PREDICTED ENERGY ASSESSMENT

Design SAP
elmhurst energy

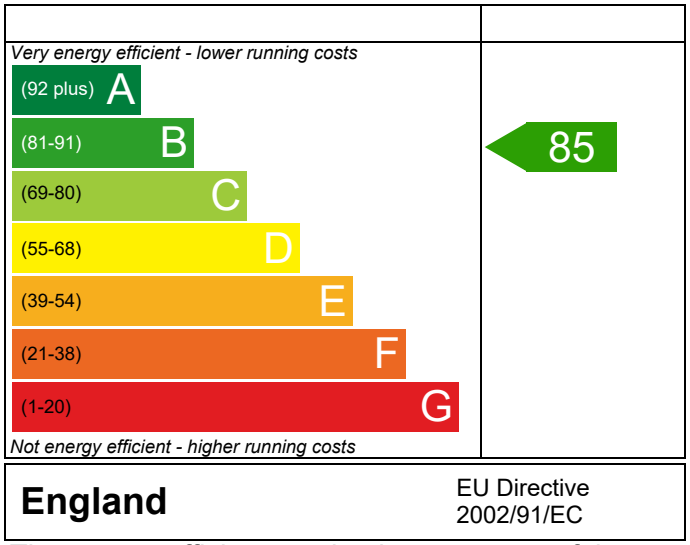
Land North of Grange Road,
SO31

Dwelling type:	House, Semi-Detached
Date of assessment:	27/01/2023
Produced by:	Scott Binstead
Total floor area:	82.16 m²

This document is a Predicted Energy Assessment for properties marketed when they are incomplete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, this rating will be updated and an official Energy Performance Certificate will be created for the property. This will include more detailed information about the energy performance of the completed property.

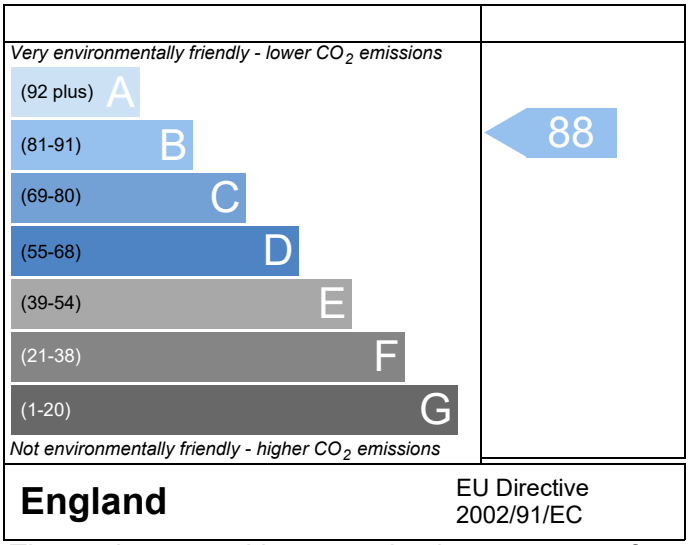
The energy performance has been assessed using the Government approved SAP2012 methodology and is rated in terms of the energy use per square meter of floor area; the energy efficiency is based on fuel costs and the environmental impact is based on carbon dioxide (CO_2) emissions.

Energy Efficiency Rating



The energy efficiency rating is a measure of the overall efficiency of a home. The higher the rating the more energy efficient the home is and the lower the fuel bills are likely to be.

Environmental Impact (CO_2) Rating



The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO_2) emissions. The higher the rating the less impact it has on the environment.

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

Design SAP
elmhurst energy

Property Reference	078 - PRJ013014	**Issued on Date**	27/01/2023
Assessment Reference	078	**Prop Type Ref**	2B
Property	Land North of Grange Road, SO31		

SAP Rating	85 B	**DER**	15.11	**TER**	18.29
Environmental	88 B	**% DER<TER**	17.38		
CO_2 Emissions (t/year)	1.04	**DFEE**	45.10	**TFEE**	50.94
General Requirements Compliance	Pass	**% DFEE<TFEE**	11.46		

Assessor Details	Chris Nicholls, , Tel: ,	**Assessor ID**	U903-0001
Client			

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

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

DWELLING AS DESIGNED

Semi-Detached House, total floor area 82 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) 18.29 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 15.11 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)50.9 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)45.1 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.19 (max. 0.25)	0.19 (max. 0.70)	OK
Roof	0.08 (max. 0.20)	0.08 (max. 0.35)	OK
Openings	1.37 (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: 5.00 (design value)
Maximum 10.0 OK

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 30
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage: No cylinder

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

Hot water controls: No cylinder

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): Slight OK
Based on:
Overshading: Average
Windows facing East: 7.17 m², No overhang
Windows facing West: 2.72 m², No overhang
Air change rate: 4.66 ach
Blinds/curtains: Dark-coloured curtain or roller blind, closed 100% of daylight hours

10 Key features
Party wall U-value 0.00 W/m²K
Roof U-value 0.08 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.0800 (1b)	x	2.3700 (2b)	=	97.3596	(1b) - (3b)
First floor	41.0800 (1c)	x	2.6200 (2c)	=	107.6296	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	82.1600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	204.9892	(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) =	0.1463	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3963	(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) =	0.3666	(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	0.4674	0.4583	0.4491	0.4033	0.3941	0.3483	0.3483	0.3391	0.3666	0.3941	0.4125	0.4308	(22b)
Effective ac	0.6093	0.6050	0.6009	0.5813	0.5777	0.5607	0.5607	0.5575	0.5672	0.5777	0.5851	0.5928	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.0900	1.2000	2.5080			(26)
Windows (Uw = 1.40)			9.8900	1.3258	13.1117			(27)
Flr - Ground			41.0820	0.1939	7.9671	75.6000	3105.7992	(28a)
Wl - Brick (Timber Frame)	90.5550	11.9790	78.5760	0.2500	19.6440	7.4000	581.4624	(29a)
Rf - Ins Joist	41.0820		41.0820	0.0800	3.2866	7.4000	304.0068	(30)
Total net area of external elements Aum(A, m2)			172.7200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		46.5174			(33)
Party Wall			46.2060	0.0000	0.0000	7.4000	341.9244	(32)
Stud			70.8677			7.4000	524.4213	(32c)
Internal Floor			41.0820			7.4000	304.0068	(32d)
Internal Ceiling			41.0820			7.4000	304.0068	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	5465.6277 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		66.5242 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		8.0038 (36)
Total fabric heat loss	(33) + (36) =	54.5212 (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	41.2137	40.9267	40.6454	39.3242	39.0770	37.9262	37.9262	37.7131	38.3695	39.0770	39.5771	40.0999	(38)
Heat transfer coeff	95.7349	95.4479	95.1666	93.8454	93.5982	92.4474	92.4474	92.2343	92.8907	93.5982	94.0983	94.6211	(39)
Average = Sum(39)m / 12 =												93.8442	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1652	1.1617	1.1583	1.1422	1.1392	1.1252	1.1252	1.1226	1.1306	1.1392	1.1453	1.1517	(40)
HLP (average)												1.1422	(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	2.5026 (42)
Average daily hot water use (litres/day)	93.6360 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.9996	99.2542	95.5087	91.7633	88.0178	84.2724	84.2724	88.0178	91.7633	95.5087	99.2542	102.9996	(44)
Energy conte	152.7454	133.5921	137.8551	120.1854	115.3208	99.5131	92.2135	105.8163	107.0801	124.7915	136.2197	147.9258	(45)
Energy content (annual)										Total = Sum(45)m =		1473.2589	(45)

Distribution loss (46)m = 0.15 x (45)m

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	22.9118	20.0388	20.6783	18.0278	17.2981	14.9270	13.8320	15.8724	16.0620	18.7187	20.4330	22.1889	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6751	13.2389	14.6119	14.0892	14.5214	14.0099	14.4500	14.4963	14.0531	14.5745	14.1639	14.6607	(61)
Total heat required for water heating calculated for each month													
	167.4206	146.8310	152.4670	134.2746	129.8422	113.5229	106.6635	120.3126	121.1332	139.3660	150.3836	162.5865	(62)
WWHRS	-55.0980	-48.4777	-49.4786	-40.7198	-37.8145	-31.1988	-26.4114	-31.9758	-32.9055	-40.6704	-47.1011	-53.2525	eq.(G10)
Total of WWHRS savings												-495.1042	
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													
	112.3225	98.3533	102.9884	93.5548	92.0277	82.3241	80.2521	88.3368	88.2276	98.6956	103.2825	109.3340	(64)
								Total per year (kWh/year) = Sum(64)m =				1149.6996	(64)
Heat gains from water heating, kWh/month													
	54.4566	47.7291	49.4898	43.4839	41.9745	36.5906	34.2735	38.8080	39.1174	45.1368	48.8340	52.8505	(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	125.1284	125.1284	125.1284	125.1284	125.1284	125.1284	125.1284	125.1284	125.1284	125.1284	125.1284	125.1284	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	22.0027	19.5426	15.8931	12.0321	8.9942	7.5933	8.2048	10.6649	14.3144	18.1754	21.2134	22.6143	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	223.8956	226.2189	220.3642	207.9002	192.1666	177.3792	167.5003	165.1770	171.0317	183.4958	199.2294	214.0167	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.5128	35.5128	35.5128	35.5128	35.5128	35.5128	35.5128	35.5128	35.5128	35.5128	35.5128	35.5128	(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)													
	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	(71)
Water heating gains (Table 5)													
	73.1944	71.0254	66.5185	60.3944	56.4174	50.8202	46.0665	52.1613	54.3297	60.6677	67.8250	71.0356	(72)
Total internal gains													
	382.6313	380.3255	366.3144	343.8652	321.1166	299.3312	285.3102	291.5417	303.2144	325.8774	351.8063	371.2051	(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	
East	7.1650	19.6403	0.5000	0.7200	0.7700	35.1074	(76)
West	2.7240	19.6403	0.5000	0.7200	0.7700	13.3472	(80)

Solar gains	48.4546	94.7876	156.1016	227.6649	279.0119	285.6183	271.9203	233.5755	181.5526	112.4734	60.4172	39.8467	(83)
Total gains	431.0859	475.1131	522.4160	571.5301	600.1285	584.9495	557.2304	525.1172	484.7670	438.3509	412.2235	411.0519	(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	15.8587	15.9064	15.9534	16.1780	16.2207	16.4226	16.4226	16.4606	16.3443	16.2207	16.1345	16.0454	
alpha	2.0572	2.0604	2.0636	2.0785	2.0814	2.0948	2.0948	2.0974	2.0896	2.0814	2.0756	2.0697	
util living area													
	0.9498	0.9367	0.9118	0.8644	0.7900	0.6807	0.5662	0.6027	0.7648	0.8858	0.9358	0.9542	(86)
MIT	17.7830	18.0427	18.5485	19.2474	19.9158	20.4675	20.7488	20.7030	20.2581	19.3993	18.4839	17.7420	(87)
Th 2	19.9479	19.9507	19.9535	19.9665	19.9689	19.9803	19.9803	19.9824	19.9759	19.9689	19.9640	19.9589	(88)
util rest of house													
	0.9438	0.9291	0.9005	0.8455	0.7566	0.6206	0.4728	0.5133	0.7155	0.8661	0.9268	0.9487	(89)
MIT 2	15.6569	16.0309	16.7581	17.7584	18.6950	19.4417	19.7836	19.7381	19.1803	17.9888	16.6749	15.6003	(90)
Living area fraction									fLA = Living area / (4) =			0.1671	(91)
MIT	16.0122	16.3671	17.0573	18.0072	18.8990	19.6131	19.9449	19.8994	19.3604	18.2245	16.9772	15.9582	(92)
Temperature adjustment												-0.1500	
adjusted MIT	15.8622	16.2171	16.9073	17.8572	18.7490	19.4631	19.7949	19.7494	19.2104	18.0745	16.8272	15.8082	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9071	0.8878	0.8531	0.7935	0.7069	0.5847	0.4534	0.4896	0.6692	0.8151	0.8852	0.9140	(94)
Useful gains	391.0218	421.8021	445.6551	453.4908	424.2167	341.9971	252.6552	257.1037	324.4156	357.2896	364.8885	375.6814	(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													
	1106.9083	1080.1938	990.4257	840.5955	659.7730	449.5821	295.3639	308.9259	474.7101	699.6005	915.3154	1098.3801	(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													
	532.6196	442.4392	405.3094	278.7154	175.2539	0.0000	0.0000	0.0000	0.0000	254.6793	396.3074	537.6878	(98)
Space heating												3023.0119	(98)
Space heating per m2											(98) / (4) =	36.7942	(99)

8c. Space cooling requirement

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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 %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3340.3447	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	532.6196	442.4392	405.3094	278.7154	175.2539	0.0000	0.0000	0.0000	0.0000	254.6793	396.3074	537.6878	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	588.5299	488.8831	447.8557	307.9728	193.6507	0.0000	0.0000	0.0000	0.0000	281.4136	437.9087	594.1302	(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	112.3225	98.3533	102.9884	93.5548	92.0277	82.3241	80.2521	88.3368	88.2276	98.6956	103.2825	109.3340	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9259	89.9007	89.8328	89.6739	89.3721	87.3000	87.3000	87.3000	87.3000	89.5829	89.8194	89.9429	(217)
Fuel for water heating, kWh/month	124.9056	109.4021	114.6445	104.3277	102.9715	94.3003	91.9268	101.1877	101.0626	110.1724	114.9892	121.5594	(219)
Water heating fuel used												1291.4497	(219)
Annual totals kWh/year													
Space heating fuel - main system												3340.3447	(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)	388.5754	(232)
Total delivered energy for all uses	5095.3698	(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	3340.3447	0.2160	721.5144	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1291.4497	0.2160	278.9531	(264)
Space and water heating			1000.4676	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	388.5754	0.5190	201.6706	(268)
Total CO2, kg/year			1241.0632	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			15.1100	(273)

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

DER		15.1100	ZC1
Total Floor Area	TFA	82.1600	
Assumed number of occupants	N	2.5026	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.1485	ZC2
CO2 emissions from cooking, equation (L16)		2.1794	ZC3
Total CO2 emissions		33.4379	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		33.4379	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.0800 (1b)	x	2.3700 (2b)	=	97.3596	(1b) - (3b)
First floor	41.0800 (1c)	x	2.6200 (2c)	=	107.6296	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	82.1600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	204.9892	(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) =	0.1463	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3963	(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) =	0.3666	(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	0.4674	0.4583	0.4491	0.4033	0.3941	0.3483	0.3483	0.3391	0.3666	0.3941	0.4125	0.4308	(22b)
Effective ac	0.6093	0.6050	0.6009	0.5813	0.5777	0.5607	0.5607	0.5575	0.5672	0.5777	0.5851	0.5928	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.0900	1.0000	2.0900			(26)
TER Opening Type (Uw = 1.40)			9.8900	1.3258	13.1117			(27)
Flr - Ground			41.0820	0.1300	5.3407			(28a)
Wl - Brick (Timber Frame)	90.5550	11.9790	78.5760	0.1800	14.1437			(29a)
Rf - Ins Joist	41.0820		41.0820	0.1300	5.3407			(30)
Total net area of external elements Aum(A, m2)			172.7200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		40.0267			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.8841	(36)
Total fabric heat loss (33) + (36) =	48.9108	(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	41.2137	40.9267	40.6454	39.3242	39.0770	37.9262	37.9262	37.7131	38.3695	39.0770	39.5771	40.0999	(38)
Heat transfer coeff	90.1246	89.8376	89.5563	88.2350	87.9878	86.8371	86.8371	86.6240	87.2803	87.9878	88.4879	89.0107	(39)
Average = Sum(39)m / 12 =												88.2339	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0969	1.0934	1.0900	1.0739	1.0709	1.0569	1.0569	1.0543	1.0623	1.0709	1.0770	1.0834	(40)
HLP (average)												1.0739	(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	2.5026	(42)
Average daily hot water use (litres/day)	93.6360	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.9996	99.2542	95.5087	91.7633	88.0178	84.2724	84.2724	88.0178	91.7633	95.5087	99.2542	102.9996	(44)
Energy conte	152.7454	133.5921	137.8551	120.1854	115.3208	99.5131	92.2135	105.8163	107.0801	124.7915	136.2197	147.9258	(45)
Energy content (annual)										Total = Sum(45)m =		1473.2589	(45)
Distribution loss (46)m = 0.15 x (45)m	22.9118	20.0388	20.6783	18.0278	17.2981	14.9270	13.8320	15.8724	16.0620	18.7187	20.4330	22.1889	(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 EMISSIONS 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)
Combi loss	50.9589	45.6841	48.6702	45.2531	44.8529	41.5590	42.9443	44.8529	45.2531	48.6702	48.9473	50.9589	(61)
Total heat required for water heating calculated for each month													
	203.7043	179.2762	186.5253	165.4385	160.1737	141.0721	135.1578	150.6692	152.3332	173.4617	185.1670	198.8847	(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													
	203.7043	179.2762	186.5253	165.4385	160.1737	141.0721	135.1578	150.6692	152.3332	173.4617	185.1670	198.8847	(64)
								Total per year (kWh/year) = Sum(64)m =				2031.8638	(64)
Heat gains from water heating, kWh/month													
	63.5276	55.8404	58.0044	51.2749	49.5574	43.4778	41.3971	46.3972	46.9174	53.6607	57.5299	61.9251	(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	125.1284	125.1284	125.1284	125.1284	125.1284	125.1284	125.1284	125.1284	125.1284	125.1284	125.1284	125.1284	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	22.1406	19.6651	15.9927	12.1075	9.0505	7.6408	8.2562	10.7317	14.4041	18.2893	21.3463	22.7559	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	223.8956	226.2189	220.3642	207.9002	192.1666	177.3792	167.5003	165.1770	171.0317	183.4958	199.2294	214.0167	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.5128	35.5128	35.5128	35.5128	35.5128	35.5128	35.5128	35.5128	35.5128	35.5128	35.5128	35.5128	(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)													
	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	(71)
Water heating gains (Table 5)													
	85.3865	83.0958	77.9629	71.2152	66.6094	60.3859	55.6412	62.3618	65.1631	72.1246	79.9026	83.2326	(72)
Total internal gains													
	394.9612	392.5184	377.8583	354.7614	331.3650	308.9444	294.9362	301.8090	314.1374	337.4482	364.0167	383.5438	(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	
East	7.1650	19.6403	0.6300	0.7000	0.7700	43.0066	(76)
West	2.7240	19.6403	0.6300	0.7000	0.7700	16.3503	(80)

Solar gains	59.3569	116.1148	191.2245	278.8895	341.7896	349.8824	333.1024	286.1300	222.4020	137.7800	74.0111	48.8123	(83)
Total gains	454.3182	508.6331	569.0828	633.6509	673.1546	658.8269	628.0386	587.9390	536.5394	475.2281	438.0279	432.3561	(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	63.3074	63.5097	63.7092	64.6632	64.8448	65.7042	65.7042	65.8658	65.3705	64.8448	64.4784	64.0996	
alpha	5.2205	5.2340	5.2473	5.3109	5.3230	5.3803	5.3803	5.3911	5.3580	5.3230	5.2986	5.2733	
util living area													
	0.9987	0.9973	0.9926	0.9736	0.9115	0.7638	0.5912	0.6485	0.8871	0.9851	0.9973	0.9990	(86)
MIT	19.7865	19.9153	20.1520	20.4775	20.7626	20.9389	20.9875	20.9800	20.8533	20.4816	20.0812	19.7694	(87)
Th 2	20.0033	20.0062	20.0090	20.0222	20.0246	20.0362	20.0362	20.0383	20.0317	20.0246	20.0196	20.0144	(88)
util rest of house													
	0.9982	0.9963	0.9898	0.9629	0.8751	0.6781	0.4705	0.5273	0.8273	0.9773	0.9962	0.9986	(89)
MIT 2	18.3774	18.5677	18.9146	19.3920	19.7811	19.9931	20.0313	20.0295	19.9061	19.4049	18.8202	18.3605	(90)
Living area fraction									fLA = Living area / (4) =			0.1671	(91)
MIT	18.6129	18.7929	19.1214	19.5734	19.9451	20.1512	20.1911	20.1883	20.0644	19.5849	19.0309	18.5960	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6129	18.7929	19.1214	19.5734	19.9451	20.1512	20.1911	20.1883	20.0644	19.5849	19.0309	18.5960	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9972	0.9946	0.9863	0.9566	0.8716	0.6894	0.4907	0.5473	0.8297	0.9723	0.9944	0.9978	(94)
Useful gains	453.0491	505.8774	561.2611	606.1199	586.7102	454.1630	308.1636	321.7533	445.1748	462.0781	435.5952	431.4241	(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													
	1289.9437	1248.1057	1130.3232	941.7671	725.4706	482.0468	311.8364	328.1607	520.5725	790.5583	1055.7442	1281.3946	(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													
	622.6495	498.7774	423.3822	241.6660	103.2377	0.0000	0.0000	0.0000	0.0000	244.3893	446.5073	632.3780	(98)
Space heating												3212.9876	(98)
Space heating per m2											(98) / (4) =	39.1065	(99)

8c. Space cooling requirement

Not applicable

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

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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 %)	93.4000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3440.0295	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	622.6495	498.7774	423.3822	241.6660	103.2377	0.0000	0.0000	0.0000	0.0000	244.3893	446.5073	632.3780	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	666.6483	534.0229	453.3000	258.7431	110.5329	0.0000	0.0000	0.0000	0.0000	261.6587	478.0592	677.0643	(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													
	203.7043	179.2762	186.5253	165.4385	160.1737	141.0721	135.1578	150.6692	152.3332	173.4617	185.1670	198.8847	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.6814	87.4905	87.0515	86.0040	83.9772	80.3000	80.3000	80.3000	80.3000	85.9141	87.1854	87.7590	(217)
Fuel for water heating, kWh/month													
	232.3233	204.9095	214.2702	192.3614	190.7347	175.6813	168.3160	187.6329	189.7051	201.9014	212.3829	226.6259	(219)
Water heating fuel used												2396.8447	(219)
Annual totals kWh/year													
Space heating fuel - main system												3440.0295	(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)												391.0097	(232)
Total delivered energy for all uses												6302.8839	(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	3440.0295	0.2160	743.0464	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2396.8447	0.2160	517.7184	(264)
Space and water heating			1260.7648	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	391.0097	0.5190	202.9341	(268)
Total CO2, kg/m2/year			1502.6239	(272)
Emissions per m2 for space and water heating			15.3452	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.4700	(272b)
Emissions per m2 for pumps and fans			0.4738	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.3452 * 1.00) + 2.4700 + 0.4738, rounded to 2 d.p.			18.2900	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.0800 (1b)	x	2.3700 (2b)	=	97.3596	(1b) - (3b)
First floor	41.0800 (1c)	x	2.6200 (2c)	=	107.6296	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	82.1600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	204.9892	(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) =	0.1463	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3963	(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) =	0.3666	(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	0.4674	0.4583	0.4491	0.4033	0.3941	0.3483	0.3483	0.3391	0.3666	0.3941	0.4125	0.4308	(22b)
Effective ac	0.6093	0.6050	0.6009	0.5813	0.5777	0.5607	0.5607	0.5575	0.5672	0.5777	0.5851	0.5928	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.0900	1.2000	2.5080			(26)
Windows (Uw = 1.40)			9.8900	1.3258	13.1117			(27)
Flr - Ground			41.0820	0.1939	7.9671	75.6000	3105.7992	(28a)
Wl - Brick (Timber Frame)	90.5550	11.9790	78.5760	0.2500	19.6440	7.4000	581.4624	(29a)
Rf - Ins Joist	41.0820		41.0820	0.0800	3.2866	7.4000	304.0068	(30)
Total net area of external elements Aum(A, m2)			172.7200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		46.5174			(33)
Party Wall			46.2060	0.0000	0.0000	7.4000	341.9244	(32)
Stud			70.8677			7.4000	524.4213	(32c)
Internal Floor			41.0820			7.4000	304.0068	(32d)
Internal Ceiling			41.0820			7.4000	304.0068	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	5465.6277 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		66.5242 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		8.0038 (36)
Total fabric heat loss	(33) + (36) =	54.5212 (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	41.2137	40.9267	40.6454	39.3242	39.0770	37.9262	37.9262	37.7131	38.3695	39.0770	39.5771	40.0999	(38)
Heat transfer coeff	95.7349	95.4479	95.1666	93.8454	93.5982	92.4474	92.4474	92.2343	92.8907	93.5982	94.0983	94.6211	(39)
Average = Sum(39)m / 12 =												93.8442	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1652	1.1617	1.1583	1.1422	1.1392	1.1252	1.1252	1.1226	1.1306	1.1392	1.1453	1.1517	(40)
HLP (average)												1.1422	(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	2.5026 (42)
Average daily hot water use (litres/day)	93.6360 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.9996	99.2542	95.5087	91.7633	88.0178	84.2724	84.2724	88.0178	91.7633	95.5087	99.2542	102.9996	(44)
Energy conte	152.7454	133.5921	137.8551	120.1854	115.3208	99.5131	92.2135	105.8163	107.0801	124.7915	136.2197	147.9258	(45)
Energy content (annual)										Total = Sum(45)m =		1473.2589	(45)

Distribution loss (46)m = 0.15 x (45)m

CALCULATION OF 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	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.4584	28.3883	29.2942	25.5394	24.5057	21.1465	19.5954	22.4860	22.7545	26.5182	28.9467	31.4342	(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	125.1284	125.1284	125.1284	125.1284	125.1284	125.1284	125.1284	125.1284	125.1284	125.1284	125.1284	125.1284	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	22.0027	19.5426	15.8931	12.0321	8.9942	7.5933	8.2048	10.6649	14.3144	18.1754	21.2134	22.6143	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	223.8956	226.2189	220.3642	207.9002	192.1666	177.3792	167.5003	165.1770	171.0317	183.4958	199.2294	214.0167	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.5128	35.5128	35.5128	35.5128	35.5128	35.5128	35.5128	35.5128	35.5128	35.5128	35.5128	35.5128	(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)													
	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	(71)
Water heating gains (Table 5)													
	43.6269	42.2445	39.3739	35.4714	32.9377	29.3702	26.3379	30.2231	31.6035	35.6427	40.2037	42.2503	(72)
Total internal gains													
	350.0638	348.5446	336.1698	315.9422	294.6370	274.8812	262.5815	266.6035	277.4881	297.8524	321.1850	339.4198	(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	
East	7.1650	19.6403	0.5000	0.7200	0.7700	35.1074	(76)
West	2.7240	19.6403	0.5000	0.7200	0.7700	13.3472	(80)

Solar gains	48.4546	94.7876	156.1016	227.6649	279.0119	285.6183	271.9203	233.5755	181.5526	112.4734	60.4172	39.8467	(83)
Total gains	398.5184	443.3322	492.2714	543.6071	573.6489	560.4995	534.5018	500.1790	459.0408	410.3259	381.6022	379.2666	(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	15.8587	15.9064	15.9534	16.1780	16.2207	16.4226	16.4226	16.4606	16.3443	16.2207	16.1345	16.0454	
alpha	2.0572	2.0604	2.0636	2.0785	2.0814	2.0948	2.0948	2.0974	2.0896	2.0814	2.0756	2.0697	
util living area													
	0.9563	0.9438	0.9199	0.8742	0.8021	0.6950	0.5811	0.6200	0.7804	0.8970	0.9438	0.9603	(86)
MIT	17.7063	17.9706	18.4849	19.1961	19.8775	20.4437	20.7353	20.6854	20.2237	19.3440	18.4140	17.6658	(87)
Th 2	19.9479	19.9507	19.9535	19.9665	19.9689	19.9803	19.9803	19.9824	19.9759	19.9689	19.9640	19.9589	(88)
util rest of house													
	0.9510	0.9369	0.9095	0.8563	0.7697	0.6357	0.4873	0.5307	0.7328	0.8788	0.9358	0.9555	(89)
MIT 2	16.9210	17.1844	17.6947	18.4009	19.0596	19.5919	19.8370	19.8033	19.4008	18.5565	17.6357	16.8878	(90)
Living area fraction									fLA = Living area / (4) =			0.1671	(91)
MIT	17.0522	17.3157	17.8267	18.5338	19.1963	19.7343	19.9872	19.9507	19.5383	18.6881	17.7658	17.0178	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.0522	17.3157	17.8267	18.5338	19.1963	19.7343	19.9872	19.9507	19.5383	18.6881	17.7658	17.0178	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9304	0.9132	0.8814	0.8249	0.7406	0.6192	0.4880	0.5275	0.7081	0.8491	0.9122	0.9362	(94)
Useful gains	370.7861	404.8390	433.9125	448.4358	424.8296	347.0567	260.8274	263.8350	325.0479	348.4238	348.1108	355.0780	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1220.8321	1185.0568	1077.9265	904.0897	701.6410	474.6511	313.1333	327.4975	505.1682	757.0316	1003.6294	1212.8328	(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													
	632.4343	524.3064	479.1464	328.0707	205.9477	0.0000	0.0000	0.0000	0.0000	304.0042	471.9734	638.1695	(98)
Space heating												3584.0527	(98)
Space heating per m2											(98) / (4) =	43.6228	(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	869.0055	684.1107	700.9806	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.6257	0.6927	0.6663	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	543.7034	473.9154	467.0613	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	749.5073	717.2486	678.9978	0.0000	0.0000	0.0000	0.0000	(103)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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	148.1788	181.0399	157.6808	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												486.8995 (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	37.0447	45.2600	39.4202	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												121.7249 (107)
Space cooling per m2												1.4816 (108)
Energy for space heating												43.6228 (99)
Energy for space cooling												1.4816 (108)
Total												45.1044 (109)
Dwelling Fabric Energy Efficiency (DFEE)												45.1 (109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.0800 (1b)	x	2.3700 (2b)	=	97.3596	(1b) - (3b)
First floor	41.0800 (1c)	x	2.6200 (2c)	=	107.6296	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	82.1600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	204.9892	(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) =	0.1463	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3963	(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) =	0.3666	(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	0.4674	0.4583	0.4491	0.4033	0.3941	0.3483	0.3483	0.3391	0.3666	0.3941	0.4125	0.4308	(22b)
Effective ac	0.6093	0.6050	0.6009	0.5813	0.5777	0.5607	0.5607	0.5575	0.5672	0.5777	0.5851	0.5928	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.0900	1.0000	2.0900			(26)
TER Opening Type (Uw = 1.40)			9.8900	1.3258	13.1117			(27)
Flr - Ground			41.0820	0.1300	5.3407			(28a)
Wl - Brick (Timber Frame)	90.5550	11.9790	78.5760	0.1800	14.1437			(29a)
Rf - Ins Joist	41.0820		41.0820	0.1300	5.3407			(30)
Total net area of external elements Aum(A, m2)			172.7200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		40.0267			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	8.8841	(36)
Total fabric heat loss	(33) + (36) = 48.9108	(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	41.2137	40.9267	40.6454	39.3242	39.0770	37.9262	37.9262	37.7131	38.3695	39.0770	39.5771	40.0999	(38)
Heat transfer coeff	90.1246	89.8376	89.5563	88.2350	87.9878	86.8371	86.8371	86.6240	87.2803	87.9878	88.4879	89.0107	(39)
Average = Sum(39)m / 12 =												88.2339	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0969	1.0934	1.0900	1.0739	1.0709	1.0569	1.0569	1.0543	1.0623	1.0709	1.0770	1.0834	(40)
HLP (average)												1.0739	(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	2.5026	(42)
Average daily hot water use (litres/day)	93.6360	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.9996	99.2542	95.5087	91.7633	88.0178	84.2724	84.2724	88.0178	91.7633	95.5087	99.2542	102.9996	(44)
Energy conte	152.7454	133.5921	137.8551	120.1854	115.3208	99.5131	92.2135	105.8163	107.0801	124.7915	136.2197	147.9258	(45)
Energy content (annual)										Total = Sum(45)m =		1473.2589	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	32.4584	28.3883	29.2942	25.5394	24.5057	21.1465	19.5954	22.4860	22.7545	26.5182	28.9467	31.4342	(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	125.1284	125.1284	125.1284	125.1284	125.1284	125.1284	125.1284	125.1284	125.1284	125.1284	125.1284	125.1284	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	22.1406	19.6651	15.9927	12.1075	9.0505	7.6408	8.2562	10.7317	14.4041	18.2893	21.3463	22.7559	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	223.8956	226.2189	220.3642	207.9002	192.1666	177.3792	167.5003	165.1770	171.0317	183.4958	199.2294	214.0167	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.5128	35.5128	35.5128	35.5128	35.5128	35.5128	35.5128	35.5128	35.5128	35.5128	35.5128	35.5128	(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)													
	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	(71)
Water heating gains (Table 5)													
	43.6269	42.2445	39.3739	35.4714	32.9377	29.3702	26.3379	30.2231	31.6035	35.6427	40.2037	42.2503	(72)
Total internal gains													
	350.2016	348.6671	336.2694	316.0176	294.6933	274.9287	262.6329	266.6703	277.5778	297.9663	321.3179	339.5615	(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	
East	7.1650	19.6403	0.6300	0.7000	0.7700	43.0066	(76)
West	2.7240	19.6403	0.6300	0.7000	0.7700	16.3503	(80)

Solar gains	59.3569	116.1148	191.2245	278.8895	341.7896	349.8824	333.1024	286.1300	222.4020	137.7800	74.0111	48.8123	(83)
Total gains	409.5585	464.7818	527.4939	594.9071	636.4829	624.8112	595.7352	552.8003	499.9798	435.7462	395.3290	388.3738	(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	63.3074	63.5097	63.7092	64.6632	64.8448	65.7042	65.7042	65.8658	65.3705	64.8448	64.4784	64.0996	
alpha	5.2205	5.2340	5.2473	5.3109	5.3230	5.3803	5.3803	5.3911	5.3580	5.3230	5.2986	5.2733	
util living area													
	0.9992	0.9982	0.9947	0.9797	0.9267	0.7900	0.6190	0.6815	0.9097	0.9898	0.9983	0.9994	(86)
MIT	19.7351	19.8653	20.1056	20.4380	20.7350	20.9277	20.9845	20.9747	20.8288	20.4389	20.0323	19.7188	(87)
Th 2	20.0033	20.0062	20.0090	20.0222	20.0246	20.0362	20.0362	20.0383	20.0317	20.0246	20.0196	20.0144	(88)
util rest of house													
	0.9989	0.9976	0.9927	0.9712	0.8946	0.7064	0.4947	0.5579	0.8570	0.9843	0.9976	0.9992	(89)
MIT 2	18.8420	18.9743	19.2160	19.5543	19.8355	20.0005	20.0319	20.0305	19.9281	19.5603	19.1521	18.8346	(90)
Living area fraction									fLA = Living area / (4) =			0.1671	(91)
MIT	18.9912	19.1232	19.3647	19.7020	19.9858	20.1555	20.1911	20.1883	20.0786	19.7071	19.2992	18.9824	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9912	19.1232	19.3647	19.7020	19.9858	20.1555	20.1911	20.1883	20.0786	19.7071	19.2992	18.9824	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9985	0.9968	0.9909	0.9676	0.8930	0.7179	0.5157	0.5786	0.8602	0.9818	0.9969	0.9989	(94)
Useful gains	408.9397	463.2929	522.7145	575.6279	568.4081	448.5802	307.2002	319.8411	430.0605	427.8136	394.1040	387.9342	(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													
	1324.0425	1277.7761	1152.1112	953.1158	729.0522	482.4199	311.8408	328.1543	521.8135	801.3179	1079.4834	1315.7905	(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													
	680.8365	547.3327	468.2711	271.7913	119.5192	0.0000	0.0000	0.0000	0.0000	277.8871	493.4732	690.3251	(98)
Space heating												3549.4362	(98)
Space heating per m2											(98) / (4) =	43.2015	(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	816.2684	642.5942	658.3421	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8476	0.9157	0.8887	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	691.8588	588.4361	585.0396	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	824.7402	788.8886	740.5921	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	95.6746	149.1366	115.7311	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												360.5423	(104)
Cooled fraction									fC = cooled area / (4) =			1.0000	(105)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

```
Intermittency factor (Table 10b)
          0.0000    0.0000    0.0000    0.0000    0.0000    0.2500    0.2500    0.2500    0.0000    0.0000    0.0000    0.0000 (106)
Space cooling kWh
          0.0000    0.0000    0.0000    0.0000    0.0000   23.9186   37.2842   28.9328    0.0000    0.0000    0.0000    0.0000 (107)
Space cooling                                                                                                              90.1356 (107)
Space cooling per m2                                                                                                        1.0971 (108)
Energy for space heating                                                                                                   43.2015 (99)
Energy for space cooling                                                                                                    1.0971 (108)
Total                                                                                                                      44.2986 (109)
Target Fabric Energy Efficiency (TFEE)                                                                                        50.9 (109)


-------------------------------------------------------------------------------------------------------
```

CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.0800	(1b)	x 2.3700	(2b) =	97.3596	(1b) - (3b)
First floor	41.0800	(1c)	x 2.6200	(2c) =	107.6296	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	82.1600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		204.9892	(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) =	0.1463	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3963	(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) =	0.3666	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.9000	4.6000	4.5000	4.2000	4.2000	4.1000	4.1000	4.0000	4.0000	4.3000	4.3000	4.4000	(22)
Wind factor	1.2250	1.1500	1.1250	1.0500	1.0500	1.0250	1.0250	1.0000	1.0000	1.0750	1.0750	1.1000	(22a)
Adj infilt rate	0.4491	0.4216	0.4125	0.3850	0.3850	0.3758	0.3758	0.3666	0.3666	0.3941	0.3941	0.4033	(22b)
Effective ac	0.6009	0.5889	0.5851	0.5741	0.5741	0.5706	0.5706	0.5672	0.5672	0.5777	0.5777	0.5813	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.0900	1.2000	2.5080			(26)
Windows (Uw = 1.40)			9.8900	1.3258	13.1117			(27)
Flr - Ground			41.0820	0.1939	7.9671	75.6000	3105.7992	(28a)
Wl - Brick (Timber Frame)	90.5550	11.9790	78.5760	0.2500	19.6440	7.4000	581.4624	(29a)
Rf - Ins Joist	41.0820		41.0820	0.0800	3.2866	7.4000	304.0068	(30)
Total net area of external elements Aum(A, m2)			172.7200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		46.5174			(33)
Party Wall			46.2060	0.0000	0.0000	7.4000	341.9244	(32)
Stud			70.8677			7.4000	524.4213	(32c)
Internal Floor			41.0820			7.4000	304.0068	(32d)
Internal Ceiling			41.0820			7.4000	304.0068	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	5465.6277 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		66.5242 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		8.0038 (36)
Total fabric heat loss	(33) + (36) =	54.5212 (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	40.6454	39.8356	39.5771	38.8355	38.8355	38.5996	38.5996	38.3695	38.3695	39.0770	39.0770	39.3242	(38)
Heat transfer coeff	95.1666	94.3568	94.0983	93.3566	93.3566	93.1208	93.1208	92.8907	92.8907	93.5982	93.5982	93.8454	(39)
Average = Sum(39)m / 12 =												93.6166	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1583	1.1485	1.1453	1.1363	1.1363	1.1334	1.1334	1.1306	1.1306	1.1392	1.1392	1.1422	(40)
HLP (average)												1.1394	(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	2.5026 (42)
Average daily hot water use (litres/day)	93.6360 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.9996	99.2542	95.5087	91.7633	88.0178	84.2724	84.2724	88.0178	91.7633	95.5087	99.2542	102.9996	(44)
Energy conte	152.7454	133.5921	137.8551	120.1854	115.3208	99.5131	92.2135	105.8163	107.0801	124.7915	136.2197	147.9258	(45)
Energy content (annual)										Total = Sum(45)m =		1473.2589	(45)

Distribution loss (46)m = 0.15 x (45)m

CALCULATION OF HEAT DEMAND 09 Jan 2014

	22.9118	20.0388	20.6783	18.0278	17.2981	14.9270	13.8320	15.8724	16.0620	18.7187	20.4330	22.1889	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6751	13.2389	14.6119	14.0892	14.5214	14.0099	14.4500	14.4963	14.0531	14.5745	14.1639	14.6607	(61)
Total heat required for water heating calculated for each month													
	167.4206	146.8310	152.4670	134.2746	129.8422	113.5229	106.6635	120.3126	121.1332	139.3660	150.3836	162.5865	(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													
	167.4206	146.8310	152.4670	134.2746	129.8422	113.5229	106.6635	120.3126	121.1332	139.3660	150.3836	162.5865	(64)
								Total per year (kWh/year) = Sum(64)m =				1644.8038	(64)
RHI water heating demand												1645	(64)
Heat gains from water heating, kWh/month													
	54.4566	47.7291	49.4898	43.4839	41.9745	36.5906	34.2735	38.8080	39.1174	45.1368	48.8340	52.8505	(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	150.1541	150.1541	150.1541	150.1541	150.1541	150.1541	150.1541	150.1541	150.1541	150.1541	150.1541	150.1541	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	55.0069	48.8566	39.7329	30.0803	22.4854	18.9831	20.5119	26.6622	35.7859	45.4385	53.0334	56.5357	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	334.1725	337.6402	328.9018	310.2988	286.8158	264.7451	250.0005	246.5328	255.2712	273.8743	297.3573	319.4279	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.5180	52.5180	52.5180	52.5180	52.5180	52.5180	52.5180	52.5180	52.5180	52.5180	52.5180	52.5180	(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)													
	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	(71)
Water heating gains (Table 5)													
	73.1944	71.0254	66.5185	60.3944	56.4174	50.8202	46.0665	52.1613	54.3297	60.6677	67.8250	71.0356	(72)
Total internal gains													
	567.9432	563.0916	540.7225	506.3428	471.2879	440.1178	422.1483	430.9257	450.9563	485.5498	523.7851	552.5686	(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	
East	7.1650	25.1733	0.5000	0.7200	0.7700	44.9978	(76)
West	2.7240	25.1733	0.5000	0.7200	0.7700	17.1073	(80)

Solar gains	62.1051	103.3475	172.7227	253.0605	291.8284	329.6170	303.3863	271.8514	211.4207	133.8820	77.1843	50.2012	(83)
Total gains	630.0483	666.4391	713.4453	759.4033	763.1163	769.7347	725.5346	702.7771	662.3769	619.4318	600.9694	602.7697	(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	15.9534	16.0903	16.1345	16.2627	16.2627	16.3039	16.3039	16.3443	16.3443	16.2207	16.2207	16.1780	
alpha	2.0636	2.0727	2.0756	2.0842	2.0842	2.0869	2.0869	2.0896	2.0896	2.0814	2.0814	2.0785	
util living area													
	0.8909	0.8755	0.8372	0.7681	0.6642	0.5057	0.3798	0.3795	0.5855	0.7622	0.8555	0.8963	(86)
MIT	18.5726	18.7591	19.2151	19.8104	20.3681	20.7650	20.9130	20.9161	20.6620	20.0640	19.2826	18.5790	(87)
Th 2	19.9535	19.9615	19.9640	19.9713	19.9713	19.9736	19.9736	19.9759	19.9759	19.9689	19.9689	19.9665	(88)
util rest of house													
	0.8784	0.8613	0.8178	0.7385	0.6156	0.4285	0.2756	0.2721	0.5119	0.7237	0.8359	0.8843	(89)
MIT 2	16.7850	17.0519	17.6986	18.5327	19.2865	19.7759	19.9268	19.9324	19.6693	18.8958	17.8065	16.7996	(90)
Living area fraction									fLA = Living area / (4) =			0.1671	(91)
MIT	17.0837	17.3372	17.9520	18.7463	19.4673	19.9412	20.0916	20.0968	19.8352	19.0910	18.0532	17.0970	(92)
Temperature adjustment												-0.1500	
adjusted MIT	16.9337	17.1872	17.8020	18.5963	19.3173	19.7912	19.9416	19.9468	19.6852	18.9410	17.9032	16.9470	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8280	0.8099	0.7655	0.6903	0.5800	0.4134	0.2721	0.2688	0.4883	0.6766	0.7838	0.8350	(94)
Useful gains	521.7112	539.7430	546.1181	524.2530	442.6088	318.2381	197.4538	188.9300	323.4306	419.1348	471.0146	503.3323	(95)
Ext temp.	5.7000	6.1000	7.7000	10.1000	13.1000	15.9000	17.7000	17.8000	15.5000	12.3000	8.8000	5.8000	(96)
Heat loss rate W													
	1069.0762	1046.1536	950.5828	793.1816	580.4247	362.3528	208.7389	199.4167	388.7636	621.5896	852.0419	1046.0920	(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													
	407.2395	340.3079	300.9218	193.6286	102.5351	0.0000	0.0000	0.0000	0.0000	150.6264	274.3396	403.8132	(98)
Space heating												2173.4121	(98)
RHI space heating demand												2173	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.0800	(1b)	x 2.3700	(2b) =	97.3596	(1b) - (3b)
First floor	41.0800	(1c)	x 2.6200	(2c) =	107.6296	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	82.1600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		204.9892	(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) =	0.1463	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3963	(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) =	0.3666	(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	0.4674	0.4583	0.4491	0.4033	0.3941	0.3483	0.3483	0.3391	0.3666	0.3941	0.4125	0.4308	(22b)
Effective ac	0.6093	0.6050	0.6009	0.5813	0.5777	0.5607	0.5607	0.5575	0.5672	0.5777	0.5851	0.5928	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.0900	1.2000	2.5080			(26)
Windows (Uw = 1.40)			9.8900	1.3258	13.1117			(27)
Flr - Ground			41.0820	0.1939	7.9671	75.6000	3105.7992	(28a)
Wl - Brick (Timber Frame)	90.5550	11.9790	78.5760	0.2500	19.6440	7.4000	581.4624	(29a)
Rf - Ins Joist	41.0820		41.0820	0.0800	3.2866	7.4000	304.0068	(30)
Total net area of external elements Aum(A, m2)			172.7200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		46.5174			(33)
Party Wall			46.2060	0.0000	0.0000	7.4000	341.9244	(32)
Stud			70.8677			7.4000	524.4213	(32c)
Internal Floor			41.0820			7.4000	304.0068	(32d)
Internal Ceiling			41.0820			7.4000	304.0068	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	5465.6277 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		66.5242 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		8.0038 (36)
Total fabric heat loss	(33) + (36) =	54.5212 (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	41.2137	40.9267	40.6454	39.3242	39.0770	37.9262	37.9262	37.7131	38.3695	39.0770	39.5771	40.0999	(38)
Heat transfer coeff	95.7349	95.4479	95.1666	93.8454	93.5982	92.4474	92.4474	92.2343	92.8907	93.5982	94.0983	94.6211	(39)
Average = Sum(39)m / 12 =												93.8442	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1652	1.1617	1.1583	1.1422	1.1392	1.1252	1.1252	1.1226	1.1306	1.1392	1.1453	1.1517	(40)
HLP (average)												1.1422	(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	2.5026 (42)
Average daily hot water use (litres/day)	93.6360 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.9996	99.2542	95.5087	91.7633	88.0178	84.2724	84.2724	88.0178	91.7633	95.5087	99.2542	102.9996	(44)
Energy conte	152.7454	133.5921	137.8551	120.1854	115.3208	99.5131	92.2135	105.8163	107.0801	124.7915	136.2197	147.9258	(45)
Energy content (annual)										Total = Sum(45)m =		1473.2589	(45)

Distribution loss (46)m = 0.15 x (45)m

CALCULATION OF ENERGY RATINGS 09 Jan 2014

	22.9118	20.0388	20.6783	18.0278	17.2981	14.9270	13.8320	15.8724	16.0620	18.7187	20.4330	22.1889	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6751	13.2389	14.6119	14.0892	14.5214	14.0099	14.4500	14.4963	14.0531	14.5745	14.1639	14.6607	(61)
Total heat required for water heating calculated for each month													
	167.4206	146.8310	152.4670	134.2746	129.8422	113.5229	106.6635	120.3126	121.1332	139.3660	150.3836	162.5865	(62)
WWHRS	-55.0980	-48.4777	-49.4786	-40.7198	-37.8145	-31.1988	-26.4114	-31.9758	-32.9055	-40.6704	-47.1011	-53.2525	eq.(G10)
Total of WWHRS savings												-495.1042	
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													
	112.3225	98.3533	102.9884	93.5548	92.0277	82.3241	80.2521	88.3368	88.2276	98.6956	103.2825	109.3340	(64)
								Total per year (kWh/year) = Sum(64)m =				1149.6996	(64)
Heat gains from water heating, kWh/month													
	54.4566	47.7291	49.4898	43.4839	41.9745	36.5906	34.2735	38.8080	39.1174	45.1368	48.8340	52.8505	(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	150.1541	150.1541	150.1541	150.1541	150.1541	150.1541	150.1541	150.1541	150.1541	150.1541	150.1541	150.1541	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	55.0069	48.8566	39.7329	30.0803	22.4854	18.9831	20.5119	26.6622	35.7859	45.4385	53.0334	56.5357	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	334.1725	337.6402	328.9018	310.2988	286.8158	264.7451	250.0005	246.5328	255.2712	273.8743	297.3573	319.4279	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.5180	52.5180	52.5180	52.5180	52.5180	52.5180	52.5180	52.5180	52.5180	52.5180	52.5180	52.5180	(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)													
	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	(71)
Water heating gains (Table 5)													
	73.1944	71.0254	66.5185	60.3944	56.4174	50.8202	46.0665	52.1613	54.3297	60.6677	67.8250	71.0356	(72)
Total internal gains													
	567.9432	563.0916	540.7225	506.3428	471.2879	440.1178	422.1483	430.9257	450.9563	485.5498	523.7851	552.5686	(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	
East	7.1650	19.6403	0.5000	0.7200	0.7700	35.1074	(76)
West	2.7240	19.6403	0.5000	0.7200	0.7700	13.3472	(80)

Solar gains	48.4546	94.7876	156.1016	227.6649	279.0119	285.6183	271.9203	233.5755	181.5526	112.4734	60.4172	39.8467	(83)
Total gains	616.3978	657.8792	696.8242	734.0077	750.2998	725.7361	694.0686	664.5012	632.5089	598.0233	584.2023	592.4153	(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	15.8587	15.9064	15.9534	16.1780	16.2207	16.4226	16.4226	16.4606	16.3443	16.2207	16.1345	16.0454	
alpha	2.0572	2.0604	2.0636	2.0785	2.0814	2.0948	2.0948	2.0974	2.0896	2.0814	2.0756	2.0697	
util living area													
	0.9086	0.8924	0.8621	0.8068	0.7241	0.6057	0.4881	0.5185	0.6808	0.8200	0.8866	0.9145	(86)
MIT	18.1903	18.4275	18.8861	19.5156	20.1050	20.5814	20.8129	20.7803	20.4225	19.6786	18.8446	18.1490	(87)
Th 2	19.9479	19.9507	19.9535	19.9665	19.9689	19.9803	19.9803	19.9824	19.9759	19.9689	19.9640	19.9589	(88)
util rest of house													
	0.8986	0.8806	0.8463	0.7829	0.6859	0.5436	0.3994	0.4320	0.6253	0.7930	0.8724	0.9052	(89)
MIT 2	16.2350	16.5741	17.2286	18.1219	18.9363	19.5679	19.8389	19.8084	19.3750	18.3654	17.1814	16.1794	(90)
Living area fraction									fLA = Living area / (4) =			0.1671	(91)
MIT	16.5618	16.8838	17.5056	18.3548	19.1316	19.7372	20.0017	19.9708	19.5500	18.5849	17.4594	16.5085	(92)
Temperature adjustment												-0.1500	
adjusted MIT	16.4118	16.7338	17.3556	18.2048	18.9816	19.5872	19.8517	19.8208	19.4000	18.4349	17.3094	16.3585	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8507	0.8305	0.7939	0.7317	0.6425	0.5166	0.3871	0.4167	0.5887	0.7414	0.8218	0.8588	(94)
Useful gains	524.3709	546.3560	553.2006	537.0549	482.0680	374.8854	268.6837	276.9299	372.3746	443.3496	480.1250	508.7559	(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													
	1159.5207	1129.5145	1033.0929	873.2119	681.5434	461.0568	300.6068	315.5161	492.3249	733.3277	960.6851	1150.4523	(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													
	472.5515	391.8825	357.0398	242.0331	148.4097	0.0000	0.0000	0.0000	0.0000	215.7437	346.0032	477.4221	(98)
Space heating												2651.0856	(98)
Space heating per m2											(98) / (4) =	32.2674	(99)

8c. Space cooling requirement

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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 %)	90.5000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	2929.3764 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	472.5515	391.8825	357.0398	242.0331	148.4097	0.0000	0.0000	0.0000	0.0000	215.7437	346.0032	477.4221	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	522.1563	433.0194	394.5192	267.4399	163.9886	0.0000	0.0000	0.0000	0.0000	238.3908	382.3240	527.5382	(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	112.3225	98.3533	102.9884	93.5548	92.0277	82.3241	80.2521	88.3368	88.2276	98.6956	103.2825	109.3340	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8674	89.8393	89.7634	89.5846	89.2479	87.3000	87.3000	87.3000	87.3000	89.4706	89.7438	89.8861	(217)
Fuel for water heating, kWh/month	124.9870	109.4769	114.7332	104.4318	103.1147	94.3003	91.9268	101.1877	101.0626	110.3106	115.0860	121.6362	(219)
Water heating fuel used												1292.2538	(219)
Annual totals kWh/year													
Space heating fuel - main system												2929.3764	(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)												388.5754	(232)
Total delivered energy for all uses												4685.2056	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2929.3764	3.4800	101.9423	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1292.2538	3.4800	44.9704	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	388.5754	13.1900	51.2531	(250)
Additional standing charges			120.0000	(251)
Total energy cost			328.0583	(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] =	1.0836 (257)
SAP value		84.8844
SAP rating (Section 12)		85 (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	2929.3764	0.2160	632.7453	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1292.2538	0.2160	279.1268	(264)
Space and water heating			911.8721	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	388.5754	0.5190	201.6706	(268)
Total kg/year			1152.4678	(272)
CO2 emissions per m2			14.0300	(273)
EI value			87.8554	
EI rating			88	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8888 = 3.915, stars = 5
Water heating environmental impact	0.216 / 0.8888 = 0.2430, stars = 5

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.0800	(1b)	x 2.3700	(2b) =	97.3596	(1b) - (3b)
First floor	41.0800	(1c)	x 2.6200	(2c) =	107.6296	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	82.1600					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	204.9892	(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) =	0.1463	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3963	(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) =	0.3666	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.9000	4.6000	4.5000	4.2000	4.2000	4.1000	4.1000	4.0000	4.0000	4.3000	4.3000	4.4000	(22)
Wind factor	1.2250	1.1500	1.1250	1.0500	1.0500	1.0250	1.0250	1.0000	1.0000	1.0750	1.0750	1.1000	(22a)
Adj infilt rate	0.4491	0.4216	0.4125	0.3850	0.3850	0.3758	0.3758	0.3666	0.3666	0.3941	0.3941	0.4033	(22b)
Effective ac	0.6009	0.5889	0.5851	0.5741	0.5741	0.5706	0.5706	0.5672	0.5672	0.5777	0.5777	0.5813	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.0900	1.2000	2.5080			(26)
Windows (Uw = 1.40)			9.8900	1.3258	13.1117			(27)
Flr - Ground			41.0820	0.1939	7.9671	75.6000	3105.7992	(28a)
Wl - Brick (Timber Frame)	90.5550	11.9790	78.5760	0.2500	19.6440	7.4000	581.4624	(29a)
Rf - Ins Joist	41.0820		41.0820	0.0800	3.2866	7.4000	304.0068	(30)
Total net area of external elements Aum(A, m2)			172.7200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		46.5174			(33)
Party Wall			46.2060	0.0000	0.0000	7.4000	341.9244	(32)
Stud			70.8677			7.4000	524.4213	(32c)
Internal Floor			41.0820			7.4000	304.0068	(32d)
Internal Ceiling			41.0820			7.4000	304.0068	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	5465.6277 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		66.5242 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		8.0038 (36)
Total fabric heat loss	(33) + (36) =	54.5212 (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	40.6454	39.8356	39.5771	38.8355	38.8355	38.5996	38.5996	38.3695	38.3695	39.0770	39.0770	39.3242	(38)
Heat transfer coeff	95.1666	94.3568	94.0983	93.3566	93.3566	93.1208	93.1208	92.8907	92.8907	93.5982	93.5982	93.8454	(39)
Average = Sum(39)m / 12 =												93.6166	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1583	1.1485	1.1453	1.1363	1.1363	1.1334	1.1334	1.1306	1.1306	1.1392	1.1392	1.1422	(40)
HLP (average)												1.1394	(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	2.5026 (42)
Average daily hot water use (litres/day)	93.6360 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.9996	99.2542	95.5087	91.7633	88.0178	84.2724	84.2724	88.0178	91.7633	95.5087	99.2542	102.9996	(44)
Energy conte	152.7454	133.5921	137.8551	120.1854	115.3208	99.5131	92.2135	105.8163	107.0801	124.7915	136.2197	147.9258	(45)
Energy content (annual)										Total = Sum(45)m =		1473.2589	(45)

Distribution loss (46)m = 0.15 x (45)m

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

	22.9118	20.0388	20.6783	18.0278	17.2981	14.9270	13.8320	15.8724	16.0620	18.7187	20.4330	22.1889	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6751	13.2389	14.6119	14.0892	14.5214	14.0099	14.4500	14.4963	14.0531	14.5745	14.1639	14.6607	(61)
Total heat required for water heating calculated for each month													
	167.4206	146.8310	152.4670	134.2746	129.8422	113.5229	106.6635	120.3126	121.1332	139.3660	150.3836	162.5865	(62)
WWHRS	-55.0980	-48.4777	-49.4786	-40.7198	-37.8145	-31.1988	-26.4114	-31.9758	-32.9055	-40.6704	-47.1011	-53.2525	eq.(G10)
Total of WWHRS savings												-495.1042	
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													
	112.3225	98.3533	102.9884	93.5548	92.0277	82.3241	80.2521	88.3368	88.2276	98.6956	103.2825	109.3340	(64)
								Total per year (kWh/year) = Sum(64)m =				1149.6996	(64)
Heat gains from water heating, kWh/month													
	54.4566	47.7291	49.4898	43.4839	41.9745	36.5906	34.2735	38.8080	39.1174	45.1368	48.8340	52.8505	(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	150.1541	150.1541	150.1541	150.1541	150.1541	150.1541	150.1541	150.1541	150.1541	150.1541	150.1541	150.1541	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	55.0069	48.8566	39.7329	30.0803	22.4854	18.9831	20.5119	26.6622	35.7859	45.4385	53.0334	56.5357	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	334.1725	337.6402	328.9018	310.2988	286.8158	264.7451	250.0005	246.5328	255.2712	273.8743	297.3573	319.4279	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.5180	52.5180	52.5180	52.5180	52.5180	52.5180	52.5180	52.5180	52.5180	52.5180	52.5180	52.5180	(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)													
	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	(71)
Water heating gains (Table 5)													
	73.1944	71.0254	66.5185	60.3944	56.4174	50.8202	46.0665	52.1613	54.3297	60.6677	67.8250	71.0356	(72)
Total internal gains													
	567.9432	563.0916	540.7225	506.3428	471.2879	440.1178	422.1483	430.9257	450.9563	485.5498	523.7851	552.5686	(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	
East	7.1650	25.1733	0.5000	0.7200	0.7700	44.9978	(76)
West	2.7240	25.1733	0.5000	0.7200	0.7700	17.1073	(80)

Solar gains	62.1051	103.3475	172.7227	253.0605	291.8284	329.6170	303.3863	271.8514	211.4207	133.8820	77.1843	50.2012	(83)
Total gains	630.0483	666.4391	713.4453	759.4033	763.1163	769.7347	725.5346	702.7771	662.3769	619.4318	600.9694	602.7697	(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	15.9534	16.0903	16.1345	16.2627	16.2627	16.3039	16.3039	16.3443	16.3443	16.2207	16.2207	16.1780	
alpha	2.0636	2.0727	2.0756	2.0842	2.0842	2.0869	2.0869	2.0896	2.0896	2.0814	2.0814	2.0785	
util living area													
	0.8909	0.8755	0.8372	0.7681	0.6642	0.5057	0.3798	0.3795	0.5855	0.7622	0.8555	0.8963	(86)
MIT	18.5726	18.7591	19.2151	19.8104	20.3681	20.7650	20.9130	20.9161	20.6620	20.0640	19.2826	18.5790	(87)
Th 2	19.9535	19.9615	19.9640	19.9713	19.9713	19.9736	19.9736	19.9759	19.9759	19.9689	19.9689	19.9665	(88)
util rest of house													
	0.8784	0.8613	0.8178	0.7385	0.6156	0.4285	0.2756	0.2721	0.5119	0.7237	0.8359	0.8843	(89)
MIT 2	16.7850	17.0519	17.6986	18.5327	19.2865	19.7759	19.9268	19.9324	19.6693	18.8958	17.8065	16.7996	(90)
Living area fraction									fLA = Living area / (4) =			0.1671	(91)
MIT	17.0837	17.3372	17.9520	18.7463	19.4673	19.9412	20.0916	20.0968	19.8352	19.0910	18.0532	17.0970	(92)
Temperature adjustment												-0.1500	
adjusted MIT	16.9337	17.1872	17.8020	18.5963	19.3173	19.7912	19.9416	19.9468	19.6852	18.9410	17.9032	16.9470	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8280	0.8099	0.7655	0.6903	0.5800	0.4134	0.2721	0.2688	0.4883	0.6766	0.7838	0.8350	(94)
Useful gains	521.7112	539.7430	546.1181	524.2530	442.6088	318.2381	197.4538	188.9300	323.4306	419.1348	471.0146	503.3323	(95)
Ext temp.	5.7000	6.1000	7.7000	10.1000	13.1000	15.9000	17.7000	17.8000	15.5000	12.3000	8.8000	5.8000	(96)
Heat loss rate W													
	1069.0762	1046.1536	950.5828	793.1816	580.4247	362.3528	208.7389	199.4167	388.7636	621.5896	852.0419	1046.0920	(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													
	407.2395	340.3079	300.9218	193.6286	102.5351	0.0000	0.0000	0.0000	0.0000	150.6264	274.3396	403.8132	(98)
Space heating												2173.4121	(98)
Space heating per m2											(98) / (4) =	26.4534	(99)

8c. Space cooling requirement

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

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 %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2401.5604	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	407.2395	340.3079	300.9218	193.6286	102.5351	0.0000	0.0000	0.0000	0.0000	150.6264	274.3396	403.8132	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	449.9884	376.0308	332.5102	213.9543	113.2984	0.0000	0.0000	0.0000	0.0000	166.4380	303.1377	446.2025	(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													
	112.3225	98.3533	102.9884	93.5548	92.0277	82.3241	80.2521	88.3368	88.2276	98.6956	103.2825	109.3340	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7885	89.7623	89.6620	89.4321	88.9577	87.3000	87.3000	87.3000	87.3000	89.2056	89.6017	89.7987	(217)
Fuel for water heating, kWh/month													
	125.0968	109.5708	114.8629	104.6099	103.4511	94.3003	91.9268	101.1877	101.0626	110.6383	115.2685	121.7546	(219)
Water heating fuel used												1293.7304	(219)
Annual totals kWh/year													
Space heating fuel - main system												2401.5604	(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)												388.5754	(232)
Total delivered energy for all uses												4158.8662	(238)

10a. Fuel costs - using BEDF prices (495)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2401.5604	3.6300	87.1766	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1293.7304	3.6300	46.9624	(247)
Pumps and fans for heating	75.0000	19.4400	14.5800	(249)
Energy for lighting	388.5754	19.4400	75.5391	(250)
Additional standing charges			95.0000	(251)
Total energy cost			319.2581	(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	2401.5604	0.2160	518.7370	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1293.7304	0.2160	279.4458	(264)
Space and water heating			798.1828	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	388.5754	0.5190	201.6706	(268)
Total kg/year			1038.7784	(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	2401.5604	1.2200	2929.9036	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1293.7304	1.2200	1578.3511	(264)
Space and water heating			4508.2547	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	388.5754	3.0700	1192.9265	(268)
Primary energy kWh/year			5931.4312	(272)
Primary energy kWh/m2/year			72.1937	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating:	B 85
Current environmental impact rating:	B 88

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

(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	SAP increase too small
O		Not considered
P		Not considered
R		Not considered
S		Not considered
T		Not considered
U	Solar photovoltaic panels	Recommended
A2		Not considered
A3		Not considered
T2		Not considered
W		Not considered
X		Not considered
Y		Not considered
J2		Not considered
Q2		Not considered
Z1		Not considered
Z2		Not considered
Z3		Not considered
Z4		Not considered
Z5		Not considered
V2	Wind turbine	Not applicable
L2		Not considered
Q3		Not considered
O3		Not considered

Recommended measures:	SAP change	Cost change	CO2 change
U Solar photovoltaic panels	+ 10.5	-£ 378	-1010 kg (97.2%)

Measures omitted - SAP change or cost saving too small:

N Solar water heating	+ 0.8	-£ 17	-131 kg (12.6%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar photovoltaic panels	£378	12.30 kg/m²	A 95	A 97
Total Savings	£378	12.30 kg/m²		

Potential energy efficiency rating: A 95
Potential environmental impact rating: A 97

Fuel prices for cost data on this page from database revision number 495 TEST (29 Apr 2022)
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	£90	£90	£0
Mains gas	£229	£229	£0
Space heating	£197	£197	£0
Water heating	£47	£47	£0
Lighting	£76	£76	£0
Generated (PV)	-£0	-£378	£378
Total cost of fuels	£319	-£59	£378
Total cost of uses	£320	-£58	£378
Delivered energy	51 kWh/m²	27 kWh/m²	24 kWh/m²
Carbon dioxide emissions	1.0 tonnes	0.0 tonnes	1.0 tonnes
CO2 emissions per m²	13 kg/m²	0 kg/m²	12 kg/m²
Primary energy	72 kWh/m²	-1 kWh/m²	73 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.0800	(1b)	x 2.3700	(2b) =	97.3596	(1b) - (3b)
First floor	41.0800	(1c)	x 2.6200	(2c) =	107.6296	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	82.1600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		204.9892	(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) =	0.1463	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3963	(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) =	0.3666	(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	0.4674	0.4583	0.4491	0.4033	0.3941	0.3483	0.3483	0.3391	0.3666	0.3941	0.4125	0.4308	(22b)
Effective ac	0.6093	0.6050	0.6009	0.5813	0.5777	0.5607	0.5607	0.5575	0.5672	0.5777	0.5851	0.5928	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.0900	1.2000	2.5080			(26)
Windows (Uw = 1.40)			9.8900	1.3258	13.1117			(27)
Flr - Ground			41.0820	0.1939	7.9671	75.6000	3105.7992	(28a)
Wl - Brick (Timber Frame)	90.5550	11.9790	78.5760	0.2500	19.6440	7.4000	581.4624	(29a)
Rf - Ins Joist	41.0820		41.0820	0.0800	3.2866	7.4000	304.0068	(30)
Total net area of external elements Aum(A, m2)			172.7200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		46.5174			(33)
Party Wall			46.2060	0.0000	0.0000	7.4000	341.9244	(32)
Stud			70.8677			7.4000	524.4213	(32c)
Internal Floor			41.0820			7.4000	304.0068	(32d)
Internal Ceiling			41.0820			7.4000	304.0068	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	5465.6277 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		66.5242 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		8.0038 (36)
Total fabric heat loss	(33) + (36) =	54.5212 (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	41.2137	40.9267	40.6454	39.3242	39.0770	37.9262	37.9262	37.7131	38.3695	39.0770	39.5771	40.0999	(38)
Heat transfer coeff	95.7349	95.4479	95.1666	93.8454	93.5982	92.4474	92.4474	92.2343	92.8907	93.5982	94.0983	94.6211	(39)
Average = Sum(39)m / 12 =												93.8442	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1652	1.1617	1.1583	1.1422	1.1392	1.1252	1.1252	1.1226	1.1306	1.1392	1.1453	1.1517	(40)
HLP (average)												1.1422	(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	2.5026 (42)
Average daily hot water use (litres/day)	93.6360 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.9996	99.2542	95.5087	91.7633	88.0178	84.2724	84.2724	88.0178	91.7633	95.5087	99.2542	102.9996	(44)
Energy conte	152.7454	133.5921	137.8551	120.1854	115.3208	99.5131	92.2135	105.8163	107.0801	124.7915	136.2197	147.9258	(45)
Energy content (annual)										Total = Sum(45)m =		1473.2589	(45)

Distribution loss (46)m = 0.15 x (45)m

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	22.9118	20.0388	20.6783	18.0278	17.2981	14.9270	13.8320	15.8724	16.0620	18.7187	20.4330	22.1889	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6751	13.2389	14.6119	14.0892	14.5214	14.0099	14.4500	14.4963	14.0531	14.5745	14.1639	14.6607	(61)
Total heat required for water heating calculated for each month													
	167.4206	146.8310	152.4670	134.2746	129.8422	113.5229	106.6635	120.3126	121.1332	139.3660	150.3836	162.5865	(62)
WWHRS	-55.0980	-48.4777	-49.4786	-40.7198	-37.8145	-31.1988	-26.4114	-31.9758	-32.9055	-40.6704	-47.1011	-53.2525	eq.(G10)
Total of WWHRS savings												-495.1042	
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													
	112.3225	98.3533	102.9884	93.5548	92.0277	82.3241	80.2521	88.3368	88.2276	98.6956	103.2825	109.3340	(64)
								Total per year (kWh/year) = Sum(64)m =				1149.6996	(64)
Heat gains from water heating, kWh/month													
	54.4566	47.7291	49.4898	43.4839	41.9745	36.5906	34.2735	38.8080	39.1174	45.1368	48.8340	52.8505	(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	150.1541	150.1541	150.1541	150.1541	150.1541	150.1541	150.1541	150.1541	150.1541	150.1541	150.1541	150.1541	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	55.0069	48.8566	39.7329	30.0803	22.4854	18.9831	20.5119	26.6622	35.7859	45.4385	53.0334	56.5357	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	334.1725	337.6402	328.9018	310.2988	286.8158	264.7451	250.0005	246.5328	255.2712	273.8743	297.3573	319.4279	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.5180	52.5180	52.5180	52.5180	52.5180	52.5180	52.5180	52.5180	52.5180	52.5180	52.5180	52.5180	(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)													
	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	(71)
Water heating gains (Table 5)													
	73.1944	71.0254	66.5185	60.3944	56.4174	50.8202	46.0665	52.1613	54.3297	60.6677	67.8250	71.0356	(72)
Total internal gains													
	567.9432	563.0916	540.7225	506.3428	471.2879	440.1178	422.1483	430.9257	450.9563	485.5498	523.7851	552.5686	(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	
East	7.1650	19.6403	0.5000	0.7200	0.7700	35.1074	(76)
West	2.7240	19.6403	0.5000	0.7200	0.7700	13.3472	(80)

Solar gains	48.4546	94.7876	156.1016	227.6649	279.0119	285.6183	271.9203	233.5755	181.5526	112.4734	60.4172	39.8467	(83)
Total gains	616.3978	657.8792	696.8242	734.0077	750.2998	725.7361	694.0686	664.5012	632.5089	598.0233	584.2023	592.4153	(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	15.8587	15.9064	15.9534	16.1780	16.2207	16.4226	16.4226	16.4606	16.3443	16.2207	16.1345	16.0454	
alpha	2.0572	2.0604	2.0636	2.0785	2.0814	2.0948	2.0948	2.0974	2.0896	2.0814	2.0756	2.0697	
util living area													
	0.9086	0.8924	0.8621	0.8068	0.7241	0.6057	0.4881	0.5185	0.6808	0.8200	0.8866	0.9145	(86)
MIT	18.1903	18.4275	18.8861	19.5156	20.1050	20.5814	20.8129	20.7803	20.4225	19.6786	18.8446	18.1490	(87)
Th 2	19.9479	19.9507	19.9535	19.9665	19.9689	19.9803	19.9803	19.9824	19.9759	19.9689	19.9640	19.9589	(88)
util rest of house													
	0.8986	0.8806	0.8463	0.7829	0.6859	0.5436	0.3994	0.4320	0.6253	0.7930	0.8724	0.9052	(89)
MIT 2	16.2350	16.5741	17.2286	18.1219	18.9363	19.5679	19.8389	19.8084	19.3750	18.3654	17.1814	16.1794	(90)
Living area fraction									fLA = Living area / (4) =			0.1671	(91)
MIT	16.5618	16.8838	17.5056	18.3548	19.1316	19.7372	20.0017	19.9708	19.5500	18.5849	17.4594	16.5085	(92)
Temperature adjustment												-0.1500	
adjusted MIT	16.4118	16.7338	17.3556	18.2048	18.9816	19.5872	19.8517	19.8208	19.4000	18.4349	17.3094	16.3585	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8507	0.8305	0.7939	0.7317	0.6425	0.5166	0.3871	0.4167	0.5887	0.7414	0.8218	0.8588	(94)
Useful gains	524.3709	546.3560	553.2006	537.0549	482.0680	374.8854	268.6837	276.9299	372.3746	443.3496	480.1250	508.7559	(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													
	1159.5207	1129.5145	1033.0929	873.2119	681.5434	461.0568	300.6068	315.5161	492.3249	733.3277	960.6851	1150.4523	(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													
	472.5515	391.8825	357.0398	242.0331	148.4097	0.0000	0.0000	0.0000	0.0000	215.7437	346.0032	477.4221	(98)
Space heating												2651.0856	(98)
Space heating per m2											(98) / (4) =	32.2674	(99)

8c. Space cooling requirement

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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 %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2929.3764	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	472.5515	391.8825	357.0398	242.0331	148.4097	0.0000	0.0000	0.0000	0.0000	215.7437	346.0032	477.4221	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	522.1563	433.0194	394.5192	267.4399	163.9886	0.0000	0.0000	0.0000	0.0000	238.3908	382.3240	527.5382	(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													
	112.3225	98.3533	102.9884	93.5548	92.0277	82.3241	80.2521	88.3368	88.2276	98.6956	103.2825	109.3340	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8674	89.8393	89.7634	89.5846	89.2479	87.3000	87.3000	87.3000	87.3000	89.4706	89.7438	89.8861	(217)
Fuel for water heating, kWh/month													
	124.9870	109.4769	114.7332	104.4318	103.1147	94.3003	91.9268	101.1877	101.0626	110.3106	115.0860	121.6362	(219)
Water heating fuel used												1292.2538	(219)
Annual totals kWh/year													
Space heating fuel - main system												2929.3764	(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)												388.5754	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												2957.9662	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2929.3764	3.4800	101.9423	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1292.2538	3.4800	44.9704	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	388.5754	13.1900	51.2531	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			100.2355	(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] =	0.3311	(257)
SAP value	95.3816	
SAP rating (Section 12)	95	(258)
SAP band	A	

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2929.3764	0.2160	632.7453	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1292.2538	0.2160	279.1268	(264)
Space and water heating			911.8721	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	388.5754	0.5190	201.6706	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			256.0305	(272)
CO2 emissions per m2			3.1200	(273)
EI value			97.3020	
EI rating			97	(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 Designed) (Version 9.92, January 2014)
CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY FOR IMPROVED DWELLING 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	41.0800 (1b)	x	2.3700 (2b)	=	97.3596	(1b) - (3b)
First floor	41.0800 (1c)	x	2.6200 (2c)	=	107.6296	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	82.1600					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	204.9892	(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) =	0.1463	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3963	(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)		0.3666	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.9000	4.6000	4.5000	4.2000	4.2000	4.1000	4.1000	4.0000	4.0000	4.3000	4.3000	4.4000	(22)
Wind factor	1.2250	1.1500	1.1250	1.0500	1.0500	1.0250	1.0250	1.0000	1.0000	1.0750	1.0750	1.1000	(22a)
Adj infilt rate	0.4491	0.4216	0.4125	0.3850	0.3850	0.3758	0.3758	0.3666	0.3666	0.3941	0.3941	0.4033	(22b)
Effective ac	0.6009	0.5889	0.5851	0.5741	0.5741	0.5706	0.5706	0.5672	0.5672	0.5777	0.5777	0.5813	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Solid Door			2.0900	1.2000	2.5080			(26)
Windows (Uw = 1.40)			9.8900	1.3258	13.1117			(27)
Flr - Ground			41.0820	0.1939	7.9671	75.6000	3105.7992	(28a)
Wl - Brick (Timber Frame)	90.5550	11.9790	78.5760	0.2500	19.6440	7.4000	581.4624	(29a)
Rf - Ins Joist	41.0820		41.0820	0.0800	3.2866	7.4000	304.0068	(30)
Total net area of external elements Aum(A, m2)			172.7200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		46.5174			(33)
Party Wall			46.2060	0.0000	0.0000	7.4000	341.9244	(32)
Stud			70.8677			7.4000	524.4213	(32c)
Internal Floor			41.0820			7.4000	304.0068	(32d)
Internal Ceiling			41.0820			7.4000	304.0068	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	5465.6277 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		66.5242 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		8.0038 (36)
Total fabric heat loss	(33) + (36) =	54.5212 (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	40.6454	39.8356	39.5771	38.8355	38.8355	38.5996	38.5996	38.3695	38.3695	39.0770	39.0770	39.3242	(38)
Heat transfer coeff	95.1666	94.3568	94.0983	93.3566	93.3566	93.1208	93.1208	92.8907	92.8907	93.5982	93.5982	93.8454	(39)
Average = Sum(39)m / 12 =												93.6166	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1583	1.1485	1.1453	1.1363	1.1363	1.1334	1.1334	1.1306	1.1306	1.1392	1.1392	1.1422	(40)
HLP (average)												1.1394	(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	2.5026 (42)
Average daily hot water use (litres/day)	93.6360 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	102.9996	99.2542	95.5087	91.7633	88.0178	84.2724	84.2724	88.0178	91.7633	95.5087	99.2542	102.9996	(44)
Energy conte	152.7454	133.5921	137.8551	120.1854	115.3208	99.5131	92.2135	105.8163	107.0801	124.7915	136.2197	147.9258	(45)
Energy content (annual)										Total = Sum(45)m =		1473.2589	(45)

Distribution loss (46)m = 0.15 x (45)m

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

	22.9118	20.0388	20.6783	18.0278	17.2981	14.9270	13.8320	15.8724	16.0620	18.7187	20.4330	22.1889	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.6751	13.2389	14.6119	14.0892	14.5214	14.0099	14.4500	14.4963	14.0531	14.5745	14.1639	14.6607	(61)
Total heat required for water heating calculated for each month													
	167.4206	146.8310	152.4670	134.2746	129.8422	113.5229	106.6635	120.3126	121.1332	139.3660	150.3836	162.5865	(62)
WWHRS	-55.0980	-48.4777	-49.4786	-40.7198	-37.8145	-31.1988	-26.4114	-31.9758	-32.9055	-40.6704	-47.1011	-53.2525	eq.(G10)
Total of WWHRS savings												-495.1042	
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													
	112.3225	98.3533	102.9884	93.5548	92.0277	82.3241	80.2521	88.3368	88.2276	98.6956	103.2825	109.3340	(64)
								Total per year (kWh/year) = Sum(64)m =				1149.6996	(64)
Heat gains from water heating, kWh/month													
	54.4566	47.7291	49.4898	43.4839	41.9745	36.5906	34.2735	38.8080	39.1174	45.1368	48.8340	52.8505	(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	150.1541	150.1541	150.1541	150.1541	150.1541	150.1541	150.1541	150.1541	150.1541	150.1541	150.1541	150.1541	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	55.0069	48.8566	39.7329	30.0803	22.4854	18.9831	20.5119	26.6622	35.7859	45.4385	53.0334	56.5357	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	334.1725	337.6402	328.9018	310.2988	286.8158	264.7451	250.0005	246.5328	255.2712	273.8743	297.3573	319.4279	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.5180	52.5180	52.5180	52.5180	52.5180	52.5180	52.5180	52.5180	52.5180	52.5180	52.5180	52.5180	(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)													
	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	-100.1027	(71)
Water heating gains (Table 5)													
	73.1944	71.0254	66.5185	60.3944	56.4174	50.8202	46.0665	52.1613	54.3297	60.6677	67.8250	71.0356	(72)
Total internal gains													
	567.9432	563.0916	540.7225	506.3428	471.2879	440.1178	422.1483	430.9257	450.9563	485.5498	523.7851	552.5686	(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	
East	7.1650	25.1733	0.5000	0.7200	0.7700	44.9978	(76)
West	2.7240	25.1733	0.5000	0.7200	0.7700	17.1073	(80)

Solar gains	62.1051	103.3475	172.7227	253.0605	291.8284	329.6170	303.3863	271.8514	211.4207	133.8820	77.1843	50.2012	(83)
Total gains	630.0483	666.4391	713.4453	759.4033	763.1163	769.7347	725.5346	702.7771	662.3769	619.4318	600.9694	602.7697	(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	15.9534	16.0903	16.1345	16.2627	16.2627	16.3039	16.3039	16.3443	16.3443	16.2207	16.2207	16.1780	
alpha	2.0636	2.0727	2.0756	2.0842	2.0842	2.0869	2.0869	2.0896	2.0896	2.0814	2.0814	2.0785	
util living area													
	0.8909	0.8755	0.8372	0.7681	0.6642	0.5057	0.3798	0.3795	0.5855	0.7622	0.8555	0.8963	(86)
MIT	18.5726	18.7591	19.2151	19.8104	20.3681	20.7650	20.9130	20.9161	20.6620	20.0640	19.2826	18.5790	(87)
Th 2	19.9535	19.9615	19.9640	19.9713	19.9713	19.9736	19.9736	19.9759	19.9759	19.9689	19.9689	19.9665	(88)
util rest of house													
	0.8784	0.8613	0.8178	0.7385	0.6156	0.4285	0.2756	0.2721	0.5119	0.7237	0.8359	0.8843	(89)
MIT 2	16.7850	17.0519	17.6986	18.5327	19.2865	19.7759	19.9268	19.9324	19.6693	18.8958	17.8065	16.7996	(90)
Living area fraction									fLA = Living area / (4) =			0.1671	(91)
MIT	17.0837	17.3372	17.9520	18.7463	19.4673	19.9412	20.0916	20.0968	19.8352	19.0910	18.0532	17.0970	(92)
Temperature adjustment												-0.1500	
adjusted MIT	16.9337	17.1872	17.8020	18.5963	19.3173	19.7912	19.9416	19.9468	19.6852	18.9410	17.9032	16.9470	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8280	0.8099	0.7655	0.6903	0.5800	0.4134	0.2721	0.2688	0.4883	0.6766	0.7838	0.8350	(94)
Useful gains	521.7112	539.7430	546.1181	524.2530	442.6088	318.2381	197.4538	188.9300	323.4306	419.1348	471.0146	503.3323	(95)
Ext temp.	5.7000	6.1000	7.7000	10.1000	13.1000	15.9000	17.7000	17.8000	15.5000	12.3000	8.8000	5.8000	(96)
Heat loss rate W													
	1069.0762	1046.1536	950.5828	793.1816	580.4247	362.3528	208.7389	199.4167	388.7636	621.5896	852.0419	1046.0920	(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													
	407.2395	340.3079	300.9218	193.6286	102.5351	0.0000	0.0000	0.0000	0.0000	150.6264	274.3396	403.8132	(98)
Space heating												2173.4121	(98)
Space heating per m2											(98) / (4) =	26.4534	(99)

8c. Space cooling requirement

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

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 %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2401.5604	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	407.2395	340.3079	300.9218	193.6286	102.5351	0.0000	0.0000	0.0000	0.0000	150.6264	274.3396	403.8132	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	449.9884	376.0308	332.5102	213.9543	113.2984	0.0000	0.0000	0.0000	0.0000	166.4380	303.1377	446.2025	(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													
	112.3225	98.3533	102.9884	93.5548	92.0277	82.3241	80.2521	88.3368	88.2276	98.6956	103.2825	109.3340	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.7885	89.7623	89.6620	89.4321	88.9577	87.3000	87.3000	87.3000	87.3000	89.2056	89.6017	89.7987	(217)
Fuel for water heating, kWh/month													
	125.0968	109.5708	114.8629	104.6099	103.4511	94.3003	91.9268	101.1877	101.0626	110.6383	115.2685	121.7546	(219)
Water heating fuel used												1293.7304	(219)
Annual totals kWh/year													
Space heating fuel - main system												2401.5604	(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)												388.5754	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1217 * 0.80) =										-1946.4459		-1946.4459	(233)
Total delivered energy for all uses												2212.4202	(238)

10a. Fuel costs - using BEDF prices (495)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2401.5604	3.6300	87.1766	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1293.7304	3.6300	46.9624	(247)
Pumps and fans for heating	75.0000	19.4400	14.5800	(249)
Energy for lighting	388.5754	19.4400	75.5391	(250)
Additional standing charges			95.0000	(251)
Energy saving/generation technologies				
PV Unit	-1946.4459	19.4400	-378.3891	(252)
Total energy cost			-59.1310	(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	2401.5604	0.2160	518.7370	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1293.7304	0.2160	279.4458	(264)
Space and water heating			798.1828	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	388.5754	0.5190	201.6706	(268)
Energy saving/generation technologies				
PV Unit	-1946.4459	0.5190	-1010.2054	(269)
Total kg/year			28.5730	(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	2401.5604	1.2200	2929.9036	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1293.7304	1.2200	1578.3511	(264)
Space and water heating			4508.2547	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	388.5754	3.0700	1192.9265	(268)
Energy saving/generation technologies				
PV Unit	-1946.4459	3.0700	-5975.5890	(269)
Primary energy kWh/year			-44.1578	(272)
Primary energy kWh/m2/year			-0.5375	(273)

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

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

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	Southern England
Front of dwelling faces	West
Overshading	Average or unknown
Thermal mass parameter	66.5 (calculated from construction elements)
Night ventilation	Yes
Ventilation rate during hot weather (ach)	4.66 (Calculated rate)

Overheating Calculation

Summer ventilation heat loss coefficient	315.23 (P1)
Transmission heat loss coefficient	54.52 (37)
Summer heat loss coefficient	369.75 (P2)

Overhangs

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

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer
East	0.850	0.90	1.000	0.765 (P8)
West	0.850	0.90	1.000	0.765 (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
East	7.1650	125.2818	0.5000	0.7200	0.7650	222.4900
West	2.7240	125.2818	0.5000	0.7200	0.7650	84.5866
total:						307.0766

	Jun	Jul	Aug	
Solar gains	330	307	270	(P3)
Internal gains	437	419	428	
Total summer gains	767	726	698	(P5)
Summer gain/loss ratio	2.08	1.96	1.89	(P6)
Summer external temperature	15.40	17.30	17.30	
Thermal mass temperature increment (TMP = 66.5)	1.53	1.53	1.53	
Threshold temperature	19.01	20.80	20.72	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

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

Design SAP
elmhurst energy

Property Reference	078 - PRJ013014	**Issued on Date**	27/01/2023
Assessment Reference	078	**Prop Type Ref**	2B
Property	Land North of Grange Road, SO31		

SAP Rating	85 B	**DER**	15.11	**TER**	18.29
Environmental	88 B	**% DER<TER**	17.38		
CO_2 Emissions (t/year)	1.04	**DFEE**	45.10	**TFEE**	50.94
General Requirements Compliance	Pass	**% DFEE<TFEE**	11.46		

Assessor Details	Chris Nicholls, , Tel: ,	**Assessor ID**	U903-0001
Client			

SUMARY FOR INPUT DATA FOR New Build (As Designed)

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)	18.29	$kgCO_2/m^2$	
Dwelling Carbon Dioxide Emission Rate (DER)	15.11	$kgCO_2/m^2$	Pass
	-3.18 (-17.4%)	$kgCO_2/m^2$	

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	50.94	$kWh/m^2/yr$	
Dwelling Fabric Energy Efficiency (DFEE)	45.10	$kWh/m^2/yr$	
	-5.8 (-11.4%)	$kWh/m^2/yr$	Pass

Criterion 2 – Limits on design flexibility

Limiting Fabric Standards

2 Fabric U-values

Element	Average	Highest	
External wall	0.25 (max. 0.30)	0.25 (max. 0.70)	Pass
Party wall	0.00 (max. 0.20)	-	Pass
Floor	0.19 (max. 0.25)	0.19 (max. 0.70)	Pass
Roof	0.08 (max. 0.20)	0.08 (max. 0.35)	Pass
Openings	1.37 (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	5.00 (design value)	
Maximum	10.0	Pass

Limiting System Efficiencies

4 Heating efficiency

Main heating system	Boiler system with radiators or underfloor - Mains gas Data from database Ideal LOGIC COMBI ESP1 30 Combi boiler Efficiency: 89.6% SEDBUK2009 Minimum: 88.0%	Pass

Secondary heating system	None		
5 Cylinder insulation			
Hot water storage	No cylinder		
6 Controls			
Space heating controls	Time and temperature zone control		Pass
Hot water controls	No cylinder		
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)	Slight		Pass

Based on:

Overshading	Average		
Windows facing East Windows facing West	7.17 m², No overhang 2.72 m², No overhang		
Air change rate	4.66 ach		
Blinds/curtains	Dark-coloured curtain or roller blind, closed 100% of daylight hours		

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	5.00 (design value)		
Maximum	10.0		Pass

10 Key features

Party wall U-value	0.00	W/m²K
Roof U-value	0.08	W/m²K