elmhurst energy



SAP Report Submission for Building Regulations Compliance

Client: Imperial Homes Southern

Project: Chestnut Lodge, Winchester Road
Botley, SOUTHAMPTON, SO32 2SZ

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

Report Issue Date: 01/09/2019

EXCELLENCE IN ENERGY ASSESSMENT

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

Property Reference	sc120824	**Issued on Date**	01/09/2019
Assessment Reference	002 As Built	**Prop Type Ref**	New Dwelling
Property	Chestnut Lodge, Winchester Road, Botley, SOUTHAMPTON, SO32 2SZ		

SAP Rating	88 B	**DER**	13.17	**TER**	16.76
Environmental	90 B	**% DER<TER**	21.43		
CO_2 Emissions (t/year)	0.96	**DFEE**	38.35	**TFEE**	49.48
General Requirements Compliance	Pass	**% DFEE<TFEE**	22.50		

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	13.17	$kgCO_2/yr/m^2$	
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	13.17	$kgCO_2/yr/m^2$	
Reduction DER/TER	21.43	%	
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.)	38.35	$kWh/m^2/yr$	
CfSH ENE2 credits achieved	8.9		
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	17.01	$kgCO_2/yr/m^2$	
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	34.19	$kgCO_2/yr/m^2$	(ZC4)
Net Standard case CO_2 emissions	34.19	$kgCO_2/yr/m^2$	(ZC8)

Actual case CO_2 emissions

DER	13.97	$kgCO_2/yr/m^2$	
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	31.15	$kgCO_2/yr/m^2$	(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	31.15	$kgCO_2/yr/m^2$	(ZC8)
Improvement in net actual/net standard case CO_2 emissions	9	%	

ENE7 credits achieved	0

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

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CO_2 Emissions (t/year)	0.96	**DFEE**	38.35	**TFEE**	49.48
General Requirements Compliance	Pass	**% DFEE<TFEE**	22.50		

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

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)	13.17	$kgCO_2/m^2$	Pass
	-3.59 (-21.4%)	$kgCO_2/m^2$	

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	49.48	$kWh/m^2/yr$	
Dwelling Fabric Energy Efficiency (DFEE)	38.35	$kWh/m^2/yr$	
	-11.2 (-22.6%)	$kWh/m^2/yr$	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	4.04 (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 South Windows facing West	3.60 m², No overhang 8.12 m², No overhang 2.00 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	4.04 (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
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General Requirements Compliance	Pass	**% DFEE<TFEE**	22.50		

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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) 13.17 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)49.5 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)38.3 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: 4.04 (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 South: 8.12 m², No overhang
Windows facing West: 2.00 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		4.0400	
Infiltration rate		0.3608	(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) =	0.3338	(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	0.4255	0.4172	0.4089	0.3671	0.3588	0.3171	0.3171	0.3087	0.3338	0.3588	0.3755	0.3922	(22b)
Effective ac	0.5905	0.5870	0.5836	0.5674	0.5644	0.5503	0.5503	0.5477	0.5557	0.5644	0.5705	0.5769	(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	49.0822	48.7900	48.5036	47.1582	46.9065	45.7347	45.7347	45.5177	46.1861	46.9065	47.4157	47.9481	(38)
Heat transfer coeff	104.0692	103.7769	103.4905	102.1452	101.8934	100.7217	100.7217	100.5047	101.1730	101.8934	102.4026	102.9350	(39)
Average = Sum(39)m / 12 =												102.1439	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0619	1.0589	1.0560	1.0423	1.0397	1.0278	1.0278	1.0256	1.0324	1.0397	1.0449	1.0504	(40)
HLP (average)												1.0423	(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)
South	8.1200	46.7521	0.7100	0.7000	0.7700	130.7514	(78)
West	2.0000	19.6403	0.7100	0.7000	0.7700	13.5290	(80)

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	65.3946	65.5787	65.7602	66.6263	66.7909	67.5679	67.5679	67.7138	67.2665	66.7909	66.4588	66.1151	
alpha	5.3596	5.3719	5.3840	5.4418	5.4527	5.5045	5.5045	5.5143	5.4844	5.4527	5.4306	5.4077	
util living area													
	0.9972	0.9931	0.9826	0.9508	0.8671	0.6983	0.5221	0.5629	0.8000	0.9614	0.9934	0.9979	(86)
MIT	20.1393	20.2631	20.4377	20.6514	20.8258	20.9231	20.9459	20.9437	20.8916	20.6684	20.3635	20.1190	(87)
Th 2	20.0320	20.0345	20.0369	20.0482	20.0504	20.0603	20.0603	20.0621	20.0564	20.0504	20.0461	20.0416	(88)
util rest of house													
	0.9963	0.9908	0.9767	0.9334	0.8217	0.6128	0.4147	0.4542	0.7252	0.9442	0.9909	0.9973	(89)
MIT 2	18.8786	19.0607	19.3149	19.6258	19.8554	19.9695	19.9862	19.9870	19.9382	19.6557	19.2169	18.8566	(90)
Living area fraction									fLA = Living area / (4) =			0.1919	(91)
MIT	19.1206	19.2914	19.5304	19.8226	20.0417	20.1526	20.1704	20.1706	20.1212	19.8501	19.4369	19.0989	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.9706	19.1414	19.3804	19.6726	19.8917	20.0026	20.0204	20.0206	19.9712	19.7001	19.2869	18.9489	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9948	0.9879	0.9713	0.9248	0.8129	0.6072	0.4100	0.4492	0.7176	0.9359	0.9880	0.9961	(94)
Useful gains	627.5856	727.9243	791.4303	805.9420	729.4381	527.9575	342.9687	361.3673	554.2807	657.6456	619.5752	593.4043	(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													
	1526.7566	1477.9338	1332.9971	1100.3737	834.6809	544.1554	344.5080	363.8918	594.0086	927.2376	1247.9758	1518.1809	(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													
	668.9832	504.0064	402.9257	211.9908	78.3007	0.0000	0.0000	0.0000	0.0000	200.5765	452.4484	688.0338	(98)
Space heating												3207.2655	(98)
Space heating per m2											(98) / (4) =	32.7272	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 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												3551.7891	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	668.9832	504.0064	402.9257	211.9908	78.3007	0.0000	0.0000	0.0000	0.0000	200.5765	452.4484	688.0338	(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)													
	740.8452	558.1466	446.2079	234.7628	86.7117	0.0000	0.0000	0.0000	0.0000	222.1224	501.0503	761.9422	(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	87.4465	87.1056	86.4610	85.0744	82.6270	79.6000	79.6000	79.6000	79.6000	84.8295	86.7828	87.5542	(217)
Fuel for water heating, kWh/month													
	245.2396	217.0781	229.8624	209.6723	211.7502	196.6883	189.1707	207.2031	206.7194	218.0331	225.0411	239.1295	(219)
Water heating fuel used												2595.5879	(219)
Annual totals kWh/year													
Space heating fuel - main system												3551.7891	(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												6076.3355	(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	3551.7891	0.2160	767.1864	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2595.5879	0.2160	560.6470	(264)
Space and water heating			1327.8334	(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			1290.9629	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			13.1700	(273)

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

DER		13.1700	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		30.3519	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		30.3519	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)
South	8.1200	46.7521	0.6300	0.7000	0.7700	116.0189	(78)
West	2.0000	19.6403	0.6300	0.7000	0.7700	12.0046	(80)

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			4.0400	
Infiltration rate			0.3211	(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) =		0.2970	(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	0.3787	0.3713	0.3639	0.3267	0.3193	0.2822	0.2822	0.2748	0.2970	0.3193	0.3342	0.3490	(22b)
Effective ac	0.5717	0.5689	0.5662	0.5534	0.5510	0.5398	0.5398	0.5377	0.5441	0.5510	0.5558	0.5609	(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	47.5172	47.2857	47.0589	45.9933	45.7939	44.8659	44.8659	44.6940	45.2233	45.7939	46.1972	46.6189	(38)
Heat transfer coeff	102.5041	102.2727	102.0458	100.9802	100.7809	99.8528	99.8528	99.6809	100.2103	100.7809	101.1842	101.6058	(39)
Average = Sum(39)m / 12 =												100.9793	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0460	1.0436	1.0413	1.0304	1.0284	1.0189	1.0189	1.0172	1.0226	1.0284	1.0325	1.0368	(40)
HLP (average)												1.0304	(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	(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	(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)
South	8.1200	46.7521	0.7100	0.7000	0.7700	130.7514	(78)
West	2.0000	19.6403	0.7100	0.7000	0.7700	13.5290	(80)

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	66.3930	66.5433	66.6912	67.3949	67.5282	68.1559	68.1559	68.2734	67.9127	67.5282	67.2591	66.9800	
alpha	5.4262	5.4362	5.4461	5.4930	5.5019	5.5437	5.5437	5.5516	5.5275	5.5019	5.4839	5.4653	
util living area	0.9986	0.9961	0.9890	0.9658	0.8977	0.7442	0.5657	0.6124	0.8457	0.9763	0.9967	0.9990	(86)
MIT	19.8591	20.0249	20.2603	20.5505	20.8007	20.9511	20.9911	20.9864	20.8968	20.5671	20.1525	19.8285	(87)
Th 2	20.0452	20.0472	20.0491	20.0581	20.0598	20.0676	20.0676	20.0691	20.0646	20.0598	20.0563	20.0528	(88)
util rest of house	0.9982	0.9948	0.9851	0.9528	0.8587	0.6597	0.4521	0.4981	0.7777	0.9648	0.9953	0.9987	(89)
MIT 2	18.9996	19.1664	19.4014	19.6917	19.9220	20.0444	20.0652	20.0651	20.0072	19.7128	19.3017	18.9753	(90)
Living area fraction									fLA = Living area / (4) =			0.1919	(91)
MIT	19.1646	19.3312	19.5662	19.8565	20.0906	20.2184	20.2429	20.2419	20.1779	19.8768	19.4650	19.1391	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.1646	19.3312	19.5662	19.8565	20.0906	20.2184	20.2429	20.2419	20.1779	19.8768	19.4650	19.1391	(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	0.9825	0.9493	0.8602	0.6744	0.4741	0.5201	0.7871	0.9619	0.9942	0.9983	(94)
Useful gains	543.2418	647.0690	718.2866	750.0490	703.1369	533.9549	360.5505	377.6960	545.7043	597.5247	539.6856	509.3713	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W	1523.6801	1475.9191	1333.3556	1106.3923	845.6154	561.0127	363.7572	382.9644	609.0722	934.9201	1251.1388	1517.8974	(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	729.4462	556.9873	457.6114	256.5671	106.0040	0.0000	0.0000	0.0000	0.0000	251.0222	512.2462	750.3434	(98)
Space heating												3620.2278	(98)
Space heating per m2											(98) / (4) =	36.9411	(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	938.6164	738.9108	757.5752	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8836	0.9415	0.9263	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	829.4071	695.7110	701.7587	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	144.4543	219.9938	187.1325	0.0000	0.0000	0.0000	0.0000	(104)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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Space cooling                                                                                                                                  551.5805 (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    36.1136    54.9984    46.7831     0.0000     0.0000     0.0000     0.0000 (107)
Space cooling                                                                                                                                  137.8951 (107)
Space cooling per m2                                                                                                                             1.4071 (108)
Energy for space heating                                                                                                                        36.9411 (99)
Energy for space cooling                                                                                                                         1.4071 (108)
Total                                                                                                                                           38.3482 (109)
Dwelling Fabric Energy Efficiency (DFEE)                                                                                                           38.3 (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)
South	8.1200	46.7521	0.6300	0.7000	0.7700	116.0189	(78)
West	2.0000	19.6403	0.6300	0.7000	0.7700	12.0046	(80)

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		4.0400	
Infiltration rate		0.3608	(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) =	0.3338	(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	0.3504	0.3254	0.3338	0.3171	0.3171	0.3087	0.3004	0.2920	0.2837	0.3087	0.2920	0.3087	(22b)
Effective ac	0.5614	0.5529	0.5557	0.5503	0.5503	0.5477	0.5451	0.5426	0.5402	0.5477	0.5426	0.5477	(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	46.6606	45.9575	46.1861	45.7347	45.7347	45.5177	45.3065	45.1011	44.9015	45.5177	45.1011	45.5177	(38)
Heat transfer coeff	101.6475	100.9445	101.1730	100.7217	100.7217	100.5047	100.2935	100.0881	99.8884	100.5047	100.0881	100.5047	(39)
Average = Sum(39)m / 12 =												100.5900	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0372	1.0300	1.0324	1.0278	1.0278	1.0256	1.0234	1.0213	1.0193	1.0256	1.0213	1.0256	(40)
HLP (average)												1.0264	(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)
South	8.1200	56.7559	0.7100	0.7000	0.7700	158.7290	(78)
West	2.0000	25.1925	0.7100	0.7000	0.7700	17.3537	(80)

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	66.9525	67.4188	67.2665	67.5679	67.5679	67.7138	67.8564	67.9957	68.1316	67.7138	67.9957	67.7138	
alpha	5.4635	5.4946	5.4844	5.5045	5.5045	5.5143	5.5238	5.5330	5.5421	5.5143	5.5330	5.5143	
util living area													
	0.9848	0.9750	0.9461	0.8739	0.7367	0.5224	0.3763	0.3846	0.6212	0.8677	0.9645	0.9876	(86)
MIT	20.3793	20.4671	20.6239	20.7936	20.9032	20.9447	20.9500	20.9500	20.9359	20.8255	20.5957	20.3669	(87)
Th 2	20.0524	20.0584	20.0564	20.0603	20.0603	20.0621	20.0639	20.0656	20.0673	20.0621	20.0656	20.0621	(88)
util rest of house													
	0.9801	0.9676	0.9304	0.8393	0.6740	0.4400	0.2866	0.2931	0.5381	0.8243	0.9524	0.9837	(89)
MIT 2	19.2426	19.3726	19.5910	19.8197	19.9478	19.9867	19.9916	19.9934	19.9861	19.8653	19.5631	19.2329	(90)
Living area fraction									fLA = Living area / (4) =			0.1919	(91)
MIT	19.4607	19.5827	19.7892	20.0066	20.1312	20.1706	20.1755	20.1770	20.1684	20.0496	19.7613	19.4505	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.3107	19.4327	19.6392	19.8566	19.9812	20.0206	20.0255	20.0270	20.0184	19.8996	19.6113	19.3005	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9754	0.9614	0.9220	0.8308	0.6683	0.4363	0.2829	0.2893	0.5335	0.8156	0.9449	0.9796	(94)
Useful gains	850.2966	913.9593	947.0543	898.0976	718.0619	471.5855	293.2161	292.7420	522.9264	746.8971	811.7297	807.5222	(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													
	1464.8163	1426.6154	1278.7485	1043.1354	753.5151	474.4382	293.4136	292.9608	531.2441	854.2481	1172.1575	1437.2693	(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													
	457.2027	344.5049	246.7804	104.4272	26.3771	0.0000	0.0000	0.0000	0.0000	79.8692	259.5081	468.5319	(98)
Space heating												1987.2015	(98)
RHI space heating demand												1987	(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		4.0400	
Infiltration rate		0.3608	(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) =	0.3338	(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	0.4255	0.4172	0.4089	0.3671	0.3588	0.3171	0.3171	0.3087	0.3338	0.3588	0.3755	0.3922	(22b)
Effective ac	0.5905	0.5870	0.5836	0.5674	0.5644	0.5503	0.5503	0.5477	0.5557	0.5644	0.5705	0.5769	(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	49.0822	48.7900	48.5036	47.1582	46.9065	45.7347	45.7347	45.5177	46.1861	46.9065	47.4157	47.9481	(38)
Heat transfer coeff	104.0692	103.7769	103.4905	102.1452	101.8934	100.7217	100.7217	100.5047	101.1730	101.8934	102.4026	102.9350	(39)
Average = Sum(39)m / 12 =												102.1439	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0619	1.0589	1.0560	1.0423	1.0397	1.0278	1.0278	1.0256	1.0324	1.0397	1.0449	1.0504	(40)
HLP (average)												1.0423	(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 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)
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)
South	8.1200	46.7521	0.7100	0.7000	0.7700	130.7514	(78)
West	2.0000	19.6403	0.7100	0.7000	0.7700	13.5290	(80)

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	65.3946	65.5787	65.7602	66.6263	66.7909	67.5679	67.5679	67.7138	67.2665	66.7909	66.4588	66.1151	
alpha	5.3596	5.3719	5.3840	5.4418	5.4527	5.5045	5.5045	5.5143	5.4844	5.4527	5.4306	5.4077	
util living area													
	0.9896	0.9796	0.9581	0.9042	0.7923	0.6096	0.4456	0.4778	0.7013	0.9120	0.9784	0.9918	(86)
MIT	20.2844	20.4010	20.5587	20.7411	20.8733	20.9363	20.9484	20.9475	20.9198	20.7612	20.4932	20.2623	(87)
Th 2	20.0320	20.0345	20.0369	20.0482	20.0504	20.0603	20.0603	20.0621	20.0564	20.0504	20.0461	20.0416	(88)
util rest of house													
	0.9864	0.9736	0.9456	0.8763	0.7378	0.5281	0.3520	0.3827	0.6221	0.8806	0.9709	0.9893	(89)
MIT 2	19.0889	19.2584	19.4838	19.7420	19.9065	19.9789	19.9872	19.9887	19.9620	19.7749	19.4020	19.0648	(90)
Living area fraction										fLA = Living area / (4) =		0.1919	(91)
MIT	19.3184	19.4777	19.6901	19.9337	20.0921	20.1627	20.1717	20.1727	20.1458	19.9643	19.6114	19.2947	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.1684	19.3277	19.5401	19.7837	19.9421	20.0127	20.0217	20.0227	19.9958	19.8143	19.4614	19.1447	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9827	0.9679	0.9377	0.8672	0.7309	0.5238	0.3482	0.3787	0.6167	0.8713	0.9649	0.9860	(94)
Useful gains	821.9201	909.4361	945.4895	912.0595	777.5595	537.1548	343.9550	363.0130	577.1652	766.2408	788.9532	785.6882	(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													
	1547.3420	1497.2652	1349.5286	1111.7217	839.8119	545.1720	344.6372	364.0999	596.4973	938.8719	1265.8442	1538.3280	(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													
	539.7138	395.0212	300.6051	143.7567	46.3158	0.0000	0.0000	0.0000	0.0000	128.4376	343.3615	559.9640	(98)
Space heating												2457.1757	(98)
Space heating per m2											(98) / (4) =	25.0732	(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												2721.1248	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	539.7138	395.0212	300.6051	143.7567	46.3158	0.0000	0.0000	0.0000	0.0000	128.4376	343.3615	559.9640	(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)													
	597.6898	437.4542	332.8960	159.1991	51.2910	0.0000	0.0000	0.0000	0.0000	142.2343	380.2453	620.1152	(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	86.9754	86.5344	85.7143	84.0442	81.6244	79.6000	79.6000	79.6000	79.6000	83.6628	86.1036	87.1132	(217)
Fuel for water heating, kWh/month													
	246.5680	218.5109	231.8648	212.2424	214.3510	196.6883	189.1707	207.2031	206.7194	221.0736	226.8162	240.3399	(219)
Water heating fuel used												2611.5484	(219)
Annual totals kWh/year													
Space heating fuel - main system												2721.1248	(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												5261.6318	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2721.1248	3.4800	94.6951	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2611.5484	3.4800	90.8819	(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			296.2067	(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] =	0.8700	(257)
SAP value		87.8638	
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	2721.1248	0.2160	587.7630	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2611.5484	0.2160	564.0945	(264)
Space and water heating			1151.8574	(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			1114.9869	(272)
CO2 emissions per m2			11.3800	(273)
EI value			89.5519	
EI rating			90	(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 / 0.8335 = 4.175, stars = 4
Water heating environmental impact	0.216 / 0.8335 = 0.2592, 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		4.0400	
Infiltration rate		0.3608	(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) =	0.3338	(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	0.3504	0.3254	0.3338	0.3171	0.3171	0.3087	0.3004	0.2920	0.2837	0.3087	0.2920	0.3087	(22b)
Effective ac	0.5614	0.5529	0.5557	0.5503	0.5503	0.5477	0.5451	0.5426	0.5402	0.5477	0.5426	0.5477	(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	46.6606	45.9575	46.1861	45.7347	45.7347	45.5177	45.3065	45.1011	44.9015	45.5177	45.1011	45.5177	(38)
Heat transfer coeff	101.6475	100.9445	101.1730	100.7217	100.7217	100.5047	100.2935	100.0881	99.8884	100.5047	100.0881	100.5047	(39)
Average = Sum(39)m / 12 =												100.5900	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0372	1.0300	1.0324	1.0278	1.0278	1.0256	1.0234	1.0213	1.0193	1.0256	1.0213	1.0256	(40)
HLP (average)												1.0264	(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)


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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)
              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          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)
South                                   8.1200           56.7559            0.7100             0.7000            0.7700          158.7290 (78)
West                                    2.0000           25.1925            0.7100             0.7000            0.7700           17.3537 (80)
-------------------------------------------------------------------------------------------------------------

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           66.9525    67.4188    67.2665    67.5679    67.5679    67.7138    67.8564    67.9957    68.1316    67.7138    67.9957    67.7138
alpha          5.4635     5.4946     5.4844     5.5045     5.5045     5.5143     5.5238     5.5330     5.5421     5.5143     5.5330     5.5143
util living area
               0.9848     0.9750     0.9461     0.8739     0.7367     0.5224     0.3763     0.3846     0.6212     0.8677     0.9645     0.9876 (86)

MIT           20.3793    20.4671    20.6239    20.7936    20.9032    20.9447    20.9500    20.9500    20.9359    20.8255    20.5957    20.3669 (87)
Th 2           20.0524    20.0584    20.0564    20.0603    20.0603    20.0621    20.0639    20.0656    20.0673    20.0621    20.0656    20.0621 (88)
util rest of house
               0.9801     0.9676     0.9304     0.8393     0.6740     0.4400     0.2866     0.2931     0.5381     0.8243     0.9524     0.9837 (89)
MIT 2          19.2426    19.3726    19.5910    19.8197    19.9478    19.9867    19.9916    19.9934    19.9861    19.8653    19.5631    19.2329 (90)
Living area fraction                                                                                    fLA = Living area / (4) =      0.1919 (91)
MIT            19.4607    19.5827    19.7892    20.0066    20.1312    20.1706    20.1755    20.1770    20.1684    20.0496    19.7613    19.4505 (92)
Temperature adjustment                                                                                                         -0.1500
adjusted MIT   19.3107    19.4327    19.6392    19.8566    19.9812    20.0206    20.0255    20.0270    20.0184    19.8996    19.6113    19.3005 (93)


-------------------------------------------------------------------------------------------------------------
8. Space heating requirement
-------------------------------------------------------------------------------------------------------------

                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation     0.9754     0.9614     0.9220     0.8308     0.6683     0.4363     0.2829     0.2893     0.5335     0.8156     0.9449     0.9796 (94)
Useful gains  850.2966   913.9593   947.0543   898.0976   718.0619   471.5855   293.2161   292.7420   522.9264   746.8971   811.7297   807.5222 (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
             1464.8163  1426.6154  1278.7485  1043.1354   753.5151   474.4382   293.4136   292.9608   531.2441   854.2481  1172.1575  1437.2693 (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
              457.2027   344.5049   246.7804   104.4272    26.3771     0.0000     0.0000     0.0000     0.0000    79.8692   259.5081   468.5319 (98)
Space heating                                                                                                 1987.2015 (98)
Space heating per m2                                                                                  (98) / (4) =     20.2776 (99)


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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												2200.6661	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	457.2027	344.5049	246.7804	104.4272	26.3771	0.0000	0.0000	0.0000	0.0000	79.8692	259.5081	468.5319	(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)													
	506.3152	381.5115	273.2895	115.6448	29.2105	0.0000	0.0000	0.0000	0.0000	88.4487	287.3844	518.8614	(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	86.5838	86.1942	85.1916	83.2422	80.8552	79.6000	79.6000	79.6000	79.6000	82.5501	85.3722	86.7005	(217)
Fuel for water heating, kWh/month													
	247.6831	219.3735	233.2874	214.2873	216.3904	196.6883	189.1707	207.2031	206.7194	224.0537	228.7596	241.4839	(219)
Water heating fuel used												2625.1005	(219)
Annual totals kWh/year													
Space heating fuel - main system												2200.6661	(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												4659.7797	(238)

10a. Fuel costs - using BEDF prices (445)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2200.6661	3.9300	86.4862	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2625.1005	3.9300	103.1664	(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			248.5053	(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	2200.6661	0.2160	475.3439	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2625.1005	0.2160	567.0217	(264)
Space and water heating			1042.3656	(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			956.2184	(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	2200.6661	1.2200	2684.8126	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2625.1005	1.2200	3202.6226	(264)
Space and water heating			5887.4352	(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			5377.8554	(272)
Primary energy kWh/m2/year			54.8761	(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 90

(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 (28.3%)

	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 445 TEST (30 Jul 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	£224	£54
Space heating	£188	£189	-£2
Water heating	£103	£56	£47
Lighting	£75	£75	£0
Generated (PV)	-£117	-£117	£0
Total cost of fuels	£249	£204	£45
Total cost of uses	£249	£203	£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	39 kWh/m²	16 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			4.0400	
Infiltration rate			0.3608	(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) =		0.3338	(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	0.4255	0.4172	0.4089	0.3671	0.3588	0.3171	0.3171	0.3087	0.3338	0.3588	0.3755	0.3922	(22b)
Effective ac	0.5905	0.5870	0.5836	0.5674	0.5644	0.5503	0.5503	0.5477	0.5557	0.5644	0.5705	0.5769	(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	49.0822	48.7900	48.5036	47.1582	46.9065	45.7347	45.7347	45.5177	46.1861	46.9065	47.4157	47.9481	(38)
Heat transfer coeff	104.0692	103.7769	103.4905	102.1452	101.8934	100.7217	100.7217	100.5047	101.1730	101.8934	102.4026	102.9350	(39)
Average = Sum(39)m / 12 =												102.1439	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0619	1.0589	1.0560	1.0423	1.0397	1.0278	1.0278	1.0256	1.0324	1.0397	1.0449	1.0504	(40)
HLP (average)												1.0423	(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)
South	8.1200	46.7521	0.7100	0.7000	0.7700	130.7514	(78)
West	2.0000	19.6403	0.7100	0.7000	0.7700	13.5290	(80)

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	65.3946	65.5787	65.7602	66.6263	66.7909	67.5679	67.5679	67.7138	67.2665	66.7909	66.4588	66.1151	
alpha	5.3596	5.3719	5.3840	5.4418	5.4527	5.5045	5.5045	5.5143	5.4844	5.4527	5.4306	5.4077	
util living area													
	0.9902	0.9807	0.9602	0.9098	0.8038	0.6230	0.4570	0.4897	0.7114	0.9163	0.9797	0.9923	(86)
MIT	20.2765	20.3935	20.5511	20.7328	20.8675	20.9347	20.9482	20.9471	20.9176	20.7553	20.4857	20.2543	(87)
Th 2	20.0320	20.0345	20.0369	20.0482	20.0504	20.0603	20.0603	20.0621	20.0564	20.0504	20.0461	20.0416	(88)
util rest of house													
	0.9872	0.9749	0.9482	0.8829	0.7503	0.5406	0.3613	0.3926	0.6323	0.8860	0.9726	0.9899	(89)
MIT 2	19.0775	19.2477	19.4734	19.7314	19.9004	19.9778	19.9871	19.9885	19.9602	19.7676	19.3914	19.0532	(90)
Living area fraction									fLA = Living area / (4) =			0.1919	(91)
MIT	19.3076	19.4676	19.6802	19.9236	20.0860	20.1615	20.1715	20.1725	20.1440	19.9572	19.6015	19.2837	(92)
Temperature adjustment												-0.1500	
adjusted MIT	19.1576	19.3176	19.5302	19.7736	19.9360	20.0115	20.0215	20.0225	19.9940	19.8072	19.4515	19.1337	(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	0.9836	0.9693	0.9404	0.8738	0.7431	0.5362	0.3573	0.3884	0.6266	0.8766	0.9668	0.9869	(94)
Useful gains	811.3850	899.6526	935.9664	902.3608	771.7596	536.0942	343.8460	362.8447	575.4647	759.4837	779.3191	774.9760	(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	1546.2200	1496.2175	1348.5031	1110.6864	839.1959	545.0543	344.6228	364.0784	596.3120	938.1482	1264.8215	1537.2000	(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	546.7172	400.8917	306.9273	149.9945	50.1726	0.0000	0.0000	0.0000	0.0000	132.9264	349.5617	567.0947	(98)

Space heating		2504.2861 (98)
Space heating per m2	(98) / (4) =	25.5539 (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	2773.2958 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	546.7172	400.8917	306.9273	149.9945	50.1726	0.0000	0.0000	0.0000	0.0000	132.9264	349.5617	567.0947	(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)	605.4454	443.9553	339.8974	166.1068	55.5622	0.0000	0.0000	0.0000	0.0000	147.2053	387.1115	628.0118	(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	87.4244	87.3425	87.1878	86.9654	86.3203	79.6000	79.6000	79.6000	79.6000	84.9757	86.7445	87.5094	(217)
Fuel for water heating, kWh/month	202.5923	154.5471	127.2815	68.8334	30.3421	13.1096	6.6743	45.1565	82.4337	136.5761	176.7827	201.5474	(219)

Water heating fuel used	1245.8766 (219)
Annual totals kWh/year	
Space heating fuel - main system	2773.2958 (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	3998.1309 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2773.2958	3.4800	96.5107	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1245.8766	3.4800	43.3565	(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			257.0918	(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] =	0.7551 (257)
SAP value		89.4664
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	2773.2958	0.2160	599.0319	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1245.8766	0.2160	269.1093	(264)
Space and water heating			868.1412	(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			857.2207	(272)
CO2 emissions per m2			8.7500	(273)
EI value			91.9673	
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			4.0400	
Infiltration rate			0.3608	(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) =		0.3338	(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	0.3504	0.3254	0.3338	0.3171	0.3171	0.3087	0.3004	0.2920	0.2837	0.3087	0.2920	0.3087	(22b)
Effective ac	0.5614	0.5529	0.5557	0.5503	0.5503	0.5477	0.5451	0.5426	0.5402	0.5477	0.5426	0.5477	(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	46.6606	45.9575	46.1861	45.7347	45.7347	45.5177	45.3065	45.1011	44.9015	45.5177	45.1011	45.5177	(38)
Heat transfer coeff	101.6475	100.9445	101.1730	100.7217	100.7217	100.5047	100.2935	100.0881	99.8884	100.5047	100.0881	100.5047	(39)
Average = Sum(39)m / 12 =												100.5900	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0372	1.0300	1.0324	1.0278	1.0278	1.0256	1.0234	1.0213	1.0193	1.0256	1.0213	1.0256	(40)
HLP (average)												1.0264	(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

[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)
South	8.1200	56.7559	0.7100	0.7000	0.7700	158.7290	(78)
West	2.0000	25.1925	0.7100	0.7000	0.7700	17.3537	(80)

```
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)

```
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           66.9525    67.4188    67.2665    67.5679    67.5679    67.7138    67.8564    67.9957    68.1316    67.7138    67.9957    67.7138
alpha          5.4635     5.4946     5.4844     5.5045     5.5045     5.5143     5.5238     5.5330     5.5421     5.5143     5.5330     5.5143
util living area
               0.9856     0.9762     0.9487     0.8805     0.7492     0.5341     0.3856     0.3939     0.6309     0.8732     0.9664     0.9884 (86)

MIT           20.3716    20.4597    20.6168    20.7866    20.8991    20.9440    20.9499    20.9499    20.9347    20.8209    20.5887    20.3590 (87)
Th 2           20.0524    20.0584    20.0564    20.0603    20.0603    20.0621    20.0639    20.0656    20.0673    20.0621    20.0656    20.0621 (88)
util rest of house
               0.9812     0.9692     0.9335     0.8469     0.6869     0.4503     0.2938     0.3004     0.5471     0.8307     0.9548     0.9847 (89)
MIT 2         19.2314    19.3622    19.5813    19.8112    19.9440    19.9863    19.9916    19.9934    19.9853    19.8600    19.5535    19.2215 (90)
Living area fraction                                                                    fLA = Living area / (4) =     0.1919 (91)
MIT           19.4503    19.5729    19.7801    19.9984    20.1273    20.1701    20.1755    20.1770    20.1675    20.0444    19.7522    19.4398 (92)
Temperature adjustment                                                                                       -0.1500
adjusted MIT  19.3003    19.4229    19.6301    19.8484    19.9773    20.0201    20.0255    20.0270    20.0175    19.8944    19.6022    19.2898 (93)
```

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

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9767	0.9631	0.9252	0.8382	0.6809	0.4465	0.2900	0.2965	0.5424	0.8219	0.9475	0.9807	(94)
Useful gains	840.1552	904.5155	938.2952	890.2150	714.3712	471.1997	293.1846	292.7077	522.1507	741.9764	803.0407	797.1702	(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	1463.7520	1425.6242	1277.8211	1042.3058	753.1251	474.3935	293.4090	292.9558	531.1583	853.7277	1171.2468	1436.1953	(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	463.9560	350.1851	252.6073	109.5054	28.8329	0.0000	0.0000	0.0000	0.0000	83.1430	265.1084	475.4346	(98)
Space heating												2028.7727	(98)
Space heating per m2											(98) / (4) =	20.7018	(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	2246.7029	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	463.9560	350.1851	252.6073	109.5054	28.8329	0.0000	0.0000	0.0000	0.0000	83.1430	265.1084	475.4346	(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)	513.7940	387.8018	279.7423	121.2685	31.9302	0.0000	0.0000	0.0000	0.0000	92.0742	293.5862	526.5057	(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	87.1247	87.0426	86.7515	86.2615	84.4387	79.6000	79.6000	79.6000	79.6000	83.8389	86.1498	87.1733	(217)
Fuel for water heating, kWh/month	198.0846	155.2191	127.3607	67.8419	36.4618	5.9023	0.8275	36.6678	75.8237	133.2476	171.8830	198.4913	(219)
Water heating fuel used												1207.8112	(219)
Annual totals kWh/year													
Space heating fuel - main system												2246.7029	(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												3338.5272	(238)

10a. Fuel costs - using BEDF prices (445)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2246.7029	3.9300	88.2954	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1207.8112	3.9300	47.4670	(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			203.3951	(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	2246.7029	0.2160	485.2878	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1207.8112	0.2160	260.8872	(264)
Space and water heating			746.1750	(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)

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

Total kg/year 685.9778 (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	2246.7029	1.2200	2740.9775	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1207.8112	1.2200	1473.5297	(264)
Space and water heating			4214.5072	(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			3858.4274	(272)
Primary energy kWh/m2/year			39.3717	(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
South	0.000	1.000	None
West	0.000	1.000	None

Solar shading

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

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	3.6000	87.1704	0.7100	0.7000	0.9000	126.3319
South	8.1200	118.5567	0.7100	0.7000	0.9000	387.5462
West	2.0000	125.2818	0.7100	0.7000	0.9000	100.8694
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