =	54.9869	(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	49.6992	49.3830	49.0731	47.6174	47.3451	46.0773	46.0773	45.8425	46.5656	47.3451	47.8961	48.4721	(38)
Heat transfer coeff	104.6861	104.3700	104.0600	102.6044	102.3320	101.0642	101.0642	100.8294	101.5526	102.3320	102.8830	103.4590	(39)
Average = Sum(39)m / 12 =												102.6031	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0682	1.0650	1.0618	1.0470	1.0442	1.0313	1.0313	1.0289	1.0363	1.0442	1.0498	1.0557	(40)
HLP (average)												1.0470	(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	2.7202 (42)
Average daily hot water use (litres/day)	98.8053 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.6858	104.7336	100.7814	96.8292	92.8770	88.9248	88.9248	92.8770	96.8292	100.7814	104.7336	108.6858	(44)
Energy conte	161.1780	140.9673	145.4656	126.8204	121.6872	105.0068	97.3043	111.6581	112.9916	131.6808	143.7399	156.0923	(45)
Energy content (annual)										Total = Sum(45)m =		1554.5924	(45)
Distribution loss (46)m = 0.15 x (45)m	24.1767	21.1451	21.8198	19.0231	18.2531	15.7510	14.5956	16.7487	16.9487	19.7521	21.5610	23.4138	(46)
Water storage loss:													
Store volume												210.0000	(47)

b) If manufacturer declared loss factor is not known :

Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0103	(51)
Volume factor from Table 2a												0.8298	(52)
Temperature factor from Table 2b												0.5400	(53)
Enter (49) or (54) in (55)												0.9682	(55)
Total storage loss													
	30.0132	27.1087	30.0132	29.0450	30.0132	29.0450	30.0132	30.0132	29.0450	30.0132	29.0450	30.0132	(56)
If cylinder contains dedicated solar storage													
	30.0132	27.1087	30.0132	29.0450	30.0132	29.0450	30.0132	30.0132	29.0450	30.0132	29.0450	30.0132	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	214.4536	189.0872	198.7412	178.3775	174.9628	156.5639	150.5799	164.9337	164.5487	184.9565	195.2970	209.3679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
Output from w/h													
	214.4536	189.0872	198.7412	178.3775	174.9628	156.5639	150.5799	164.9337	164.5487	184.9565	195.2970	209.3679	(64)
Total per year (kWh/year) = Sum(64)m =												2181.8698	(64)
Heat gains from water heating, kWh/month													
	96.2122	85.3675	90.9878	83.4134	83.0815	76.1604	74.9742	79.7468	78.8154	86.4044	89.0392	94.5212	(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	163.2134	163.2134	163.2134	163.2134	163.2134	163.2134	163.2134	163.2134	163.2134	163.2134	163.2134	163.2134	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	60.5065	53.7414	43.7054	33.0878	24.7335	20.8811	22.5627	29.3279	39.3639	49.9815	58.3357	62.1882	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	377.6916	381.6108	371.7344	350.7087	324.1676	299.2226	282.5579	278.6386	288.5150	309.5407	336.0819	361.0268	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.0416	54.0416	54.0416	54.0416	54.0416	54.0416	54.0416	54.0416	54.0416	54.0416	54.0416	54.0416	(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)													
	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	(71)
Water heating gains (Table 5)													
	129.3174	127.0350	122.2954	115.8520	111.6687	105.7783	100.7717	107.1866	109.4658	116.1349	123.6655	127.0446	(72)
Total internal gains													
	678.9615	673.8333	649.1813	611.0946	572.0158	537.3281	517.3384	526.5991	548.7907	587.1031	629.5292	661.7056	(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	3.6000	10.6334	0.7100	0.7000	0.7700	13.1845	(74)
East	2.0000	19.6403	0.7100	0.7000	0.7700	13.5290	(76)
South	8.1200	46.7521	0.7100	0.7000	0.7700	130.7514	(78)

Solar gains	157.4650	265.7991	359.1726	440.6301	491.8040	488.0915	470.5924	432.0355	387.1118	292.3636	188.1189	135.0982	(83)
Total gains	836.4265	939.6323	1008.3539	1051.7246	1063.8198	1025.4196	987.9308	958.6347	935.9025	879.4667	817.6481	796.8038	(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	65.0091	65.2061	65.4003	66.3281	66.5046	67.3389	67.3389	67.4957	67.0151	66.5046	66.1485	65.7802	
alpha	5.3339	5.3471	5.3600	5.4219	5.4336	5.4893	5.4893	5.4997	5.4677	5.4336	5.4099	5.3853	
util living area													
	0.9897	0.9798	0.9586	0.9051	0.7940	0.6112	0.4470	0.4792	0.7030	0.9128	0.9786	0.9918	(86)
MIT	20.2775	20.3946	20.5532	20.7378	20.8715	20.9358	20.9482	20.9473	20.9189	20.7584	20.4886	20.2564	(87)
Th 2	20.0269	20.0295	20.0321	20.0444	20.0467	20.0574	20.0574	20.0593	20.0532	20.0467	20.0420	20.0372	(88)
util rest of house													
	0.9865	0.9738	0.9462	0.8773	0.7394	0.5295	0.3529	0.3836	0.6237	0.8816	0.9711	0.9893	(89)
MIT 2	19.0747	19.2451	19.4721	19.7341	19.9010	19.9756	19.9841	19.9857	19.9580	19.7680	19.3922	19.0526	(90)
Living area fraction										fLA = Living area / (4) =		0.1919	(91)
MIT	19.3056	19.4657	19.6796	19.9268	20.0873	20.1599	20.1691	20.1703	20.1425	19.9581	19.6026	19.2837	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.1556	19.3157	19.5296	19.7768	19.9373	20.0099	20.0191	20.0203	19.9925	19.8081	19.4526	19.1337	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9828	0.9681	0.9382	0.8682	0.7325	0.5252	0.3491	0.3796	0.6182	0.8722	0.9651	0.9861	(94)
Useful gains	822.0003	909.6566	946.0232	913.1012	779.2732	538.5208	344.8463	363.9111	578.5911	767.0355	789.1322	785.7354	(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													
	1555.1725	1504.5667	1355.8592	1116.0044	842.9352	546.7454	345.5506	365.0301	598.3949	942.2838	1270.8743	1545.0239	(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													
	545.4801	399.7796	304.9179	146.0903	47.3645	0.0000	0.0000	0.0000	0.0000	130.3848	346.8543	564.9107	(98)
Space heating												2485.7822	(98)
Space heating per m2											(98) / (4) =	25.3651	(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 %)												90.3000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2752.8042	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	545.4801	399.7796	304.9179	146.0903	47.3645	0.0000	0.0000	0.0000	0.0000	130.3848	346.8543	564.9107	(98)
Space heating efficiency (main heating system 1)													
	90.3000	90.3000	90.3000	90.3000	90.3000	0.0000	0.0000	0.0000	0.0000	90.3000	90.3000	90.3000	(210)
Space heating fuel (main heating system)													
	604.0754	442.7238	337.6721	161.7832	52.4524	0.0000	0.0000	0.0000	0.0000	144.3907	384.1133	625.5932	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	214.4536	189.0872	198.7412	178.3775	174.9628	156.5639	150.5799	164.9337	164.5487	184.9565	195.2970	209.3679	(64)
Efficiency of water heater												79.6000	(216)
(217)m	86.9998	86.5636	85.7515	84.0861	81.6615	79.6000	79.6000	79.6000	79.6000	83.7008	86.1294	87.1329	(217)
Fuel for water heating, kWh/month													
	246.4991	218.4373	231.7640	212.1367	214.2539	196.6883	189.1707	207.2031	206.7194	220.9733	226.7483	240.2857	(219)
Water heating fuel used												2610.8798	(219)
Annual totals kWh/year													
Space heating fuel - main system												2752.8042	(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)												427.4256	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.20 * 597 * 1.00) =										-573.4671		-573.4671	(233)
Total delivered energy for all uses												5292.6425	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2752.8042	3.4800	95.7976	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2610.8798	3.4800	90.8586	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	427.4256	13.1900	56.3774	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-573.4671	13.1900	-75.6403	(252)
Total energy cost			297.2858	(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] =	0.8731	(257)
SAP value		87.8196	
SAP rating (Section 12)		88	(258)
SAP band		B	

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2752.8042	0.2160	594.6057	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2610.8798	0.2160	563.9500	(264)
Space and water heating			1158.5557	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	427.4256	0.5190	221.8339	(268)
Energy saving/generation technologies				
PV Unit	-573.4671	0.5190	-297.6294	(269)
Total kg/year			1121.6852	(272)
CO2 emissions per m2			11.4500	(273)
EI value			89.4891	
EI rating			89	(274)
EI band			B	

Calculation of stars for heating and DHW

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.25) / 0.9030 = 4.133, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.25) / 0.9030 = 0.2565, stars = 4
Water heating energy efficiency	3.48 / 0.8337 = 4.174, stars = 4
Water heating environmental impact	0.216 / 0.8337 = 0.2591, stars = 4

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.0000	(1b)	x 2.3900	(2b) =	117.1100	(1b) - (3b)
First floor	49.0000	(1c)	x 2.7500	(2c) =	134.7500	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	98.0000					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	251.8600	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							4 * 10	=	40.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1588	(8)
Pressure test			Yes	
Measured/design AP50			4.3300	
Infiltration rate			0.3753	(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) =		0.3472	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3645	0.3385	0.3472	0.3298	0.3298	0.3211	0.3125	0.3038	0.2951	0.3211	0.3038	0.3211	(22b)
Effective ac	0.5664	0.5573	0.5603	0.5544	0.5544	0.5516	0.5488	0.5461	0.5435	0.5516	0.5461	0.5516	(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	
New Dwelling DG Door			2.1000	1.4000	2.9400			(26a)
New Dwelling DG Window (Uw = 1.40)			13.7200	1.3258	18.1894			(27)
Ground Floor			49.0000	0.1100	5.3900			(28a)
External Wall	102.5400	15.8200	86.7200	0.2000	17.3440			(29a)
External Roof	49.0000		49.0000	0.1100	5.3900			(30)
Total net area of external elements Aum(A, m2)			200.5400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		49.2534			(33)
Party Wall			49.3400	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	5.7336	(36)
Total fabric heat loss (33) + (36) =	54.9869	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	47.0790	46.3183	46.5656	46.0773	46.0773	45.8425	45.6140	45.3917	45.1757	45.8425	45.3917	45.8425	(38)
Heat transfer coeff	102.0660	101.3053	101.5526	101.0642	101.0642	100.8294	100.6009	100.3786	100.1626	100.8294	100.3786	100.8294	(39)
Average = Sum(39)m / 12 =												100.9218	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0415	1.0337	1.0363	1.0313	1.0313	1.0289	1.0265	1.0243	1.0221	1.0289	1.0243	1.0289	(40)
HLP (average)												1.0298	(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	2.7202 (42)
Average daily hot water use (litres/day)	98.8053 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.6858	104.7336	100.7814	96.8292	92.8770	88.9248	88.9248	92.8770	96.8292	100.7814	104.7336	108.6858	(44)
Energy conte	161.1780	140.9673	145.4656	126.8204	121.6872	105.0068	97.3043	111.6581	112.9916	131.6808	143.7399	156.0923	(45)
Energy content (annual)										Total = Sum(45)m =		1554.5924	(45)
Distribution loss (46)m = 0.15 x (45)m	24.1767	21.1451	21.8198	19.0231	18.2531	15.7510	14.5956	16.7487	16.9487	19.7521	21.5610	23.4138	(46)
Water storage loss:													
Store volume												210.0000	(47)

b) If manufacturer declared loss factor is not known :

Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0103	(51)
Volume factor from Table 2a												0.8298	(52)
Temperature factor from Table 2b												0.5400	(53)
Enter (49) or (54) in (55)												0.9682	(55)
Total storage loss													
	30.0132	27.1087	30.0132	29.0450	30.0132	29.0450	30.0132	30.0132	29.0450	30.0132	29.0450	30.0132	(56)
If cylinder contains dedicated solar storage													
	30.0132	27.1087	30.0132	29.0450	30.0132	29.0450	30.0132	30.0132	29.0450	30.0132	29.0450	30.0132	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	214.4536	189.0872	198.7412	178.3775	174.9628	156.5639	150.5799	164.9337	164.5487	184.9565	195.2970	209.3679	(62)
Solar input	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(63)
Solar input (sum of months) = Sum(63)m =												0.0000	(63)
Output from w/h													
	214.4536	189.0872	198.7412	178.3775	174.9628	156.5639	150.5799	164.9337	164.5487	184.9565	195.2970	209.3679	(64)
Total per year (kWh/year) = Sum(64)m =												2181.8698	(64)
Heat gains from water heating, kWh/month													
	96.2122	85.3675	90.9878	83.4134	83.0815	76.1604	74.9742	79.7468	78.8154	86.4044	89.0392	94.5212	(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	163.2134	163.2134	163.2134	163.2134	163.2134	163.2134	163.2134	163.2134	163.2134	163.2134	163.2134	163.2134	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	60.5065	53.7414	43.7054	33.0878	24.7335	20.8811	22.5627	29.3279	39.3639	49.9815	58.3357	62.1882	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	377.6916	381.6108	371.7344	350.7087	324.1676	299.2226	282.5579	278.6386	288.5150	309.5407	336.0819	361.0268	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.0416	54.0416	54.0416	54.0416	54.0416	54.0416	54.0416	54.0416	54.0416	54.0416	54.0416	54.0416	(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)													
	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	(71)
Water heating gains (Table 5)													
	129.3174	127.0350	122.2954	115.8520	111.6687	105.7783	100.7717	107.1866	109.4658	116.1349	123.6655	127.0446	(72)
Total internal gains													
	678.9615	673.8333	649.1813	611.0946	572.0158	537.3281	517.3384	526.5991	548.7907	587.1031	629.5292	661.7056	(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	3.6000	13.4839	0.7100	0.7000	0.7700	16.7189	(74)
East	2.0000	25.1925	0.7100	0.7000	0.7700	17.3537	(76)
South	8.1200	56.7559	0.7100	0.7000	0.7700	158.7290	(78)

Solar gains	192.8016	276.8577	378.0160	469.9702	502.4045	543.5973	519.1805	485.2438	431.3244	328.6820	229.5245	162.6634	(83)
Total gains	871.7632	950.6910	1027.1973	1081.0647	1074.4203	1080.9254	1036.5188	1011.8429	980.1151	915.7851	859.0537	824.3690	(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	66.6780	67.1787	67.0151	67.3389	67.3389	67.4957	67.6491	67.7988	67.9450	67.4957	67.7988	67.4957	
alpha	5.4452	5.4786	5.4677	5.4893	5.4893	5.4997	5.5099	5.5199	5.5297	5.4997	5.5199	5.4997	
util living area													
	0.9849	0.9751	0.9465	0.8748	0.7383	0.5239	0.3774	0.3856	0.6225	0.8686	0.9647	0.9877	(86)
MIT	20.3747	20.4632	20.6204	20.7914	20.9021	20.9444	20.9498	20.9498	20.9355	20.8238	20.5931	20.3633	(87)
Th 2	20.0489	20.0553	20.0532	20.0574	20.0574	20.0593	20.0613	20.0632	20.0650	20.0593	20.0632	20.0593	(88)
util rest of house													
	0.9803	0.9678	0.9309	0.8403	0.6754	0.4411	0.2872	0.2937	0.5392	0.8253	0.9526	0.9838	(89)
MIT 2	19.2331	19.3646	19.5834	19.8143	19.9439	19.9837	19.9888	19.9908	19.9834	19.8607	19.5574	19.2255	(90)
Living area fraction										fLA = Living area / (4) =		0.1919	(91)
MIT	19.4522	19.5754	19.7824	20.0018	20.1278	20.1681	20.1733	20.1749	20.1661	20.0455	19.7562	19.4439	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.3022	19.4254	19.6324	19.8518	19.9778	20.0181	20.0233	20.0249	20.0161	19.8955	19.6062	19.2939	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9755	0.9616	0.9225	0.8317	0.6697	0.4374	0.2835	0.2899	0.5346	0.8165	0.9452	0.9796	(94)
Useful gains	850.4030	914.1494	947.5539	899.1221	719.5575	472.7870	293.8798	293.3695	523.9891	747.7642	811.9464	807.5840	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W													
	1469.9731	1430.9822	1282.8564	1046.1982	755.7390	475.7194	294.0836	293.5948	532.4787	856.5985	1175.0486	1441.2441	(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													
	460.9602	347.3116	249.4651	105.8948	26.9190	0.0000	0.0000	0.0000	0.0000	80.9728	261.4336	471.4431	(98)
Space heating												2004.4001	(98)
Space heating per m2											(98) / (4) =	20.4531	(99)

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

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 %)												90.3000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2219.7122	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	460.9602	347.3116	249.4651	105.8948	26.9190	0.0000	0.0000	0.0000	0.0000	80.9728	261.4336	471.4431	(98)
Space heating efficiency (main heating system 1)													
	90.3000	90.3000	90.3000	90.3000	90.3000	0.0000	0.0000	0.0000	0.0000	90.3000	90.3000	90.3000	(210)
Space heating fuel (main heating system)													
	510.4764	384.6198	276.2626	117.2700	29.8106	0.0000	0.0000	0.0000	0.0000	89.6708	289.5167	522.0854	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	214.4536	189.0872	198.7412	178.3775	174.9628	156.5639	150.5799	164.9337	164.5487	184.9565	195.2970	209.3679	(64)
Efficiency of water heater												79.6000	(216)
(217)m	86.6037	86.2147	85.2205	83.2758	80.8779	79.6000	79.6000	79.6000	79.6000	82.5795	85.3918	86.7153	(217)
Fuel for water heating, kWh/month													
	247.6264	219.3213	233.2084	214.2008	216.3297	196.6883	189.1707	207.2031	206.7194	223.9739	228.7069	241.4428	(219)
Water heating fuel used												2624.5917	(219)
Annual totals kWh/year													
Space heating fuel - main system												2219.7122	(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)												427.4256	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.20 * 696 * 1.00) =										-668.4126		-668.4126	(233)
Total delivered energy for all uses												4678.3171	(238)

10a. Fuel costs - using BEDF prices (446)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2219.7122	3.9300	87.2347	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2624.5917	3.9300	103.1465	(247)
Pumps and fans for heating	75.0000	17.5600	13.1700	(249)
Energy for lighting	427.4256	17.5600	75.0559	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-668.4126	17.5600	-117.3732	(252)
Total energy cost			249.2338	(255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2219.7122	0.2160	479.4578	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2624.5917	0.2160	566.9118	(264)
Space and water heating			1046.3697	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	427.4256	0.5190	221.8339	(268)
Energy saving/generation technologies				
PV Unit	-668.4126	0.5190	-346.9061	(269)
Total kg/year			960.2224	(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	2219.7122	1.2200	2708.0489	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2624.5917	1.2200	3202.0019	(264)
Space and water heating			5910.0508	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	427.4256	3.0700	1312.1967	(268)
Energy saving/generation technologies				
PV Unit	-668.4126	3.0700	-2052.0266	(269)
Primary energy kWh/year			5400.4710	(272)
Primary energy kWh/m2/year			55.1068	(273)

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

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 88
Current environmental impact rating: B 89

(For testing purposes):

A		Not considered
B		Not considered
C		Not considered
D		Not considered
E	Low energy lighting	Already installed
F		Not considered
G		Not considered
H		Not considered
I		Not considered
J		Not considered
K		Not considered
M		Not considered
N	Solar water heating	Recommended
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	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	+ 1.6	-£ 45	-270 kg (28.1%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£45	2.76 kg/m²	B 89	A 92
Total Savings	£45	2.76 kg/m²		

Potential energy efficiency rating: B 89
Potential environmental impact rating: A 92

Fuel prices for cost data on this page from database revision number 446 TEST (28 Aug 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Southern England):

	Current	Potential	Saving
Electricity	£88	£97	-£9
Mains gas	£278	£225	£54
Space heating	£188	£190	-£2
Water heating	£103	£56	£47
Lighting	£75	£75	£0
Generated (PV)	-£117	-£117	£0
Total cost of fuels	£249	£205	£45
Total cost of uses	£249	£204	£45
Delivered energy	48 kWh/m²	34 kWh/m²	13 kWh/m²
Carbon dioxide emissions	1.0 tonnes	0.7 tonnes	0.3 tonnes
CO2 emissions per m²	10 kg/m²	7 kg/m²	3 kg/m²
Primary energy	55 kWh/m²	40 kWh/m²	15 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.0000	(1b)	x 2.3900	(2b) =	117.1100	(1b) - (3b)
First floor	49.0000	(1c)	x 2.7500	(2c) =	134.7500	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	98.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		251.8600	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							4 * 10 =	40.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1588	(8)
Pressure test		Yes	
Measured/design AP50		4.3300	
Infiltration rate		0.3753	(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) =	0.3472	(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	0.4426	0.4340	0.4253	0.3819	0.3732	0.3298	0.3298	0.3211	0.3472	0.3732	0.3906	0.4079	(22b)
Effective ac	0.5980	0.5942	0.5904	0.5729	0.5696	0.5544	0.5544	0.5516	0.5603	0.5696	0.5763	0.5832	(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	
New Dwelling DG Door			2.1000	1.4000	2.9400			(26a)
New Dwelling DG Window (Uw = 1.40)			13.7200	1.3258	18.1894			(27)
Ground Floor			49.0000	0.1100	5.3900			(28a)
External Wall	102.5400	15.8200	86.7200	0.2000	17.3440			(29a)
External Roof	49.0000		49.0000	0.1100	5.3900			(30)
Total net area of external elements Aum(A, m2)			200.5400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		49.2534			(33)
Party Wall			49.3400	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	5.7336	(36)
Total fabric heat loss (33) + (36) =	54.9869	(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	49.6992	49.3830	49.0731	47.6174	47.3451	46.0773	46.0773	45.8425	46.5656	47.3451	47.8961	48.4721	(38)
Heat transfer coeff	104.6861	104.3700	104.0600	102.6044	102.3320	101.0642	101.0642	100.8294	101.5526	102.3320	102.8830	103.4590	(39)
Average = Sum(39)m / 12 =												102.6031	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0682	1.0650	1.0618	1.0470	1.0442	1.0313	1.0313	1.0289	1.0363	1.0442	1.0498	1.0557	(40)
HLP (average)												1.0470	(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	2.7202 (42)
Average daily hot water use (litres/day)	98.8053 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.6858	104.7336	100.7814	96.8292	92.8770	88.9248	88.9248	92.8770	96.8292	100.7814	104.7336	108.6858	(44)
Energy conte	161.1780	140.9673	145.4656	126.8204	121.6872	105.0068	97.3043	111.6581	112.9916	131.6808	143.7399	156.0923	(45)
Energy content (annual)										Total = Sum(45)m =		1554.5924	(45)
Distribution loss (46)m = 0.15 x (45)m	24.1767	21.1451	21.8198	19.0231	18.2531	15.7510	14.5956	16.7487	16.9487	19.7521	21.5610	23.4138	(46)
Water storage loss:													
Store volume												210.0000	(47)

b) If manufacturer declared loss factor is not known :

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Hot water storage loss factor from Table 2 (kWh/litre/day)												0.0103	(51)
Volume factor from Table 2a												0.8298	(52)
Temperature factor from Table 2b												0.5400	(53)
Enter (49) or (54) in (55)												0.9682	(55)
Total storage loss													
	30.0132	27.1087	30.0132	29.0450	30.0132	29.0450	30.0132	30.0132	29.0450	30.0132	29.0450	30.0132	(56)
If cylinder contains dedicated solar storage													
	19.2942	17.4270	19.2942	18.6718	19.2942	18.6718	19.2942	19.2942	18.6718	19.2942	18.6718	19.2942	(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													
	203.7346	179.4055	186.6265	161.2507	151.4495	133.5839	126.8339	142.1182	148.7726	172.8417	184.9237	198.6489	(62)
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												1.1666	(H8)
Utilisation factor												0.5756	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												115.5000	(H13)
Daily hot water demand												98.8053	(H14)
Volume ratio Veff/V												1.1690	(H15)
Solar storage volume factor												1.0000	(H16)
Solar input												-917.9743	(H17)
Solar input	-26.6194	-44.4202	-75.6526	-101.3894	-125.2581	-123.1487	-121.5212	-106.1737	-83.1553	-56.7853	-31.5745	-22.2759	(63)
										Solar input (sum of months) = Sum(63)m =		-917.9743	(63)
Output from w/h													
	177.1152	134.9853	110.9738	59.8612	26.1914	10.4353	5.3127	35.9445	65.6173	116.0564	153.3493	176.3730	(64)
										Total per year (kWh/year) = Sum(64)m =		1072.2154	(64)
Heat gains from water heating, kWh/month													
	87.6370	77.6222	81.2960	69.7120	64.2708	57.7764	55.9774	61.4944	66.1945	76.7126	80.7406	85.9460	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	163.2134	163.2134	163.2134	163.2134	163.2134	163.2134	163.2134	163.2134	163.2134	163.2134	163.2134	163.2134	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	60.5065	53.7414	43.7054	33.0878	24.7335	20.8811	22.5627	29.3279	39.3639	49.9815	58.3357	62.1882	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	377.6916	381.6108	371.7344	350.7087	324.1676	299.2226	282.5579	278.6386	288.5150	309.5407	336.0819	361.0268	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	54.0416	54.0416	54.0416	54.0416	54.0416	54.0416	54.0416	54.0416	54.0416	54.0416	54.0416	54.0416	(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)													
	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	-108.8090	(71)
Water heating gains (Table 5)													
	117.7916	115.5092	109.2688	96.8222	86.3855	80.2451	75.2384	82.6538	91.9368	103.1083	112.1397	115.5188	(72)
Total internal gains													
	667.4357	662.3074	636.1547	592.0648	546.7327	511.7948	491.8051	502.0664	531.2617	574.0765	618.0033	650.1798	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	3.6000	10.6334	0.7100	0.7000	0.7700	13.1845	(74)
East	2.0000	19.6403	0.7100	0.7000	0.7700	13.5290	(76)
South	8.1200	46.7521	0.7100	0.7000	0.7700	130.7514	(78)

Solar gains	157.4650	265.7991	359.1726	440.6301	491.8040	488.0915	470.5924	432.0355	387.1118	292.3636	188.1189	135.0982	(83)
Total gains	824.9007	928.1065	995.3272	1032.6948	1038.5366	999.8864	962.3975	934.1019	918.3734	866.4401	806.1223	785.2780	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	65.0091	65.2061	65.4003	66.3281	66.5046	67.3389	67.3389	67.4957	67.0151	66.5046	66.1485	65.7802	
alpha	5.3339	5.3471	5.3600	5.4219	5.4336	5.4893	5.4893	5.4997	5.4677	5.4336	5.4099	5.3853	
util living area													
	0.9903	0.9808	0.9606	0.9106	0.8055	0.6247	0.4584	0.4912	0.7131	0.9171	0.9799	0.9924	(86)
MIT	20.2696	20.3870	20.5456	20.7293	20.8656	20.9342	20.9479	20.9469	20.9167	20.7524	20.4811	20.2484	(87)
Th 2	20.0269	20.0295	20.0321	20.0444	20.0467	20.0574	20.0574	20.0593	20.0532	20.0467	20.0420	20.0372	(88)
util rest of house													
	0.9873	0.9751	0.9487	0.8839	0.7519	0.5420	0.3622	0.3936	0.6338	0.8869	0.9728	0.9900	(89)
MIT 2	19.0633	19.2344	19.4616	19.7235	19.8948	19.9745	19.9839	19.9855	19.9563	19.7606	19.3816	19.0410	(90)
Living area fraction										fLA = Living area / (4) =		0.1919	(91)
MIT	19.2948	19.4556	19.6697	19.9166	20.0811	20.1587	20.1690	20.1701	20.1406	19.9510	19.5926	19.2727	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.1448	19.3056	19.5197	19.7666	19.9311	20.0087	20.0190	20.0201	19.9906	19.8010	19.4426	19.1227	(93)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9837	0.9696	0.9409	0.8747	0.7447	0.5375	0.3582	0.3894	0.6281	0.8774	0.9670	0.9869	(94)
Useful gains	811.4569	899.8565	936.4656	903.3337	773.3884	537.4378	344.7342	363.7383	576.8591	760.2344	779.4830	775.0176	(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	1554.0443	1503.5125	1354.8254	1114.9578	842.3081	546.6249	345.5357	365.0079	598.2058	941.5528	1269.8462	1543.8907	(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	552.4851	405.6569	311.2597	152.3694	51.2763	0.0000	0.0000	0.0000	0.0000	134.9009	353.0615	572.0416	(98)

Space heating 2533.0513 (98)
Space heating per m2 (98) / (4) = 25.8475 (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 %) 90.3000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 2805.1509 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	552.4851	405.6569	311.2597	152.3694	51.2763	0.0000	0.0000	0.0000	0.0000	134.9009	353.0615	572.0416	(98)
Space heating efficiency (main heating system 1)	90.3000	90.3000	90.3000	90.3000	90.3000	0.0000	0.0000	0.0000	0.0000	90.3000	90.3000	90.3000	(210)
Space heating fuel (main heating system)	611.8328	449.2324	344.6951	168.7369	56.7844	0.0000	0.0000	0.0000	0.0000	149.3919	390.9873	633.4901	(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	177.1152	134.9853	110.9738	59.8612	26.1914	10.4353	5.3127	35.9445	65.6173	116.0564	153.3493	176.3730	(64)
Efficiency of water heater												79.6000	(216)
(217)m	87.4465	87.3678	87.2186	87.0014	86.3745	79.6000	79.6000	79.6000	79.6000	85.0151	86.7681	87.5273	(217)
Fuel for water heating, kWh/month	202.5412	154.5025	127.2364	68.8049	30.3231	13.1096	6.6743	45.1565	82.4337	136.5127	176.7346	201.5062	(219)

Water heating fuel used 1245.5359 (219)
Annual totals kWh/year
Space heating fuel - main system 2805.1509 (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)
pump for solar water heating 50.0000 (230g)
Total electricity for the above, kWh/year 125.0000 (231)
Electricity for lighting (calculated in Appendix L) 427.4256 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV Unit 0 (0.80 * 1.20 * 597 * 1.00) = -573.4671 -573.4671 (233)
Total delivered energy for all uses 4029.6453 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2805.1509	3.4800	97.6193	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1245.5359	3.4800	43.3446	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	427.4256	13.1900	56.3774	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-573.4671	13.1900	-75.6403	(252)
Total energy cost			258.1885	(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] = 0.7583 (257)
SAP value 89.4215
SAP rating (Section 12) 89 (258)
SAP band B

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

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2805.1509	0.2160	605.9126	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1245.5359	0.2160	269.0357	(264)
Space and water heating			874.9483	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	427.4256	0.5190	221.8339	(268)
Energy saving/generation technologies				
PV Unit	-573.4671	0.5190	-297.6294	(269)
Total kg/year			864.0278	(272)
CO2 emissions per m2			8.8200	(273)
EI value			91.9035	
EI rating			92	(274)
EI band			A	

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	49.0000	(1b)	x 2.3900	(2b) =	117.1100	(1b) - (3b)
First floor	49.0000	(1c)	x 2.7500	(2c) =	134.7500	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	98.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		251.8600	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							4 * 10 =		40.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =		0.1588	(8)
Pressure test			Yes	
Measured/design AP50			4.3300	
Infiltration rate			0.3753	(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) =		0.3472	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	3.9000	4.0000	3.8000	3.8000	3.7000	3.6000	3.5000	3.4000	3.7000	3.5000	3.7000	(22)
Wind factor	1.0500	0.9750	1.0000	0.9500	0.9500	0.9250	0.9000	0.8750	0.8500	0.9250	0.8750	0.9250	(22a)
Adj infilt rate	0.3645	0.3385	0.3472	0.3298	0.3298	0.3211	0.3125	0.3038	0.2951	0.3211	0.3038	0.3211	(22b)
Effective ac	0.5664	0.5573	0.5603	0.5544	0.5544	0.5516	0.5488	0.5461	0.5435	0.5516	0.5461	0.5516	(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	
New Dwelling DG Door			2.1000	1.4000	2.9400			(26a)
New Dwelling DG Window (Uw = 1.40)			13.7200	1.3258	18.1894			(27)
Ground Floor			49.0000	0.1100	5.3900			(28a)
External Wall	102.5400	15.8200	86.7200	0.2000	17.3440			(29a)
External Roof	49.0000		49.0000	0.1100	5.3900			(30)
Total net area of external elements Aum(A, m2)			200.5400					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		49.2534			(33)
Party Wall			49.3400	0.0000	0.0000			(32)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	5.7336	(36)
Total fabric heat loss (33) + (36) =	54.9869	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	47.0790	46.3183	46.5656	46.0773	46.0773	45.8425	45.6140	45.3917	45.1757	45.8425	45.3917	45.8425	(38)
Heat transfer coeff	102.0660	101.3053	101.5526	101.0642	101.0642	100.8294	100.6009	100.3786	100.1626	100.8294	100.3786	100.8294	(39)
Average = Sum(39)m / 12 =												100.9218	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0415	1.0337	1.0363	1.0313	1.0313	1.0289	1.0265	1.0243	1.0221	1.0289	1.0243	1.0289	(40)
HLP (average)												1.0298	(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	2.7202 (42)
Average daily hot water use (litres/day)	98.8053 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.6858	104.7336	100.7814	96.8292	92.8770	88.9248	88.9248	92.8770	96.8292	100.7814	104.7336	108.6858	(44)
Energy conte	161.1780	140.9673	145.4656	126.8204	121.6872	105.0068	97.3043	111.6581	112.9916	131.6808	143.7399	156.0923	(45)
Energy content (annual)										Total = Sum(45)m =		1554.5924	(45)
Distribution loss (46)m = 0.15 x (45)m	24.1767	21.1451	21.8198	19.0231	18.2531	15.7510	14.5956	16.7487	16.9487	19.7521	21.5610	23.4138	(46)
Water storage loss:													
Store volume												210.0000	(47)

b) If manufacturer declared loss factor is not known :

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

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  Hot water storage loss factor from Table 2 (kWh/litre/day)                                                  0.0103 (51)
  Volume factor from Table 2a                                                                                 0.8298 (52)
  Temperature factor from Table 2b                                                                            0.5400 (53)
Enter (49) or (54) in (55)                                                                                    0.9682 (55)
Total storage loss
               30.0132    27.1087    30.0132    29.0450    30.0132    29.0450    30.0132    30.0132    29.0450    30.0132    29.0450    30.0132 (56)
If cylinder contains dedicated solar storage
               19.2942    17.4270    19.2942    18.6718    19.2942    18.6718    19.2942    19.2942    18.6718    19.2942    18.6718    19.2942 (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
              203.7346   179.4055   186.6265   161.2507   151.4495   133.5839   126.8339   142.1182   148.7726   172.8417   184.9237   198.6489 (62)
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                                                                              1208.1510 (H5)
Overshading factor                                                                                            0.8000 (H6)
Solar energy available                                                                                     2029.6937 (H7)
Adjustment factor for showers                                                                                 1.0000 (H7a)
Solar-to-load ratio                                                                                           1.3056 (H8)
Utilisation factor                                                                                            0.5351 (H9)
Collector performance factor                                                                                  0.8793 (H10)
Dedicated solar storage volume                                                                               75.0000 (H11)
Effective solar volume                                                                                      115.5000 (H13)
Daily hot water demand                                                                                       98.8053 (H14)
Volume ratio Veff/V                                                                                           1.1690 (H15)
Solar storage volume factor                                                                                   1.0000 (H16)
Solar input                                                                                                -954.9841 (H17)
Solar input    -31.1539   -44.2988   -76.1391  -102.7292  -120.6617  -128.8857  -126.1752  -112.9307   -88.4169   -61.1284   -36.8468   -25.6176 (63)
                                                                  Solar input (sum of months) = Sum(63)m =   -954.9841 (63)
Output from w/h
              172.5807   135.1067   110.4874    58.5214    30.7878     4.6982     0.6587    29.1876    60.3556   111.7133   148.0769   173.0313 (64)
                                                                   Total per year (kWh/year) = Sum(64)m =   1035.2056 (64)
Heat gains from water heating, kWh/month
               87.6370    77.6222    81.2960    69.7120    64.2708    57.7764    55.9774    61.4944    66.1945    76.7126    80.7406    85.9460 (65)


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5. Internal gains (see Table 5 and 5a)
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Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m         163.2134   163.2134   163.2134   163.2134   163.2134   163.2134   163.2134   163.2134   163.2134   163.2134   163.2134   163.2134 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               60.5065    53.7414    43.7054    33.0878    24.7335    20.8811    22.5627    29.3279    39.3639    49.9815    58.3357    62.1882 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              377.6916   381.6108   371.7344   350.7087   324.1676   299.2226   282.5579   278.6386   288.5150   309.5407   336.0819   361.0268 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               54.0416    54.0416    54.0416    54.0416    54.0416    54.0416    54.0416    54.0416    54.0416    54.0416    54.0416    54.0416 (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)
             -108.8090  -108.8090  -108.8090  -108.8090  -108.8090  -108.8090  -108.8090  -108.8090  -108.8090  -108.8090  -108.8090  -108.8090 (71)
Water heating gains (Table 5)
              117.7916   115.5092   109.2688    96.8222    86.3855    80.2451    75.2384    82.6538    91.9368   103.1083   112.1397   115.5188 (72)
Total internal gains
              667.4357   662.3074   636.1547   592.0648   546.7327   511.7948   491.8051   502.0664   531.2617   574.0765   618.0033   650.1798 (73)


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6. Solar gains
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[Jan]                                    Area          Solar flux              g                FF           Access            Gains
                                         m2            Table 6a       Specific data    Specific data       factor                W
                                                          W/m2       or Table 6b      or Table 6c      Table 6d
-------------------------------------------------------------------------------------------------------------
North                                  3.6000           13.4839           0.7100           0.7000           0.7700           16.7189 (74)
East                                   2.0000           25.1925           0.7100           0.7000           0.7700           17.3537 (76)
South                                  8.1200           56.7559           0.7100           0.7000           0.7700          158.7290 (78)
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Solar gains    192.8016   276.8577   378.0160   469.9702   502.4045   543.5973   519.1805   485.2438   431.3244   328.6820   229.5245   162.6634 (83)
Total gains    860.2373   939.1652  1014.1707  1062.0349  1049.1371  1055.3921  1010.9856   987.3102   962.5861   902.7585   847.5278   812.8432 (84)


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7. Mean internal temperature (heating season)
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Temperature during heating periods in the living area from Table 9, Th1 (C)                                  21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau            66.6780    67.1787    67.0151    67.3389    67.3389    67.4957    67.6491    67.7988    67.9450    67.4957    67.7988    67.4957
alpha           5.4452     5.4786     5.4677     5.4893     5.4893     5.4997     5.5099     5.5199     5.5297     5.4997     5.5199     5.4997
util living area
                0.9857     0.9764     0.9491     0.8813     0.7507     0.5356     0.3868     0.3951     0.6322     0.8741     0.9666     0.9884 (86)

MIT            20.3670    20.4558    20.6133    20.7843    20.8980    20.9437    20.9497    20.9497    20.9343    20.8191    20.5861    20.3554 (87)
Th 2           20.0489    20.0553    20.0532    20.0574    20.0574    20.0593    20.0613    20.0632    20.0650    20.0593    20.0632    20.0593 (88)
util rest of house
                0.9814     0.9694     0.9340     0.8479     0.6883     0.4514     0.2944     0.3010     0.5482     0.8317     0.9551     0.9848 (89)
MIT 2          19.2219    19.3542    19.5737    19.8057    19.9400    19.9833    19.9888    19.9908    19.9826    19.8553    19.5477    19.2141 (90)
Living area fraction                                                                          fLA = Living area / (4) =     0.1919 (91)
MIT            19.4417    19.5656    19.7732    19.9935    20.1239    20.1676    20.1732    20.1748    20.1653    20.0403    19.7471    19.4332 (92)
Temperature adjustment                                                                                       -0.1500
adjusted MIT   19.2917    19.4156    19.6232    19.8435    19.9739    20.0176    20.0232    20.0248    20.0153    19.8903    19.5971    19.2832 (93)
```

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

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9768	0.9633	0.9256	0.8391	0.6823	0.4476	0.2907	0.2971	0.5435	0.8228	0.9477	0.9808	(94)
Useful gains	840.2523	904.6922	938.7654	891.1828	715.8125	472.3919	293.8474	293.3343	523.2004	742.8067	803.2422	797.2260	(95)
Ext temp.	4.9000	5.3000	7.0000	9.5000	12.5000	15.3000	17.1000	17.1000	14.7000	11.4000	7.9000	5.0000	(96)
Heat loss rate W	1468.9043	1429.9868	1281.9232	1045.3603	755.3423	475.6735	294.0788	293.5897	532.3913	856.0728	1174.1341	1440.1666	(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	467.7171	352.9980	255.3094	111.0078	29.4102	0.0000	0.0000	0.0000	0.0000	84.2700	267.0421	478.3478	(98)
Space heating												2046.1024	(98)
Space heating per m2											(98) / (4) =	20.8786	(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 %)	90.3000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2265.8941	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	467.7171	352.9980	255.3094	111.0078	29.4102	0.0000	0.0000	0.0000	0.0000	84.2700	267.0421	478.3478	(98)
Space heating efficiency (main heating system 1)	90.3000	90.3000	90.3000	90.3000	90.3000	0.0000	0.0000	0.0000	0.0000	90.3000	90.3000	90.3000	(210)
Space heating fuel (main heating system)	517.9591	390.9169	282.7347	122.9323	32.5694	0.0000	0.0000	0.0000	0.0000	93.3222	295.7277	529.7318	(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	172.5807	135.1067	110.4874	58.5214	30.7878	4.6982	0.6587	29.1876	60.3556	111.7133	148.0769	173.0313	(64)
Efficiency of water heater												79.6000	(216)
(217)m	87.1427	87.0607	86.7767	86.2957	84.4913	79.6000	79.6000	79.6000	79.6000	83.8734	86.1683	87.1868	(217)
Fuel for water heating, kWh/month	198.0437	155.1868	127.3238	67.8150	36.4391	5.9023	0.8275	36.6678	75.8237	133.1927	171.8462	198.4605	(219)
Water heating fuel used												1207.5291	(219)
Annual totals kWh/year													
Space heating fuel - main system												2265.8941	(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)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												427.4256	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.20 * 696 * 1.00) =											-668.4126	-668.4126	(233)
Total delivered energy for all uses												3357.4363	(238)

10a. Fuel costs - using BEDF prices (446)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2265.8941	3.9300	89.0496	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1207.5291	3.9300	47.4559	(247)
Pumps and fans for heating	75.0000	17.5600	13.1700	(249)
Pump for solar water heating	50.0000	17.5600	8.7800	(249)
Energy for lighting	427.4256	17.5600	75.0559	(250)
Additional standing charges			88.0000	(251)
Energy saving/generation technologies				
PV Unit	-668.4126	17.5600	-117.3732	(252)
Total energy cost			204.1382	(255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2265.8941	0.2160	489.4331	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1207.5291	0.2160	260.8263	(264)
Space and water heating			750.2594	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	427.4256	0.5190	221.8339	(268)
Energy saving/generation technologies				
PV Unit	-668.4126	0.5190	-346.9061	(269)

Total kg/year 690.0622 (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	2265.8941	1.2200	2764.3908	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1207.5291	1.2200	1473.1855	(264)
Space and water heating			4237.5763	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	427.4256	3.0700	1312.1967	(268)
Energy saving/generation technologies				
PV Unit	-668.4126	3.0700	-2052.0266	(269)
Primary energy kWh/year			3881.4965	(272)
Primary energy kWh/m2/year			39.6071	(273)

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

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Southern England
Front of dwelling faces	North
Overshading	Average or unknown
Thermal mass parameter	250.0
Night ventilation	Yes
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	332.46	(P1)
Transmission heat loss coefficient	54.99	(37)
Summer heat loss coefficient	387.44	(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	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	3.6000	87.1704	0.7100	0.7000	0.9000	126.3319
East	2.0000	125.2818	0.7100	0.7000	0.9000	100.8694
South	8.1200	118.5567	0.7100	0.7000	0.9000	387.5462
total:						614.7475

	Jun	Jul	Aug	
Solar gains	654	615	573	(P3)
Internal gains	534	514	524	
Total summer gains	1189	1129	1096	(P5)
Summer gain/loss ratio	3.07	2.91	2.83	(P6)
Summer external temperature	15.40	17.30	17.30	
Thermal mass temperature increment (TMP = 250.0)	0.25	0.25	0.25	
Threshold temperature	18.72	20.46	20.38	(P7)
Likelihood of high internal temperature	Not significant	Not significant	Not significant	

Assessment of likelihood of high internal temperature: Not significant

SUMMARY FOR INPUT DATA
Calculation Type: New Build (As Built)

Property Reference	sc120823	**Issued on Date**	05/09/2019
Assessment Reference	002 As Built	**Prop Type Ref**	New Dwelling
Property	Little Oaks, Winchester Road, Botley, SOUTHAMPTON, SO32 2SZ		

SAP Rating	88 B	**DER**	13.24	**TER**	16.76
Environmental	89 B	**% DER<TER**	21.02		
CO_2 Emissions (t/year)	0.96	**DFEE**	38.63	**TFEE**	49.48
General Requirements Compliance	Pass	**% DFEE<TFEE**	21.94		

Assessor Details	Mr. Mark Rogers, Surecalc Limited, Tel: 01243572695, mark@surecalc.co.uk	**Assessor ID**	A320-0001
Client	Imperial Homes Southern, Imperial Homes Southern		

SUMMARY FOR INPUT DATA FOR: New Build (As Built)

Orientation	North
Property Tenure	Unknown
Transaction Type	New dwelling
Terrain Type	Suburban
1.0 Property Type	House, Semi-Detached
2.0 Number of Storeys	2
3.0 Date Built	2019
4.0 Sheltered Sides	1
5.0 Sunlight/Shade	Average or unknown

6.0 Measurements

	Heat Loss Perimeter	Internal Floor Area	Average Storey Height
Ground Floor:	19.95 m	49.00 m²	2.39 m
1st Storey:	19.95 m	49.00 m²	2.75 m

7.0 Living Area	18.81	m²
8.0 Thermal Mass Parameter	Simple calculation - Medium	
Thermal Mass	250.00	kJ/m²K

9.0 External Walls

Description	Type	Construction	U-Value (W/m²K)	Gross Area (m²)	Nett Area (m²)
External Wall	Cavity Wall	Other	0.20	102.54	86.72

9.1 Party Walls

Description	Type	Construction	U-Value (W/m²K)	Area (m²)
Party Wall	Filled Cavity with Edge Sealing	Other	0.00	49.34

10.0 External Roofs

Description	Type	Construction	U-Value (W/m²K)	Gross Area (m²)	Nett Area (m²)
External Roof	External Plane Roof	Other	0.11	49.00	49.00

11.0 Heat Loss Floors

Description	Type	Construction	U-Value (W/m²K)	Area (m²)
Ground Floor	Ground Floor - Solid	Other	0.11	49.00

12.0 Opening Types

SUMMARY FOR INPUT DATA
Calculation Type: New Build (As Built)

Description	Data Source	Type	Glazing	Glazing Gap	Argon Filled	G-value	Frame Type	Frame Factor	U Value (W/m²K)
New Dwelling DG Door	Manufacturer	Half Glazed Door	Double Low-E Soft 0.05			0.71		0.70	1.40
New Dwelling DG Window	Manufacturer	Window	Double Low-E Soft 0.05			0.71		0.70	1.40

13.0 Openings

Name	Opening Type	Location	Orientation	Curtain Type	Overhang Ratio	Wide Overhang	Width (m)	Height (m)	Count	Area (m²)	Curtain Closed
Front North Door	Half Glazed Door	[1] External Wall	North							2.10	
Front North Windows	Window	[1] External Wall	North	None	0.00					3.60	
Side East Windows	Window	[1] External Wall	East	None	0.00					2.00	
Rear South Windows	Window	[1] External Wall	South	None	0.00					8.12	

14.0 Conservatory	None	
15.0 Draught Proofing	100	%
16.0 Draught Lobby	No	
17.0 Thermal Bridging	Calculate Bridges	

17.1 List of Bridges

Source Type	Bridge Type	Length	Psi	Imported	Reference:
Independently assessed	E2 Other lintels (including other steel lintels)	11.29	0.050	No	IG Hi Therm Lintels
Independently assessed	E3 Sill	10.29	0.027	No	LABC Construction Detail
Independently assessed	E4 Jamb	26.70	0.029	No	LABC Construction Detail
Independently assessed	E5 Ground floor (normal)	19.95	0.048	No	LABC Construction Detail
Independently assessed	E6 Intermediate floor within a dwelling	19.95	0.003	No	LABC Construction Detail
Independently assessed	E10 Eaves (insulation at ceiling level)	13.75	0.083	No	LABC Construction Detail
Independently assessed	E12 Gable (insulation at ceiling level)	5.98	0.054	No	
Independently assessed	E16 Corner (normal)	15.42	0.056	No	LABC Construction Detail
Independently assessed	E17 Corner (inverted – internal area greater than external area)	5.14	-0.091	No	LABC Construction Detail
Independently assessed	E18 Party wall between dwellings	10.28	0.044	No	
Independently assessed	P1 Party wall - Ground floor	9.60	0.046	No	
Table K1 - Default	P2 Party wall - Intermediate floor within a dwelling	9.60	0.000	No	
Independently assessed	P4 Party wall - Roof (insulation at ceiling level)	9.60	0.036	No	

Y-value	0.029	W/m²K
18.0 Pressure Testing	Yes	
Designed AP_{50}	5.00	m³/(h.m²) @ 50 Pa
Property Tested ?	Yes	
As Built AP_{50}	4.33	m³/(h.m²) @ 50 Pa

19.0 Mechanical Ventilation

Summer Overheating

Windows open in hot weather	Windows half open
Cross ventilation possible	Yes
Night Ventilation	Yes
Air change rate	4.00

Mechanical Ventilation

Mechanical Ventilation System Present	No

20.0 Fans, Open Fireplaces, Flues

	MHS	SHS	Other	Total
Number of Chimneys	0		0	0
Number of open flues	0		0	0
Number of intermittent fans				4
Number of passive vents				0
Number of flueless gas fires				0

21.0 Fixed Cooling System	No	
22.0 Lighting		
Internal		
Total number of light fittings	48	
Total number of L.E.L. fittings	48	
Percentage of L.E.L. fittings	100.00	%
External		
External lights fitted	Yes	
Light and motion sensor	Yes	
23.0 Electricity Tariff	Standard	
24.0 Main Heating 1	Database	
Description	Gas Boiler	
Percentage of Heat	100	%
Database Ref. No.	17784	
Fuel Type	Mains gas	
Main Heating	BGB	
SAP Code	102	
In Winter	90.3	
In Summer	79.6	
Controls	CBI Time and temperature zone control	
PCDF Controls	0	
Delayed Start Stat	Yes	
Sap Code	2110	
Flue Type	Balanced	
Fan Assisted Flue	Yes	
Is MHS Pumped	Pump in heated space	
Heat Emitter	Radiators and Underfloor	
Underfloor Heating	Yes - Pipes in thin screed	
Flow Temperature	Unknown	
25.0 Main Heating 2	None	
Community Heating	None	
28.0 Water Heating	HWP From main heating 1	
Water Heating	Main Heating 1	
Flue Gas Heat Recovery System	No	
Waste Water Heat Recovery Instantaneous System 1	No	
Waste Water Heat Recovery Instantaneous System 2	No	
Waste Water Heat Recovery	No	

Storage System		
Solar Panel	No	
Water use <= 125 litres/person/day	Yes	
SAP Code	901	
29.0 Hot Water Cylinder	Hot Water Cylinder	
Cylinder Stat	Yes	
Cylinder In Heated Space	Yes	
Independent Time Control	Yes	
Insulation Type	Foam	
Insulation Thickness	100 mm	
Cylinder Volume	210.00	L
Pipes insulation	Fully insulated primary pipework	
31.0 Thermal Store	None	
32.0 Photovoltaic Unit	One Dwelling	

PV Cells kWp	Orientation	Elevation	Overshading	Connected to Dwelling
1.20	North	45°	None Or Little	Yes

Recommendations

Lower cost measures

None

Further measures to achieve even higher standards

	Typical Cost	Typical savings per year	Ratings after improvement	
			SAP rating	Environmental Impact
Solar water heating	£4,000 - £6,000	£45	B 89	