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

Property Reference	BD23 6RR Plot 19	**Issued on Date**	20/07/2022
Assessment Reference	001	**Prop Type Ref**	Type D2
Property	Plot 19, Phase 3, Shires Lane, Embsay, Skipton, BD23 6RR		

SAP Rating	93 A	**DER**	7.17	**TER**	16.93
Environmental	95 A	**% DER<TER**	57.65		
CO_2 Emissions (t/year)	0.67	**DFEE**	45.31	**TFEE**	48.40
General Requirements Compliance	Pass	**% DFEE<TFEE**	6.39		

Assessor Details	Mr. Jake Eaton, Jake Eaton, Tel: 01400283471, jake@aeratech.co.uk	**Assessor ID**	P711-0001
Client			

Regs Region: England
Elmhurst Energy Systems SAP2012 Calculator (Design System) version 4.14r19

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

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DWELLING AS DESIGNED

Semi-Detached House, total floor area 96 m²

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

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 16.93 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 7.17 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)48.4 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)45.3 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.13 (max. 0.20)	0.13 (max. 0.35)	OK
Openings	1.63 (max. 2.00)	1.80 (max. 3.30)	OK

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

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3 Air permeability
Air permeability at 50 pascals: 5.00 (design value)
Maximum 10.0 OK

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4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from manufacturer
rated a
Combi boiler
Efficiency: 90%
Minimum: 88% OK

Secondary heating system: Room heaters - Wood Logs

Closed room heater
Efficiency: 65%
Minimum: 65% OK

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5 Cylinder insulation
Hot water storage No cylinder

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

Hot water controls: No cylinder

Boiler interlock Yes OK

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

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8 Mechanical ventilation
Continuous extract system (decentralised)
Specific fan power: 0.1600 0.1600
Maximum 0.7 OK

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9 Summertime temperature
Overheating risk (North East England): Not significant OK
Based on:
Overshading: Average
Windows facing North: 4.33 m², No overhang
Windows facing East: 0.87 m², No overhang
Windows facing South: 8.74 m², No overhang
Air change rate: 2.50 ach
Blinds/curtains: Light-coloured curtain or roller blind, closed 50% of daylight hours

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10 Key features
Party wall U-value 0.00 W/m²K
Secondary heating (wood logs)
Secondary heating fuel: wood logs
Photovoltaic array 2.00 kW

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	48.0000 (1b)	x	2.4300 (2b)	=	116.6400	(1b) - (3b)
First floor	48.0000 (1c)	x	2.6700 (2c)	=	128.1600	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	96.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	244.8000	(5)

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000	/ (5) =	0.0000	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.2500	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.2125	(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	0.2709	0.2656	0.2603	0.2338	0.2284	0.2019	0.2019	0.1966	0.2125	0.2284	0.2391	0.2497	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5209	0.5156	0.5103	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1			2.1200	1.8000	3.8160			(26a)
Opening Type 2 (Uw = 1.60)			13.9400	1.5038	20.9624			(27)
Heat Loss Floor 1			48.0000	0.1300	6.2400	75.0000	3600.0000	(28a)
External Wall 1	102.0000	16.0600	85.9400	0.1800	15.4692	110.0000	9453.4000	(29a)
External Roof 2	48.0000		48.0000	0.1300	6.2400	9.0000	432.0000	(30)
Total net area of external elements Aum(A, m2)			198.0000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		52.7276			(33)
Party Wall 1			40.8000	0.0000	0.0000	70.0000	2856.0000	(32)
Internal Wall 2			85.1000			9.0000	765.9000	(32c)
Internal Wall 2			20.4100			9.0000	183.6900	(32c)
Internal Floor 1			48.0000			18.0000	864.0000	(32d)
Internal Ceiling 1			48.0000			18.0000	864.0000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	19018.9900	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		198.1145	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		17.0076	(36)
Total fabric heat loss	(33) + (36) =	69.7352	(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	42.0834	41.6543	41.2251	40.3920	40.3920	40.3920	40.3920	40.3920	40.3920	40.3920	40.3920	40.3920	(38)
Heat transfer coeff	111.8186	111.3895	110.9603	110.1272	110.1272	110.1272	110.1272	110.1272	110.1272	110.1272	110.1272	110.1272	(39)
Average = Sum(39)m / 12 =												110.4428	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1648	1.1603	1.1558	1.1472	1.1472	1.1472	1.1472	1.1472	1.1472	1.1472	1.1472	1.1472	(40)
HLP (average)												1.1504	(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		2.6993 (42)
Average daily hot water use (litres/day)		98.3080 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

	108.1388	104.2065	100.2741	96.3418	92.4095	88.4772	88.4772	92.4095	96.3418	100.2741	104.2065	108.1388	(44)
Energy conte	160.3667	140.2577	144.7334	126.1821	121.0747	104.4783	96.8145	111.0960	112.4229	131.0180	143.0164	155.3066	(45)
Energy content (annual)										Total = Sum(45)m =		1546.7672	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.0550	21.0387	21.7100	18.9273	18.1612	15.6717	14.5222	16.6644	16.8634	19.6527	21.4525	23.2960	(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	50.9589	46.0274	50.9589	47.5110	47.0909	43.6326	45.0870	47.0909	47.5110	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	211.3256	186.2851	195.6923	173.6931	168.1656	148.1109	141.9015	158.1869	159.9339	181.9769	192.3315	206.2655	(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													
	211.3256	186.2851	195.6923	173.6931	168.1656	148.1109	141.9015	158.1869	159.9339	181.9769	192.3315	206.2655	(64)
Total per year (kWh/year) = Sum(64)m =												2123.8687	(64)
Heat gains from water heating, kWh/month													
	66.0616	58.1425	60.8636	53.8333	52.0301	45.6472	43.4626	48.7121	49.2584	56.3032	59.8817	64.3792	(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	134.9642	134.9642	134.9642	134.9642	134.9642	134.9642	134.9642	134.9642	134.9642	134.9642	134.9642	134.9642	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.3546	20.7433	16.8696	12.7714	9.5468	8.0598	8.7089	11.3201	15.1938	19.2921	22.5167	24.0037	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	249.6943	252.2854	245.7560	231.8558	214.3093	197.8180	186.8008	184.2098	190.7391	204.6393	222.1859	238.6771	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.4964	36.4964	36.4964	36.4964	36.4964	36.4964	36.4964	36.4964	36.4964	36.4964	36.4964	36.4964	(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)													
	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	(71)
Water heating gains (Table 5)													
	88.7925	86.5216	81.8059	74.7685	69.9329	63.3988	58.4174	65.4733	68.4144	75.6764	83.1691	86.5311	(72)
Total internal gains													
	428.3307	426.0396	410.9207	385.8849	360.2781	335.7659	320.4164	327.4925	340.8366	366.0970	394.3609	415.7012	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.3300	10.6334	0.7600	0.7500	0.7700	18.1873	(74)
East	0.8700	19.6403	0.7600	0.7500	0.7700	6.7495	(76)
South	8.7400	46.7521	0.7600	0.7500	0.7700	161.4062	(78)

Solar gains	186.3431	312.3022	417.5293	507.1508	563.2380	558.2458	538.5028	496.0073	448.0479	342.1580	222.1737	160.1822	(83)
Total gains	614.6737	738.3418	828.4500	893.0357	923.5162	894.0117	858.9191	823.4997	788.8845	708.2551	616.5345	575.8833	(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	47.2466	47.4287	47.6121	47.9723	47.9723	47.9723	47.9723	47.9723	47.9723	47.9723	47.9723	47.9723	
alpha	4.1498	4.1619	4.1741	4.1982	4.1982	4.1982	4.1982	4.1982	4.1982	4.1982	4.1982	4.1982	
util living area													
	0.9933	0.9852	0.9686	0.9298	0.8470	0.7017	0.5407	0.5817	0.7922	0.9447	0.9868	0.9949	(86)
MIT	19.8352	20.0014	20.2282	20.4944	20.7230	20.8675	20.9178	20.9113	20.8170	20.5173	20.1254	19.8138	(87)
Th 2	19.9483	19.9519	19.9555	19.9625	19.9625	19.9625	19.9625	19.9625	19.9625	19.9625	19.9625	19.9625	(88)
util rest of house													
	0.9915	0.9813	0.9600	0.9095	0.8016	0.6161	0.4239	0.4651	0.7194	0.9246	0.9826	0.9935	(89)
MIT 2	18.3915	18.6354	18.9647	19.3457	19.6498	19.8169	19.8600	19.8561	19.7676	19.3841	18.8252	18.3711	(90)
Living area fraction									fLA = Living area / (4) =			0.1788	(91)
MIT	18.6496	18.8796	19.1906	19.5511	19.8417	20.0047	20.0491	20.0447	19.9552	19.5867	19.0576	18.6289	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.4996	18.7296	19.0406	19.4011	19.6917	19.8547	19.8991	19.8947	19.8052	19.4367	18.9076	18.4789	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9880	0.9750	0.9501	0.8959	0.7877	0.6062	0.4163	0.4569	0.7065	0.9113	0.9766	0.9906	(94)
Useful gains	607.2778	719.9165	787.1470	800.0542	727.4504	541.9879	357.5980	376.2845	557.3835	645.4175	602.1039	570.4739	(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													
	1587.7770	1540.4705	1391.5050	1156.4524	880.0996	578.6856	363.3230	384.8598	628.2949	973.1565	1300.3386	1572.5003	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh													
	729.4915	551.4123	449.6424	256.6067	113.5709	0.0000	0.0000	0.0000	0.0000	243.8378	502.7290	745.5076	(98)
Space heating												3592.7982	(98)
Space heating per m2											(98) / (4) =	37.4250	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.1000	(201)
Fraction of space heat from main system(s)												0.9000	(202)
Efficiency of main space heating system 1 (in %)												89.5000	(206)
Efficiency of secondary/supplementary heating system, %												65.0000	(208)
Space heating requirement												3612.8697	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	729.4915	551.4123	449.6424	256.6067	113.5709	0.0000	0.0000	0.0000	0.0000	243.8378	502.7290	745.5076	(98)
Space heating efficiency (main heating system 1)													
	89.5000	89.5000	89.5000	89.5000	89.5000	0.0000	0.0000	0.0000	0.0000	89.5000	89.5000	89.5000	(210)
Space heating fuel (main heating system)													
	733.5668	554.4928	452.1543	258.0403	114.2054	0.0000	0.0000	0.0000	0.0000	245.2001	505.5375	749.6725	(211)
Water heating requirement													
	112.2295	84.8327	69.1757	39.4780	17.4725	0.0000	0.0000	0.0000	0.0000	37.5135	77.3429	114.6935	(215)
Water heating													
Water heating requirement													
	211.3256	186.2851	195.6923	173.6931	168.1656	148.1109	141.9015	158.1869	159.9339	181.9769	192.3315	206.2655	(64)
Efficiency of water heater												89.5000	(216)
(217)m	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	(217)
Fuel for water heating, kWh/month													
	236.1180	208.1398	218.6506	194.0705	187.8945	165.4870	158.5491	176.7451	178.6971	203.3262	214.8955	230.4642	(219)
Water heating fuel used												2373.0377	(219)
Annual totals kWh/year													
Space heating fuel - main system												3612.8697	(211)
Space heating fuel - secondary												552.7382	(215)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 5.3360, total flow = 29.0000, SFP = 0.1840)													
mechanical ventilation fans (SFP = 0.1840)												54.9527	(230a)
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												129.9527	(231)
Electricity for lighting (calculated in Appendix L)												412.4489	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.00 * 1080 * 1.00) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												5353.8078	(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	3612.8697	0.2160	780.3799	(261)
Space heating - secondary	552.7382	0.0190	10.5020	(263)
Water heating (other fuel)	2373.0377	0.2160	512.5761	(264)
Space and water heating			1303.4580	(265)
Pumps and fans	129.9527	0.5190	67.4455	(267)
Energy for lighting	412.4489	0.5190	214.0610	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total CO2, kg/year			688.5272	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			7.1700	(273)

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

DER		7.1700	ZC1
Total Floor Area	TFA	96.0000	
Assumed number of occupants	N	2.6993	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.4129	ZC2
CO2 emissions from cooking, equation (L16)		1.9144	ZC3
Total CO2 emissions		24.4973	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		24.4973	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	48.0000 (1b)	x	2.4300 (2b)	=	116.6400	(1b) - (3b)
First floor	48.0000 (1c)	x	2.6700 (2c)	=	128.1600	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	96.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	244.8000	(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) =	0.1225 (8)
Pressure test		Yes
Measured/design AP50		5.0000
Infiltration rate		0.3725 (18)
Number of sides sheltered		2 (19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500 (20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3167 (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	0.4038	0.3958	0.3879	0.3483	0.3404	0.3008	0.3008	0.2929	0.3167	0.3404	0.3563	0.3721	(22b)
Effective ac	0.5815	0.5783	0.5752	0.5607	0.5579	0.5453	0.5453	0.5429	0.5501	0.5579	0.5635	0.5692	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Semi-glazed door			2.1200	1.2000	2.5440			(26a)
TER Opening Type (Uw = 1.40)			13.9400	1.3258	18.4811			(27)
Heat Loss Floor 1			48.0000	0.1300	6.2400			(28a)
External Wall 1	102.0000	16.0600	85.9400	0.1800	15.4692			(29a)
External Roof 2	48.0000		48.0000	0.1300	6.2400			(30)
Total net area of external elements Aum(A, m2)			198.0000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		48.9743			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.8695	(36)
Total fabric heat loss					(33) + (36) =		58.8438	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	46.9765	46.7208	46.4702	45.2930	45.0728	44.0475	44.0475	43.8576	44.4424	45.0728	45.5183	45.9841	(38)
Heat transfer coeff	105.8202	105.5645	105.3139	104.1368	103.9165	102.8913	102.8913	102.7014	103.2862	103.9165	104.3621	104.8279	(39)
Average = Sum(39)m / 12 =												104.1357	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1023	1.0996	1.0970	1.0848	1.0825	1.0718	1.0718	1.0698	1.0759	1.0825	1.0871	1.0920	(40)
HLP (average)												1.0847	(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		2.6993 (42)
Average daily hot water use (litres/day)		98.3080 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.1388	104.2065	100.2741	96.3418	92.4095	88.4772	88.4772	92.4095	96.3418	100.2741	104.2065	108.1388	(44)
Energy conte	160.3667	140.2577	144.7334	126.1821	121.0747	104.4783	96.8145	111.0960	112.4229	131.0180	143.0164	155.3066	(45)
Energy content (annual)										Total = Sum(45)m =		1546.7672	(45)
Distribution loss (46)m = 0.15 x (45)m	24.0550	21.0387	21.7100	18.9273	18.1612	15.6717	14.5222	16.6644	16.8634	19.6527	21.4525	23.2960	(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	46.0274	50.9589	47.5110	47.0909	43.6326	45.0870	47.0909	47.5110	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	211.3256	186.2851	195.6923	173.6931	168.1656	148.1109	141.9015	158.1869	159.9339	181.9769	192.3315	206.2655	(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													
	211.3256	186.2851	195.6923	173.6931	168.1656	148.1109	141.9015	158.1869	159.9339	181.9769	192.3315	206.2655	(64)
								Total per year (kWh/year) = Sum(64)m =				2123.8687	(64)
Heat gains from water heating, kWh/month													
	66.0616	58.1425	60.8636	53.8333	52.0301	45.6472	43.4626	48.7121	49.2584	56.3032	59.8817	64.3792	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	134.9642	134.9642	134.9642	134.9642	134.9642	134.9642	134.9642	134.9642	134.9642	134.9642	134.9642	134.9642	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.6938	21.0446	17.1146	12.9569	9.6854	8.1768	8.8354	11.4845	15.4145	19.5723	22.8437	24.3523	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	249.6943	252.2854	245.7560	231.8558	214.3093	197.8180	186.8008	184.2098	190.7391	204.6393	222.1859	238.6771	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.4964	36.4964	36.4964	36.4964	36.4964	36.4964	36.4964	36.4964	36.4964	36.4964	36.4964	36.4964	(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)													
	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	(71)
Water heating gains (Table 5)													
	88.7925	86.5216	81.8059	74.7685	69.9329	63.3988	58.4174	65.4733	68.4144	75.6764	83.1691	86.5311	(72)
Total internal gains													
	428.6699	426.3409	411.1658	386.0704	360.4168	335.8829	320.5429	327.6569	341.0573	366.3773	394.6879	416.0498	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.3300	10.6334	0.6300	0.7000	0.7700	14.0712	(74)
East	0.8700	19.6403	0.6300	0.7000	0.7700	5.2220	(76)
South	8.7400	46.7521	0.6300	0.7000	0.7700	124.8775	(78)

Solar gains	144.1707	241.6233	323.0358	392.3746	435.7684	431.9060	416.6311	383.7530	346.6476	264.7223	171.8923	123.9304	(83)
Total gains	572.8406	667.9642	734.2016	778.4450	796.1852	767.7889	737.1739	711.4099	687.7049	631.0995	566.5802	539.9802	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	62.9999	63.1525	63.3028	64.0184	64.1541	64.7933	64.7933	64.9131	64.5456	64.1541	63.8802	63.5963	
alpha	5.2000	5.2102	5.2202	5.2679	5.2769	5.3196	5.3196	5.3275	5.3030	5.2769	5.2587	5.2398	
util living area													
	0.9981	0.9953	0.9885	0.9682	0.9100	0.7708	0.5956	0.6368	0.8560	0.9748	0.9956	0.9986	(86)
MIT	19.8202	19.9783	20.2085	20.4987	20.7604	20.9338	20.9864	20.9808	20.8770	20.5389	20.1227	19.7919	(87)
Th 2	19.9990	20.0011	20.0033	20.0133	20.0152	20.0239	20.0239	20.0256	20.0206	20.0152	20.0114	20.0074	(88)
util rest of house													
	0.9974	0.9937	0.9844	0.9558	0.8730	0.6849	0.4729	0.5153	0.7881	0.9625	0.9939	0.9981	(89)
MIT 2	18.4236	18.6557	18.9915	19.4140	19.7700	19.9771	20.0186	20.0172	19.9196	19.4770	18.8745	18.3882	(90)
Living area fraction									fLA = Living area / (4) =			0.1788	(91)
MIT	18.6732	18.8921	19.2090	19.6079	19.9470	20.1481	20.1916	20.1895	20.0907	19.6668	19.0976	18.6391	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6732	18.8921	19.2090	19.6079	19.9470	20.1481	20.1916	20.1895	20.0907	19.6668	19.0976	18.6391	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9961	0.9912	0.9799	0.9492	0.8699	0.6969	0.4949	0.5369	0.7938	0.9567	0.9915	0.9971	(94)
Useful gains	570.6094	662.0644	719.4247	738.8984	692.6319	535.0976	364.8069	381.9349	545.8940	603.7444	561.7527	538.4101	(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													
	1520.9800	1477.0721	1338.4355	1115.0860	857.0011	570.8531	369.5464	389.1830	618.7612	942.1946	1252.0963	1513.6221	(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													
	707.0758	547.6852	460.5441	270.8551	122.2906	0.0000	0.0000	0.0000	0.0000	251.8070	497.0474	725.5577	(98)
Space heating												3582.8629	(98)
Space heating per m2											(98) / (4) =	37.3215	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3836.0416	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	707.0758	547.6852	460.5441	270.8551	122.2906	0.0000	0.0000	0.0000	0.0000	251.8070	497.0474	725.5577	(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)													
	757.0404	586.3867	493.0879	289.9948	130.9322	0.0000	0.0000	0.0000	0.0000	269.6006	532.1706	776.8284	(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													
	211.3256	186.2851	195.6923	173.6931	168.1656	148.1109	141.9015	158.1869	159.9339	181.9769	192.3315	206.2655	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.8573	87.6034	87.1319	86.1655	84.2637	80.3000	80.3000	80.3000	80.3000	85.8691	87.3353	87.9513	(217)
Fuel for water heating, kWh/month													
	240.5329	212.6459	224.5932	201.5808	199.5705	184.4469	176.7142	196.9949	199.1705	211.9237	220.2219	234.5224	(219)
Water heating fuel used												2502.9178	(219)
Annual totals kWh/year													
Space heating fuel - main system												3836.0416	(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)												418.4400	(232)
Total delivered energy for all uses												6832.3994	(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	3836.0416	0.2160	828.5850	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2502.9178	0.2160	540.6302	(264)
Space and water heating			1369.2152	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	418.4400	0.5190	217.1704	(268)
Total CO2, kg/m2/year			1625.3106	(272)
Emissions per m2 for space and water heating			14.2627	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2622	(272b)
Emissions per m2 for pumps and fans			0.4055	(272c)
Target Carbon Dioxide Emission Rate (TER) = (14.2627 * 1.00) + 2.2622 + 0.4055, rounded to 2 d.p.			16.9300	(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	48.0000 (1b)	x	2.4300 (2b)	=	116.6400	(1b) - (3b)
First floor	48.0000 (1c)	x	2.6700 (2c)	=	128.1600	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	96.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	244.8000	(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) =	0.1225	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3725	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)]	=	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20)	=	0.3167	(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	0.4038	0.3958	0.3879	0.3483	0.3404	0.3008	0.3008	0.2929	0.3167	0.3404	0.3563	0.3721	(22b)
Effective ac	0.5815	0.5783	0.5752	0.5607	0.5579	0.5453	0.5453	0.5429	0.5501	0.5579	0.5635	0.5692	(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	
Opening Type 1			2.1200	1.8000	3.8160			(26a)
Opening Type 2 (Uw = 1.60)			13.9400	1.5038	20.9624			(27)
Heat Loss Floor 1			48.0000	0.1300	6.2400	75.0000	3600.0000	(28a)
External Wall 1	102.0000	16.0600	85.9400	0.1800	15.4692	110.0000	9453.4000	(29a)
External Roof 2	48.0000		48.0000	0.1300	6.2400	9.0000	432.0000	(30)
Total net area of external elements Aum(A, m2)			198.0000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		52.7276			(33)
Party Wall 1			40.8000	0.0000	0.0000	70.0000	2856.0000	(32)
Internal Wall 2			85.1000			9.0000	765.9000	(32c)
Internal Wall 2			20.4100			9.0000	183.6900	(32c)
Internal Floor 1			48.0000			18.0000	864.0000	(32d)
Internal Ceiling 1			48.0000			9.0000	432.0000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	18586.9900	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		193.6145	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		17.0076	(36)
Total fabric heat loss	(33) + (36) =	69.7352	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	46.9765	46.7208	46.4702	45.2930	45.0728	44.0475	44.0475	43.8576	44.4424	45.0728	45.5183	45.9841	(38)
Heat transfer coeff	116.7117	116.4560	116.2054	115.0282	114.8080	113.7827	113.7827	113.5928	114.1776	114.8080	115.2535	115.7193	(39)
Average = Sum(39)m / 12 =												115.0272	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2157	1.2131	1.2105	1.1982	1.1959	1.1852	1.1852	1.1833	1.1894	1.1959	1.2006	1.2054	(40)
HLP (average)												1.1982	(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	2.6993 (42)
Average daily hot water use (litres/day)	98.3080 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.1388	104.2065	100.2741	96.3418	92.4095	88.4772	88.4772	92.4095	96.3418	100.2741	104.2065	108.1388	(44)
Energy conte	160.3667	140.2577	144.7334	126.1821	121.0747	104.4783	96.8145	111.0960	112.4229	131.0180	143.0164	155.3066	(45)
Energy content (annual)										Total = Sum(45)m =		1546.7672	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	34.0779	29.8048	30.7558	26.8137	25.7284	22.2016	20.5731	23.6079	23.8899	27.8413	30.3910	33.0026	(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	134.9642	134.9642	134.9642	134.9642	134.9642	134.9642	134.9642	134.9642	134.9642	134.9642	134.9642	134.9642	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	23.3546	20.7433	16.8696	12.7714	9.5468	8.0598	8.7089	11.3201	15.1938	19.2921	22.5167	24.0037	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	249.6943	252.2854	245.7560	231.8558	214.3093	197.8180	186.8008	184.2098	190.7391	204.6393	222.1859	238.6771	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.4964	36.4964	36.4964	36.4964	36.4964	36.4964	36.4964	36.4964	36.4964	36.4964	36.4964	36.4964	(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)	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	(71)
Water heating gains (Table 5)	45.8037	44.3523	41.3385	37.2412	34.5812	30.8356	27.6520	31.7311	33.1804	37.4211	42.2097	44.3584	(72)
Total internal gains	382.3418	380.8703	367.4534	345.3576	321.9264	300.2026	286.6509	290.7502	302.6026	324.8418	350.4015	370.5284	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.3300	10.6334	0.7600	0.7500	0.7700	18.1873	(74)
East	0.8700	19.6403	0.7600	0.7500	0.7700	6.7495	(76)
South	8.7400	46.7521	0.7600	0.7500	0.7700	161.4062	(78)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	186.3431	312.3022	417.5293	507.1508	563.2380	558.2458	538.5028	496.0073	448.0479	342.1580	222.1737	160.1822	(83)
Total gains	568.6848	693.1725	784.9827	852.5085	885.1644	858.4484	825.1537	786.7575	750.6504	666.9998	572.5752	530.7106	(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	44.2377	44.3348	44.4304	44.8851	44.9712	45.3764	45.3764	45.4523	45.2195	44.9712	44.7974	44.6170	
alpha	3.9492	3.9557	3.9620	3.9923	3.9981	4.0251	4.0251	4.0302	4.0146	3.9981	3.9865	3.9745	
util living area	0.9945	0.9876	0.9735	0.9401	0.8672	0.7303	0.5720	0.6150	0.8194	0.9545	0.9893	0.9958	(86)
MIT	19.3765	19.6023	19.9182	20.3045	20.6463	20.8804	20.9661	20.9543	20.7962	20.3431	19.7807	19.3351	(87)
Th 2	19.9074	19.9095	19.9116	19.9214	19.9233	19.9318	19.9318	19.9334	19.9285	19.9233	19.9196	19.9157	(88)
util rest of house	0.9930	0.9843	0.9661	0.9221	0.8248	0.6446	0.4484	0.4930	0.7497	0.9372	0.9859	0.9947	(89)
MIT 2	18.4326	18.6583	18.9716	19.3540	19.6711	19.8688	19.9210	19.9175	19.8073	19.3985	18.8446	18.3976	(90)
Living area fraction									fLA = Living area / (4) =			0.1788	(91)
MIT	18.6013	18.8270	19.1408	19.5239	19.8454	20.0497	20.1078	20.1028	19.9841	19.5673	19.0119	18.5652	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6013	18.8270	19.1408	19.5239	19.8454	20.0497	20.1078	20.1028	19.9841	19.5673	19.0119	18.5652	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9906	0.9799	0.9593	0.9139	0.8213	0.6550	0.4699	0.5138	0.7539	0.9299	0.9819	0.9927	(94)
Useful gains	563.3225	679.2140	753.0320	779.1290	726.9617	562.3218	387.7592	404.2170	565.9164	620.2447	562.2249	526.8331	(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	1669.1274	1621.8871	1468.9305	1222.0482	935.1565	620.0766	399.1320	420.6105	671.8283	1029.5230	1372.8927	1662.3314	(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	822.7189	633.4763	532.6284	318.9018	154.8969	0.0000	0.0000	0.0000	0.0000	304.5030	583.6808	844.8107	(98)
Space heating												4195.6169	(98)
Space heating per m2											(98) / (4) =	43.7043	(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	1069.5575	841.9921	863.3056	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8144	0.8828	0.8627	0.0000	0.0000	0.0000	0.0000	(101)

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Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	871.0471	743.2906	744.7670	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1106.6115	1065.5308	1022.6007	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	169.6064	239.7467	206.7083	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												616.0614	(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	42.4016	59.9367	51.6771	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												154.0153	(107)
Space cooling per m2												1.6043	(108)
Energy for space heating												43.7043	(99)
Energy for space cooling												1.6043	(108)
Total												45.3087	(109)
Dwelling Fabric Energy Efficiency (DFEE)												45.3	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	48.0000 (1b)	x	2.4300 (2b)	=	116.6400	(1b) - (3b)
First floor	48.0000 (1c)	x	2.6700 (2c)	=	128.1600	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	96.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	244.8000	(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) =	0.1225	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3725	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3167	(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	0.4038	0.3958	0.3879	0.3483	0.3404	0.3008	0.3008	0.2929	0.3167	0.3404	0.3563	0.3721	(22b)
Effective ac	0.5815	0.5783	0.5752	0.5607	0.5579	0.5453	0.5453	0.5429	0.5501	0.5579	0.5635	0.5692	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Semi-glazed door			2.1200	1.2000	2.5440			(26a)
TER Opening Type (Uw = 1.40)			13.9400	1.3258	18.4811			(27)
Heat Loss Floor 1			48.0000	0.1300	6.2400			(28a)
External Wall 1	102.0000	16.0600	85.9400	0.1800	15.4692			(29a)
External Roof 2	48.0000		48.0000	0.1300	6.2400			(30)
Total net area of external elements Aum(A, m2)			198.0000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		48.9743			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.8695	(36)
Total fabric heat loss					(33) + (36) =		58.8438	(37)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(38)m	46.9765	46.7208	46.4702	45.2930	45.0728	44.0475	44.0475	43.8576	44.4424	45.0728	45.5183	45.9841	(38)
Heat transfer coeff	105.8202	105.5645	105.3139	104.1368	103.9165	102.8913	102.8913	102.7014	103.2862	103.9165	104.3621	104.8279	(39)
Average = Sum(39)m / 12 =												104.1357	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1023	1.0996	1.0970	1.0848	1.0825	1.0718	1.0718	1.0698	1.0759	1.0825	1.0871	1.0920	(40)
HLP (average)												1.0847	(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	2.6993	(42)
Average daily hot water use (litres/day)	98.3080	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.1388	104.2065	100.2741	96.3418	92.4095	88.4772	88.4772	92.4095	96.3418	100.2741	104.2065	108.1388	(44)
Energy conte	160.3667	140.2577	144.7334	126.1821	121.0747	104.4783	96.8145	111.0960	112.4229	131.0180	143.0164	155.3066	(45)
Energy content (annual)										Total = Sum(45)m =		1546.7672	(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													

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	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	34.0779	29.8048	30.7558	26.8137	25.7284	22.2016	20.5731	23.6079	23.8899	27.8413	30.3910	33.0026	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	134.9642	134.9642	134.9642	134.9642	134.9642	134.9642	134.9642	134.9642	134.9642	134.9642	134.9642	134.9642	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	23.6938	21.0446	17.1146	12.9569	9.6854	8.1768	8.8354	11.4845	15.4145	19.5723	22.8437	24.3523	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	249.6943	252.2854	245.7560	231.8558	214.3093	197.8180	186.8008	184.2098	190.7391	204.6393	222.1859	238.6771	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.4964	36.4964	36.4964	36.4964	36.4964	36.4964	36.4964	36.4964	36.4964	36.4964	36.4964	36.4964	(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)													
	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	(71)
Water heating gains (Table 5)													
	45.8037	44.3523	41.3385	37.2412	34.5812	30.8356	27.6520	31.7311	33.1804	37.4211	42.2097	44.3584	(72)
Total internal gains													
	382.6810	381.1716	367.6984	345.5432	322.0651	300.3197	286.7774	290.9146	302.8233	325.1220	350.7286	370.8771	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.3300	10.6334	0.6300	0.7000	0.7700	14.0712	(74)
East	0.8700	19.6403	0.6300	0.7000	0.7700	5.2220	(76)
South	8.7400	46.7521	0.6300	0.7000	0.7700	124.8775	(78)

Solar gains	144.1707	241.6233	323.0358	392.3746	435.7684	431.9060	416.6311	383.7530	346.6476	264.7223	171.8923	123.9304	(83)
Total gains	526.8517	622.7948	690.7342	737.9177	757.8334	732.2257	703.4085	674.6676	649.4708	589.8443	522.6208	494.8075	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	62.9999	63.1525	63.3028	64.0184	64.1541	64.7933	64.7933	64.9131	64.5456	64.1541	63.8802	63.5963	
alpha	5.2000	5.2102	5.2202	5.2679	5.2769	5.3196	5.3196	5.3275	5.3030	5.2769	5.2587	5.2398	
util living area													
	0.9987	0.9966	0.9912	0.9744	0.9236	0.7939	0.6202	0.6651	0.8777	0.9810	0.9970	0.9991	(86)
MIT	19.7753	19.9347	20.1679	20.4643	20.7360	20.9234	20.9836	20.9765	20.8585	20.5027	20.0801	19.7475	(87)
Th 2	19.9990	20.0011	20.0033	20.0133	20.0152	20.0239	20.0239	20.0256	20.0206	20.0152	20.0114	20.0074	(88)
util rest of house													
	0.9983	0.9954	0.9880	0.9640	0.8903	0.7101	0.4944	0.5412	0.8150	0.9713	0.9958	0.9988	(89)
MIT 2	18.8785	19.0393	19.2726	19.5718	19.8276	19.9861	20.0195	20.0184	19.9390	19.6136	19.1929	18.8576	(90)
Living area fraction										fLA = Living area / (4) =		0.1788	(91)
MIT	19.0388	19.1993	19.4327	19.7313	19.9900	20.1536	20.1918	20.1897	20.1034	19.7725	19.3515	19.0167	(92)
Temperature adjustment												0.0000	
adjusted MIT	19.0388	19.1993	19.4327	19.7313	19.9900	20.1536	20.1918	20.1897	20.1034	19.7725	19.3515	19.0167	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9977	0.9941	0.9855	0.9602	0.8893	0.7225	0.5171	0.5634	0.8212	0.9681	0.9946	0.9983	(94)
Useful gains	525.6151	619.1488	680.7527	708.5708	673.9647	529.0173	363.7507	380.1388	533.3643	571.0570	519.8132	493.9659	(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													
	1559.6661	1509.5024	1361.9897	1127.9395	861.4689	571.4197	369.5668	389.2045	620.0676	953.1742	1278.5912	1553.2024	(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													
	769.3339	598.3176	506.8403	301.9454	139.5031	0.0000	0.0000	0.0000	0.0000	284.2952	546.3202	788.0720	(98)
Space heating												3934.6276	(98)
Space heating per m2											(98) / (4) =	40.9857	(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	967.1779	761.3954	780.5306	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8383	0.9108	0.8923	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	810.7557	693.4447	696.4872	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	959.2342	923.3996	891.8055	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	106.9046	171.0865	145.3168	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												423.3079	(104)

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Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	26.7261	42.7716	36.3292	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												105.8270 (107)
Space cooling per m2												1.1024 (108)
Energy for space heating												40.9857 (99)
Energy for space cooling												1.1024 (108)
Total												42.0881 (109)
Target Fabric Energy Efficiency (TFEE)												48.4 (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	48.0000 (1b)	x	2.4300 (2b)	=	116.6400	(1b) - (3b)
First floor	48.0000 (1c)	x	2.6700 (2c)	=	128.1600	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	96.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	244.8000	(5)

2. Ventilation rate

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

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			0.0000 / (5) =	0.0000	(8)
Pressure test				Yes	
Measured/design AP50				5.0000	
Infiltration rate				0.2500	(18)
Number of sides sheltered				2	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.2125	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.0000	5.0000	4.9000	4.3000	4.2000	3.9000	3.7000	3.5000	3.9000	4.2000	4.5000	4.7000	(22)
Wind factor	1.2500	1.2500	1.2250	1.0750	1.0500	0.9750	0.9250	0.8750	0.9750	1.0500	1.1250	1.1750	(22a)
Adj infilt rate	0.2656	0.2656	0.2603	0.2284	0.2231	0.2072	0.1966	0.1859	0.2072	0.2231	0.2391	0.2497	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5156	0.5156	0.5103	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1			2.1200	1.8000	3.8160			(26a)
Opening Type 2 (Uw = 1.60)			13.9400	1.5038	20.9624			(27)
Heat Loss Floor 1			48.0000	0.1300	6.2400	75.0000	3600.0000	(28a)
External Wall 1	102.0000	16.0600	85.9400	0.1800	15.4692	110.0000	9453.4000	(29a)
External Roof 2	48.0000		48.0000	0.1300	6.2400	9.0000	432.0000	(30)
Total net area of external elements Aum(A, m2)			198.0000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	52.7276			(33)
Party Wall 1			40.8000	0.0000	0.0000	70.0000	2856.0000	(32)
Internal Wall 2			85.1000			9.0000	765.9000	(32c)
Internal Wall 2			20.4100			9.0000	183.6900	(32c)
Internal Floor 1			48.0000			18.0000	864.0000	(32d)
Internal Ceiling 1			48.0000			18.0000	864.0000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	19018.9900	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		198.1145	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		17.0076	(36)
Total fabric heat loss	(33) + (36) =	69.7352	(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	41.6543	41.6543	41.2251	40.3920	40.3920	40.3920	40.3920	40.3920	40.3920	40.3920	40.3920	40.3920	(38)
Heat transfer coeff	111.3895	111.3895	110.9603	110.1272	110.1272	110.1272	110.1272	110.1272	110.1272	110.1272	110.1272	110.1272	(39)
Average = Sum(39)m / 12 =												110.4070	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1603	1.1603	1.1558	1.1472	1.1472	1.1472	1.1472	1.1472	1.1472	1.1472	1.1472	1.1472	(40)
HLP (average)												1.1501	(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		2.6993 (42)
Average daily hot water use (litres/day)		98.3080 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

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	108.1388	104.2065	100.2741	96.3418	92.4095	88.4772	88.4772	92.4095	96.3418	100.2741	104.2065	108.1388	(44)
Energy conte	160.3667	140.2577	144.7334	126.1821	121.0747	104.4783	96.8145	111.0960	112.4229	131.0180	143.0164	155.3066	(45)
Energy content (annual)										Total = Sum(45)m =		1546.7672	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.0550	21.0387	21.7100	18.9273	18.1612	15.6717	14.5222	16.6644	16.8634	19.6527	21.4525	23.2960	(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	50.9589	46.0274	50.9589	47.5110	47.0909	43.6326	45.0870	47.0909	47.5110	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	211.3256	186.2851	195.6923	173.6931	168.1656	148.1109	141.9015	158.1869	159.9339	181.9769	192.3315	206.2655	(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													
	211.3256	186.2851	195.6923	173.6931	168.1656	148.1109	141.9015	158.1869	159.9339	181.9769	192.3315	206.2655	(64)
									Total per year (kWh/year) = Sum(64)m =			2123.8687	(64)
RHI water heating demand												2124	(64)
Heat gains from water heating, kWh/month													
	66.0616	58.1425	60.8636	53.8333	52.0301	45.6472	43.4626	48.7121	49.2584	56.3032	59.8817	64.3792	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	161.9570	161.9570	161.9570	161.9570	161.9570	161.9570	161.9570	161.9570	161.9570	161.9570	161.9570	161.9570	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	58.3864	51.8583	42.1740	31.9284	23.8669	20.1494	21.7722	28.3003	37.9846	48.2301	56.2917	60.0092	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	372.6781	376.5453	366.8000	346.0534	319.8646	295.2507	278.8072	274.9400	284.6853	305.4319	331.6207	356.2345	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.8950	53.8950	53.8950	53.8950	53.8950	53.8950	53.8950	53.8950	53.8950	53.8950	53.8950	53.8950	(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)													
	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	(71)
Water heating gains (Table 5)													
	88.7925	86.5216	81.8059	74.7685	69.9329	63.3988	58.4174	65.4733	68.4144	75.6764	83.1691	86.5311	(72)
Total internal gains													
	630.7377	625.8059	601.6605	563.6310	524.5450	489.6797	469.8774	479.5942	501.9649	540.2190	581.9621	613.6555	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.3300	9.8938	0.7600	0.7500	0.7700	16.9223	(74)
East	0.8700	18.2144	0.7600	0.7500	0.7700	6.2595	(76)
South	8.7400	43.9264	0.7600	0.7500	0.7700	151.6508	(78)

Solar gains	174.8327	293.8884	410.4666	502.6376	552.8980	542.0889	522.1762	475.3763	434.3949	321.2844	198.4575	147.2918	(83)
Total gains	805.5704	919.6943	1012.1272	1066.2685	1077.4430	1031.7685	992.0536	954.9705	936.3598	861.5034	780.4196	760.9472	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	47.4287	47.4287	47.6121	47.9723	47.9723	47.9723	47.9723	47.9723	47.9723	47.9723	47.9723	47.9723	
alpha	4.1619	4.1619	4.1741	4.1982	4.1982	4.1982	4.1982	4.1982	4.1982	4.1982	4.1982	4.1982	
util living area													
	0.9847	0.9739	0.9519	0.9094	0.8278	0.7090	0.6037	0.6386	0.7927	0.9267	0.9752	0.9877	(86)
MIT	19.9323	20.0610	20.2721	20.5104	20.7226	20.8526	20.9005	20.8908	20.7943	20.5244	20.1822	19.9030	(87)
Th 2	19.9519	19.9519	19.9555	19.9625	19.9625	19.9625	19.9625	19.9625	19.9625	19.9625	19.9625	19.9625	(88)
util rest of house													
	0.9810	0.9678	0.9405	0.8873	0.7849	0.6371	0.5109	0.5474	0.7329	0.9045	0.9684	0.9847	(89)
MIT 2	18.5340	18.7192	19.0233	19.3621	19.6438	19.7982	19.8453	19.8375	19.7361	19.3883	18.9047	18.4998	(90)
Living area fraction									fLA = Living area / (4) =			0.1788	(91)
MIT	18.7839	18.9590	19.2465	19.5673	19.8366	19.9867	20.0340	20.0258	19.9253	19.5914	19.1331	18.7506	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.6339	18.8090	19.0965	19.4173	19.6866	19.8367	19.8840	19.8758	19.7753	19.4414	18.9831	18.6006	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9747	0.9591	0.9288	0.8734	0.7718	0.6276	0.5034	0.5392	0.7205	0.8906	0.9597	0.9793	(94)
Useful gains	785.2199	882.0797	940.0430	931.2496	831.6243	647.5075	499.3817	514.8910	674.6654	767.2626	748.9877	745.1783	(95)
Ext temp.	3.6000	4.0000	5.5000	7.8000	10.7000	13.5000	15.2000	15.0000	12.8000	9.5000	6.3000	3.5000	(96)
Heat loss rate W													
	1674.6230	1649.5694	1508.6743	1279.3842	989.6704	697.8389	515.8306	536.9574	768.1678	1094.8131	1396.7518	1662.9869	(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													
	661.7158	515.7530	423.0617	250.6569	117.5863	0.0000	0.0000	0.0000	0.0000	243.6976	466.3901	682.8496	(98)
Space heating												3361.7110	(98)
RHI space heating demand												3362	(98)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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	48.0000 (1b)	x	2.4300 (2b)	=	116.6400	(1b) - (3b)
First floor	48.0000 (1c)	x	2.6700 (2c)	=	128.1600	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	96.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	244.8000	(5)

2. Ventilation rate

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

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			0.0000 / (5) =	0.0000	(8)
Pressure test				Yes	
Measured/design AP50				5.0000	
Infiltration rate				0.2500	(18)
Number of sides sheltered				2	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.2125	(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	0.2709	0.2656	0.2603	0.2338	0.2284	0.2019	0.2019	0.1966	0.2125	0.2284	0.2391	0.2497	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5209	0.5156	0.5103	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1			2.1200	1.8000	3.8160			(26a)
Opening Type 2 (Uw = 1.60)			13.9400	1.5038	20.9624			(27)
Heat Loss Floor 1			48.0000	0.1300	6.2400	75.0000	3600.0000	(28a)
External Wall 1	102.0000	16.0600	85.9400	0.1800	15.4692	110.0000	9453.4000	(29a)
External Roof 2	48.0000		48.0000	0.1300	6.2400	9.0000	432.0000	(30)
Total net area of external elements Aum(A, m2)			198.0000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	52.7276			(33)
Party Wall 1			40.8000	0.0000	0.0000	70.0000	2856.0000	(32)
Internal Wall 2			85.1000			9.0000	765.9000	(32c)
Internal Wall 2			20.4100			9.0000	183.6900	(32c)
Internal Floor 1			48.0000			18.0000	864.0000	(32d)
Internal Ceiling 1			48.0000			18.0000	864.0000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	19018.9900	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		198.1145	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		17.0076	(36)
Total fabric heat loss	(33) + (36) =	69.7352	(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	42.0834	41.6543	41.2251	40.3920	40.3920	40.3920	40.3920	40.3920	40.3920	40.3920	40.3920	40.3920	(38)
Heat transfer coeff	111.8186	111.3895	110.9603	110.1272	110.1272	110.1272	110.1272	110.1272	110.1272	110.1272	110.1272	110.1272	(39)
Average = Sum(39)m / 12 =												110.4428	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1648	1.1603	1.1558	1.1472	1.1472	1.1472	1.1472	1.1472	1.1472	1.1472	1.1472	1.1472	(40)
HLP (average)												1.1504	(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	2.6993 (42)
Average daily hot water use (litres/day)	98.3080 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF ENERGY RATINGS 09 Jan 2014

	108.1388	104.2065	100.2741	96.3418	92.4095	88.4772	88.4772	92.4095	96.3418	100.2741	104.2065	108.1388	(44)
Energy conte	160.3667	140.2577	144.7334	126.1821	121.0747	104.4783	96.8145	111.0960	112.4229	131.0180	143.0164	155.3066	(45)
Energy content (annual)										Total = Sum(45)m =		1546.7672	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.0550	21.0387	21.7100	18.9273	18.1612	15.6717	14.5222	16.6644	16.8634	19.6527	21.4525	23.2960	(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	50.9589	46.0274	50.9589	47.5110	47.0909	43.6326	45.0870	47.0909	47.5110	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	211.3256	186.2851	195.6923	173.6931	168.1656	148.1109	141.9015	158.1869	159.9339	181.9769	192.3315	206.2655	(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													
	211.3256	186.2851	195.6923	173.6931	168.1656	148.1109	141.9015	158.1869	159.9339	181.9769	192.3315	206.2655	(64)
Total per year (kWh/year) = Sum(64)m =												2123.8687	(64)
Heat gains from water heating, kWh/month													
	66.0616	58.1425	60.8636	53.8333	52.0301	45.6472	43.4626	48.7121	49.2584	56.3032	59.8817	64.3792	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	161.9570	161.9570	161.9570	161.9570	161.9570	161.9570	161.9570	161.9570	161.9570	161.9570	161.9570	161.9570	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	58.3864	51.8583	42.1740	31.9284	23.8669	20.1494	21.7722	28.3003	37.9846	48.2301	56.2917	60.0092	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	372.6781	376.5453	366.8000	346.0534	319.8646	295.2507	278.8072	274.9400	284.6853	305.4319	331.6207	356.2345	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.8950	53.8950	53.8950	53.8950	53.8950	53.8950	53.8950	53.8950	53.8950	53.8950	53.8950	53.8950	(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)													
	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	(71)
Water heating gains (Table 5)													
	88.7925	86.5216	81.8059	74.7685	69.9329	63.3988	58.4174	65.4733	68.4144	75.6764	83.1691	86.5311	(72)
Total internal gains													
	630.7377	625.8059	601.6605	563.6310	524.5450	489.6797	469.8774	479.5942	501.9649	540.2190	581.9621	613.6555	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.3300	10.6334	0.7600	0.7500	0.7700	18.1873	(74)
East	0.8700	19.6403	0.7600	0.7500	0.7700	6.7495	(76)
South	8.7400	46.7521	0.7600	0.7500	0.7700	161.4062	(78)

Solar gains	186.3431	312.3022	417.5293	507.1508	563.2380	558.2458	538.5028	496.0073	448.0479	342.1580	222.1737	160.1822	(83)
Total gains	817.0807	938.1081	1019.1898	1070.7818	1087.7830	1047.9255	1008.3802	975.6015	950.0128	882.3771	804.1358	773.8376	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	47.2466	47.4287	47.6121	47.9723	47.9723	47.9723	47.9723	47.9723	47.9723	47.9723	47.9723	47.9723	
alpha	4.1498	4.1619	4.1741	4.1982	4.1982	4.1982	4.1982	4.1982	4.1982	4.1982	4.1982	4.1982	
util living area	0.9815	0.9667	0.9398	0.8845	0.7825	0.6249	0.4688	0.5028	0.7086	0.8965	0.9670	0.9849	(86)
MIT	20.0027	20.1586	20.3644	20.5970	20.7836	20.8916	20.9251	20.9214	20.8594	20.6244	20.2740	19.9799	(87)
Th 2	19.9483	19.9519	19.9555	19.9625	19.9625	19.9625	19.9625	19.9625	19.9625	19.9625	19.9625	19.9625	(88)
util rest of house	0.9769	0.9586	0.9251	0.8559	0.7296	0.5402	0.3637	0.3968	0.6299	0.8648	0.9576	0.9811	(89)
MIT 2	18.6334	18.8596	19.1542	19.4798	19.7185	19.8366	19.8635	19.8614	19.8073	19.5234	19.0365	18.6117	(90)
Living area fraction									fLA = Living area / (4) =			0.1788	(91)
MIT	18.8782	19.0918	19.3705	19.6795	19.9089	20.0252	20.0533	20.0509	19.9954	19.7202	19.2577	18.8563	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.7282	18.9418	19.2205	19.5295	19.7589	19.8752	19.9033	19.9009	19.8454	19.5702	19.1077	18.7063	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9698	0.9487	0.9124	0.8418	0.7179	0.5326	0.3576	0.3903	0.6201	0.8503	0.9475	0.9748	(94)
Useful gains	792.3767	889.9407	929.8628	901.3993	780.9633	558.1251	360.5483	380.7733	589.0850	750.2854	761.9061	754.3599	(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	1613.3384	1564.1065	1411.4715	1170.6000	887.5020	580.9425	363.7828	385.5431	632.7228	987.8623	1322.3762	1597.5341	(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	610.7955	453.0394	358.3168	193.8245	79.2648	0.0000	0.0000	0.0000	0.0000	176.7572	403.5385	627.3216	(98)
Space heating												2902.8583	(98)
Space heating per m2											(98) / (4) =	30.2381	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.1000	(201)
Fraction of space heat from main system(s)												0.9000	(202)
Efficiency of main space heating system 1 (in %)												89.5000	(206)
Efficiency of secondary/supplementary heating system, %												65.0000	(208)
Space heating requirement												2919.0754	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	610.7955	453.0394	358.3168	193.8245	79.2648	0.0000	0.0000	0.0000	0.0000	176.7572	403.5385	627.3216	(98)
Space heating efficiency (main heating system 1)													
	89.5000	89.5000	89.5000	89.5000	89.5000	0.0000	0.0000	0.0000	0.0000	89.5000	89.5000	89.5000	(210)
Space heating fuel (main heating system)													
	614.2077	455.5704	360.3186	194.9073	79.7076	0.0000	0.0000	0.0000	0.0000	177.7447	405.7929	630.8262	(211)
Water heating requirement													
	93.9685	69.6984	55.1257	29.8192	12.1946	0.0000	0.0000	0.0000	0.0000	27.1934	62.0828	96.5110	(215)
Water heating													
Water heating requirement													
	211.3256	186.2851	195.6923	173.6931	168.1656	148.1109	141.9015	158.1869	159.9339	181.9769	192.3315	206.2655	(64)
Efficiency of water heater												89.5000	(216)
(217)m	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	(217)
Fuel for water heating, kWh/month													
	236.1180	208.1398	218.6506	194.0705	187.8945	165.4870	158.5491	176.7451	178.6971	203.3262	214.8955	230.4642	(219)
Water heating fuel used												2373.0377	(219)
Annual totals kWh/year													
Space heating fuel - main system												2919.0754	(211)
Space heating fuel - secondary												446.5936	(215)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 5.3360, total flow = 29.0000, SFP = 0.1840)													
mechanical ventilation fans (SFP = 0.1840)												54.9527	(230a)
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												129.9527	(231)
Electricity for lighting (calculated in Appendix L)												412.4489	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.00 * 1080 * 1.00) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												4553.8689	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2919.0754	3.4800	101.5838	(240)
Space heating - secondary	446.5936	4.2300	18.8909	(242)
Water heating (other fuel)	2373.0377	3.4800	82.5817	(247)
Mechanical ventilation fans	54.9527	13.1900	7.2483	(249)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	412.4489	13.1900	54.4020	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			166.7763	(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] =	0.4968	(257)
SAP value		93.0699	
SAP rating (Section 12)		93	(258)
SAP band		A	

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2919.0754	0.2160	630.5203	(261)
Space heating - secondary	446.5936	0.0190	8.4853	(263)
Water heating (other fuel)	2373.0377	0.2160	512.5761	(264)
Space and water heating			1151.5817	(265)
Pumps and fans	129.9527	0.5190	67.4455	(267)
Energy for lighting	412.4489	0.5190	214.0610	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			536.6509	(272)
CO2 emissions per m2			5.5900	(273)
EI value			94.8999	
EI rating			95	(274)
EI band			A	

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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Calculation of stars for heating and DHW
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Main heating energy efficiency                                  3.48 × (1 + 0.29 × 0.25) / 0.8950 = 4.170, stars = 4
Main heating environmental impact                       0.216 × (1 + 0.29 × 0.25) / 0.8950 = 0.2588, stars = 4
Water heating energy efficiency                                       3.48 / 0.8950 = 3.888, stars = 4
Water heating environmental impact                                  0.216 / 0.8950 = 0.2413, stars = 4


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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	48.0000 (1b)	x	2.4300 (2b)	=	116.6400	(1b) - (3b)
First floor	48.0000 (1c)	x	2.6700 (2c)	=	128.1600	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	96.0000					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	244.8000	(5)

2. Ventilation rate

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

				Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			0.0000 / (5) =	0.0000	(8)
Pressure test				Yes	
Measured/design AP50				5.0000	
Infiltration rate				0.2500	(18)
Number of sides sheltered				2	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.2125	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.0000	5.0000	4.9000	4.3000	4.2000	3.9000	3.7000	3.5000	3.9000	4.2000	4.5000	4.7000	(22)
Wind factor	1.2500	1.2500	1.2250	1.0750	1.0500	0.9750	0.9250	0.8750	0.9750	1.0500	1.1250	1.1750	(22a)
Adj infilt rate	0.2656	0.2656	0.2603	0.2284	0.2231	0.2072	0.1966	0.1859	0.2072	0.2231	0.2391	0.2497	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5156	0.5156	0.5103	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1			2.1200	1.8000	3.8160			(26a)
Opening Type 2 (Uw = 1.60)			13.9400	1.5038	20.9624			(27)
Heat Loss Floor 1			48.0000	0.1300	6.2400	75.0000	3600.0000	(28a)
External Wall 1	102.0000	16.0600	85.9400	0.1800	15.4692	110.0000	9453.4000	(29a)
External Roof 2	48.0000		48.0000	0.1300	6.2400	9.0000	432.0000	(30)
Total net area of external elements Aum(A, m2)			198.0000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		52.7276			(33)
Party Wall 1			40.8000	0.0000	0.0000	70.0000	2856.0000	(32)
Internal Wall 2			85.1000			9.0000	765.9000	(32c)
Internal Wall 2			20.4100			9.0000	183.6900	(32c)
Internal Floor 1			48.0000			18.0000	864.0000	(32d)
Internal Ceiling 1			48.0000			18.0000	864.0000	(32e)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		19018.9900	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							198.1145	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							17.0076	(36)
Total fabric heat loss					(33) + (36) =		69.7352	(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	41.6543	41.6543	41.2251	40.3920	40.3920	40.3920	40.3920	40.3920	40.3920	40.3920	40.3920	40.3920	(38)
Heat transfer coeff	111.3895	111.3895	110.9603	110.1272	110.1272	110.1272	110.1272	110.1272	110.1272	110.1272	110.1272	110.1272	(39)
Average = Sum(39)m / 12 =												110.4070	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1603	1.1603	1.1558	1.1472	1.1472	1.1472	1.1472	1.1472	1.1472	1.1472	1.1472	1.1472	(40)
HLP (average)												1.1501	(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	2.6993	(42)
Average daily hot water use (litres/day)	98.3080	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

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

	108.1388	104.2065	100.2741	96.3418	92.4095	88.4772	88.4772	92.4095	96.3418	100.2741	104.2065	108.1388	(44)
Energy conte	160.3667	140.2577	144.7334	126.1821	121.0747	104.4783	96.8145	111.0960	112.4229	131.0180	143.0164	155.3066	(45)
Energy content (annual)										Total = Sum(45)m =		1546.7672	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.0550	21.0387	21.7100	18.9273	18.1612	15.6717	14.5222	16.6644	16.8634	19.6527	21.4525	23.2960	(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	50.9589	46.0274	50.9589	47.5110	47.0909	43.6326	45.0870	47.0909	47.5110	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	211.3256	186.2851	195.6923	173.6931	168.1656	148.1109	141.9015	158.1869	159.9339	181.9769	192.3315	206.2655	(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													
	211.3256	186.2851	195.6923	173.6931	168.1656	148.1109	141.9015	158.1869	159.9339	181.9769	192.3315	206.2655	(64)
								Total per year (kWh/year) = Sum(64)m =				2123.8687	(64)
Heat gains from water heating, kWh/month													
	66.0616	58.1425	60.8636	53.8333	52.0301	45.6472	43.4626	48.7121	49.2584	56.3032	59.8817	64.3792	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	161.9570	161.9570	161.9570	161.9570	161.9570	161.9570	161.9570	161.9570	161.9570	161.9570	161.9570	161.9570	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	58.3864	51.8583	42.1740	31.9284	23.8669	20.1494	21.7722	28.3003	37.9846	48.2301	56.2917	60.0092	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	372.6781	376.5453	366.8000	346.0534	319.8646	295.2507	278.8072	274.9400	284.6853	305.4319	331.6207	356.2345	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.8950	53.8950	53.8950	53.8950	53.8950	53.8950	53.8950	53.8950	53.8950	53.8950	53.8950	53.8950	(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)													
	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	(71)
Water heating gains (Table 5)													
	88.7925	86.5216	81.8059	74.7685	69.9329	63.3988	58.4174	65.4733	68.4144	75.6764	83.1691	86.5311	(72)
Total internal gains													
	630.7377	625.8059	601.6605	563.6310	524.5450	489.6797	469.8774	479.5942	501.9649	540.2190	581.9621	613.6555	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.3300	9.8938	0.7600	0.7500	0.7700	16.9223	(74)
East	0.8700	18.2144	0.7600	0.7500	0.7700	6.2595	(76)
South	8.7400	43.9264	0.7600	0.7500	0.7700	151.6508	(78)

Solar gains	174.8327	293.8884	410.4666	502.6376	552.8980	542.0889	522.1762	475.3763	434.3949	321.2844	198.4575	147.2918	(83)
Total gains	805.5704	919.6943	1012.1272	1066.2685	1077.4430	1031.7685	992.0536	954.9705	936.3598	861.5034	780.4196	760.9472	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	47.4287	47.4287	47.6121	47.9723	47.9723	47.9723	47.9723	47.9723	47.9723	47.9723	47.9723	47.9723	
alpha	4.1619	4.1619	4.1741	4.1982	4.1982	4.1982	4.1982	4.1982	4.1982	4.1982	4.1982	4.1982	
util living area													
	0.9847	0.9739	0.9519	0.9094	0.8278	0.7090	0.6037	0.6386	0.7927	0.9267	0.9752	0.9877	(86)
MIT	19.9323	20.0610	20.2721	20.5104	20.7226	20.8526	20.9005	20.8908	20.7943	20.5244	20.1822	19.9030	(87)
Th 2	19.9519	19.9519	19.9555	19.9625	19.9625	19.9625	19.9625	19.9625	19.9625	19.9625	19.9625	19.9625	(88)
util rest of house													
	0.9810	0.9678	0.9405	0.8873	0.7849	0.6371	0.5109	0.5474	0.7329	0.9045	0.9684	0.9847	(89)
MIT 2	18.5340	18.7192	19.0233	19.3621	19.6438	19.7982	19.8453	19.8375	19.7361	19.3883	18.9047	18.4998	(90)
Living area fraction									fLA = Living area / (4) =			0.1788	(91)
MIT	18.7839	18.9590	19.2465	19.5673	19.8366	19.9867	20.0340	20.0258	19.9253	19.5914	19.1331	18.7506	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.6339	18.8090	19.0965	19.4173	19.6866	19.8367	19.8840	19.8758	19.7753	19.4414	18.9831	18.6006	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9747	0.9591	0.9288	0.8734	0.7718	0.6276	0.5034	0.5392	0.7205	0.8906	0.9597	0.9793	(94)
Useful gains	785.2199	882.0797	940.0430	931.2496	831.6243	647.5075	499.3817	514.8910	674.6654	767.2626	748.9877	745.1783	(95)
Ext temp.	3.6000	4.0000	5.5000	7.8000	10.7000	13.5000	15.2000	15.0000	12.8000	9.5000	6.3000	3.5000	(96)
Heat loss rate W													
	1674.6230	1649.5694	1508.6743	1279.3842	989.6704	697.8389	515.8306	536.9574	768.1678	1094.8131	1396.7518	1662.9869	(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													
	661.7158	515.7530	423.0617	250.6569	117.5863	0.0000	0.0000	0.0000	0.0000	243.6976	466.3901	682.8496	(98)
Space heating												3361.7110	(98)
Space heating per m2											(98) / (4) =	35.0178	(99)

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

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.1000	(201)
Fraction of space heat from main system(s)	0.9000	(202)
Efficiency of main space heating system 1 (in %)	89.5000	(206)
Efficiency of secondary/supplementary heating system, %	65.0000	(208)
Space heating requirement	3380.4915	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	661.7158	515.7530	423.0617	250.6569	117.5863	0.0000	0.0000	0.0000	0.0000	243.6976	466.3901	682.8496	(98)
Space heating efficiency (main heating system 1)													
	89.5000	89.5000	89.5000	89.5000	89.5000	0.0000	0.0000	0.0000	0.0000	89.5000	89.5000	89.5000	(210)
Space heating fuel (main heating system)													
	665.4126	518.6343	425.4251	252.0572	118.2432	0.0000	0.0000	0.0000	0.0000	245.0590	468.9957	686.6644	(211)
Water heating requirement													
	101.8024	79.3466	65.0864	38.5626	18.0902	0.0000	0.0000	0.0000	0.0000	37.4919	71.7523	105.0538	(215)
Water heating													
Water heating requirement													
	211.3256	186.2851	195.6923	173.6931	168.1656	148.1109	141.9015	158.1869	159.9339	181.9769	192.3315	206.2655	(64)
Efficiency of water heater												89.5000	(216)
(217)m	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	(217)
Fuel for water heating, kWh/month													
	236.1180	208.1398	218.6506	194.0705	187.8945	165.4870	158.5491	176.7451	178.6971	203.3262	214.8955	230.4642	(219)
Water heating fuel used												2373.0377	(219)
Annual totals kWh/year													
Space heating fuel - main system												3380.4915	(211)
Space heating fuel - secondary												517.1863	(215)
Electricity for pumps and fans:													
(MEVDecentralised, Database: total watage = 5.3360, total flow = 29.0000, SFP = 0.1840)													
mechanical ventilation fans (SFP = 0.1840)												54.9527	(230a)
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												129.9527	(231)
Electricity for lighting (calculated in Appendix L)												412.4489	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.00 * 1037 * 1.00) =										-1658.9172		-1658.9172	(233)
Total delivered energy for all uses												5154.1999	(238)

10a. Fuel costs - using BEDF prices (500)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3380.4915	3.6300	122.7118	(240)
Space heating - secondary	517.1863	5.1600	26.6868	(242)
Water heating (other fuel)	2373.0377	3.6300	86.1413	(247)
Mechanical ventilation fans	54.9527	19.4400	10.6828	(249)
Pumps and fans for heating	75.0000	19.4400	14.5800	(249)
Energy for lighting	412.4489	19.4400	80.1801	(250)
Additional standing charges			95.0000	(251)
Energy saving/generation technologies				
PV Unit	-1658.9172	19.4400	-322.4935	(252)
Total energy cost			113.4893	(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	3380.4915	0.2160	730.1862	(261)
Space heating - secondary	517.1863	0.0190	9.8265	(263)
Water heating (other fuel)	2373.0377	0.2160	512.5761	(264)
Space and water heating			1252.5888	(265)
Pumps and fans	129.9527	0.5190	67.4455	(267)
Energy for lighting	412.4489	0.5190	214.0610	(268)
Energy saving/generation technologies				
PV Unit	-1658.9172	0.5190	-860.9780	(269)
Total kg/year			673.1173	(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	3380.4915	1.2200	4124.1997	(261)
Space heating - secondary	517.1863	1.0400	537.8738	(263)
Water heating (other fuel)	2373.0377	1.2200	2895.1059	(264)
Space and water heating			7557.1794	(265)
Pumps and fans	129.9527	3.0700	398.9548	(267)
Energy for lighting	412.4489	3.0700	1266.2182	(268)

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

Energy saving/generation technologies			
PV Unit	-1658.9172	3.0700	-5092.8758 (269)
Primary energy kWh/year			4129.4765 (272)
Primary energy kWh/m2/year			43.0154 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: A 93
Current environmental impact rating: A 95

(For testing purposes):

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 25	-180 kg (26.7%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£25	1.87 kg/m²	A 94	A 97
Total Savings	£25	1.87 kg/m²		

Potential energy efficiency rating: A 94
Potential environmental impact rating: A 97

Fuel prices for cost data on this page from database revision number 500 TEST (30 Jun 2022)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£105	£115	-£10
Mains gas	£304	£269	£35
Wood	£27	£27	£0
Space heating	£270	£270	£0
Water heating	£86	£61	£25
Lighting	£80	£80	£0
Generated (PV)	-£322	-£322	£0
Total cost of fuels	£114	£89	£25
Total cost of uses	£114	£89	£25
Delivered energy	54 kWh/m²	44 kWh/m²	9 kWh/m²
Carbon dioxide emissions	0.7 tonnes	0.5 tonnes	0.2 tonnes
CO2 emissions per m²	7 kg/m²	5 kg/m²	2 kg/m²
Primary energy	43 kWh/m²	33 kWh/m²	11 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	48.0000	(1b)	x 2.4300	(2b) =	116.6400	(1b) - (3b)
First floor	48.0000	(1c)	x 2.6700	(2c) =	128.1600	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	96.0000					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	244.8000	(5)

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000	/ (5) =	0.0000	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.2500	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.2125	(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	0.2709	0.2656	0.2603	0.2338	0.2284	0.2019	0.2019	0.1966	0.2125	0.2284	0.2391	0.2497	(22b)
Mechanical extract ventilation - decentralised													
If mechanical ventilation:												0.5000	(23a)
Effective ac	0.5209	0.5156	0.5103	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1			2.1200	1.8000	3.8160			(26a)
Opening Type 2 (Uw = 1.60)			13.9400	1.5038	20.9624			(27)
Heat Loss Floor 1			48.0000	0.1300	6.2400	75.0000	3600.0000	(28a)
External Wall 1	102.0000	16.0600	85.9400	0.1800	15.4692	110.0000	9453.4000	(29a)
External Roof 2	48.0000		48.0000	0.1300	6.2400	9.0000	432.0000	(30)
Total net area of external elements Aum(A, m2)			198.0000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		52.7276			(33)
Party Wall 1			40.8000	0.0000	0.0000	70.0000	2856.0000	(32)
Internal Wall 2			85.1000			9.0000	765.9000	(32c)
Internal Wall 2			20.4100			9.0000	183.6900	(32c)
Internal Floor 1			48.0000			18.0000	864.0000	(32d)
Internal Ceiling 1			48.0000			18.0000	864.0000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	19018.9900 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		198.1145 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		17.0076 (36)
Total fabric heat loss	(33) + (36) =	69.7352 (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	42.0834	41.6543	41.2251	40.3920	40.3920	40.3920	40.3920	40.3920	40.3920	40.3920	40.3920	40.3920	(38)
Heat transfer coeff	111.8186	111.3895	110.9603	110.1272	110.1272	110.1272	110.1272	110.1272	110.1272	110.1272	110.1272	110.1272	(39)
Average = Sum(39)m / 12 =												110.4428	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1648	1.1603	1.1558	1.1472	1.1472	1.1472	1.1472	1.1472	1.1472	1.1472	1.1472	1.1472	(40)
HLP (average)												1.1504	(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	2.6993 (42)
Average daily hot water use (litres/day)	98.3080 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	108.1388	104.2065	100.2741	96.3418	92.4095	88.4772	88.4772	92.4095	96.3418	100.2741	104.2065	108.1388	(44)
Energy conte	160.3667	140.2577	144.7334	126.1821	121.0747	104.4783	96.8145	111.0960	112.4229	131.0180	143.0164	155.3066	(45)
Energy content (annual)										Total = Sum(45)m =		1546.7672	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.0550	21.0387	21.7100	18.9273	18.1612	15.6717	14.5222	16.6644	16.8634	19.6527	21.4525	23.2960	(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	50.9589	46.0274	50.9589	47.5110	47.0909	43.6326	45.0870	47.0909	47.5110	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	211.3256	186.2851	195.6923	173.6931	168.1656	148.1109	141.9015	158.1869	159.9339	181.9769	192.3315	206.2655	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1725	(H8)
Utilisation factor												0.5738	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												98.3080	(H14)
Volume ratio Veff/V												0.7629	(H15)
Solar storage volume factor												0.9459	(H16)
Solar input												-865.5226	(H17)
Solar input	-25.0984	-41.8821	-71.3300	-95.5962	-118.1010	-116.1121	-114.5777	-100.1071	-78.4039	-53.5407	-29.7704	-21.0031	(63)
								Solar input (sum of months) = Sum(63)m =				-865.5226	(63)
Output from w/h													
	186.2271	144.4030	124.3624	78.0969	50.0645	31.9987	27.3238	58.0798	81.5300	128.4363	162.5611	185.2624	(64)
								Total per year (kWh/year) = Sum(64)m =				1258.3461	(64)
Heat gains from water heating, kWh/month													
	66.0616	58.1425	60.8636	53.8333	52.0301	45.6472	43.4626	48.7121	49.2584	56.3032	59.8817	64.3792	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	161.9570	161.9570	161.9570	161.9570	161.9570	161.9570	161.9570	161.9570	161.9570	161.9570	161.9570	161.9570	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	58.3864	51.8583	42.1740	31.9284	23.8669	20.1494	21.7722	28.3003	37.9846	48.2301	56.2917	60.0092	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	372.6781	376.5453	366.8000	346.0534	319.8646	295.2507	278.8072	274.9400	284.6853	305.4319	331.6207	356.2345	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.8950	53.8950	53.8950	53.8950	53.8950	53.8950	53.8950	53.8950	53.8950	53.8950	53.8950	53.8950	(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)													
	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	(71)
Water heating gains (Table 5)													
	88.7925	86.5216	81.8059	74.7685	69.9329	63.3988	58.4174	65.4733	68.4144	75.6764	83.1691	86.5311	(72)
Total internal gains													
	630.7377	625.8059	601.6605	563.6310	524.5450	489.6797	469.8774	479.5942	501.9649	540.2190	581.9621	613.6555	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.3300	10.6334	0.7600	0.7500	0.7700	18.1873	(74)
East	0.8700	19.6403	0.7600	0.7500	0.7700	6.7495	(76)
South	8.7400	46.7521	0.7600	0.7500	0.7700	161.4062	(78)

Solar gains	186.3431	312.3022	417.5293	507.1508	563.2380	558.2458	538.5028	496.0073	448.0479	342.1580	222.1737	160.1822	(83)
Total gains	817.0807	938.1081	1019.1898	1070.7818	1087.7830	1047.9255	1008.3802	975.6015	950.0128	882.3771	804.1358	773.8376	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	47.2466	47.4287	47.6121	47.9723	47.9723	47.9723	47.9723	47.9723	47.9723	47.9723	47.9723	47.9723	
alpha	4.1498	4.1619	4.1741	4.1982	4.1982	4.1982	4.1982	4.1982	4.1982	4.1982	4.1982	4.1982	
util living area													
	0.9815	0.9667	0.9398	0.8845	0.7825	0.6249	0.4688	0.5028	0.7086	0.8965	0.9670	0.9849	(86)
MIT	20.0027	20.1586	20.3644	20.5970	20.7836	20.8916	20.9251	20.9214	20.8594	20.6244	20.2740	19.9799	(87)
Th 2	19.9483	19.9519	19.9555	19.9625	19.9625	19.9625	19.9625	19.9625	19.9625	19.9625	19.9625	19.9625	(88)
util rest of house													
	0.9769	0.9586	0.9251	0.8559	0.7296	0.5402	0.3637	0.3968	0.6299	0.8648	0.9576	0.9811	(89)
MIT 2	18.6334	18.8596	19.1542	19.4798	19.7185	19.8366	19.8635	19.8614	19.8073	19.5234	19.0365	18.6117	(90)
Living area fraction									fLA = Living area / (4) =			0.1788	(91)
MIT	18.8782	19.0918	19.3705	19.6795	19.9089	20.0252	20.0533	20.0509	19.9954	19.7202	19.2577	18.8563	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.7282	18.9418	19.2205	19.5295	19.7589	19.8752	19.9033	19.9009	19.8454	19.5702	19.1077	18.7063	(93)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9698	0.9487	0.9124	0.8418	0.7179	0.5326	0.3576	0.3903	0.6201	0.8503	0.9475	0.9748	(94)
Useful gains	792.3767	889.9407	929.8628	901.3993	780.9633	558.1251	360.5483	380.7733	589.0850	750.2854	761.9061	754.3599	(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	1613.3384	1564.1065	1411.4715	1170.6000	887.5020	580.9425	363.7828	385.5431	632.7228	987.8623	1322.3762	1597.5341	(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	610.7955	453.0394	358.3168	193.8245	79.2648	0.0000	0.0000	0.0000	0.0000	176.7572	403.5385	627.3216	(98)

Space heating 2902.8583 (98)
Space heating per m2 (98) / (4) = 30.2381 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11) 0.1000 (201)
Fraction of space heat from main system(s) 0.9000 (202)
Efficiency of main space heating system 1 (in %) 89.5000 (206)
Efficiency of secondary/supplementary heating system, % 65.0000 (208)
Space heating requirement 2919.0754 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	610.7955	453.0394	358.3168	193.8245	79.2648	0.0000	0.0000	0.0000	0.0000	176.7572	403.5385	627.3216	(98)
Space heating efficiency (main heating system 1)	89.5000	89.5000	89.5000	89.5000	0.0000	0.0000	0.0000	0.0000	0.0000	89.5000	89.5000	89.5000	(210)
Space heating fuel (main heating system)	614.2077	455.5704	360.3186	194.9073	79.7076	0.0000	0.0000	0.0000	0.0000	177.7447	405.7929	630.8262	(211)
Water heating requirement	93.9685	69.6984	55.1257	29.8192	12.1946	0.0000	0.0000	0.0000	0.0000	27.1934	62.0828	96.5110	(215)

Water heating
Water heating requirement

	186.2271	144.4030	124.3624	78.0969	50.0645	31.9987	27.3238	58.0798	81.5300	128.4363	162.5611	185.2624	(64)
Efficiency of water heater												89.5000	(216)
(217)m	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	(217)
Fuel for water heating, kWh/month	208.0750	161.3442	138.9523	87.2591	55.9380	35.7528	30.5294	64.8936	91.0949	143.5042	181.6325	206.9971	(219)

Water heating fuel used 1405.9732 (219)
Annual totals kWh/year
Space heating fuel - main system 2919.0754 (211)
Space heating fuel - secondary 446.5936 (215)

Electricity for pumps and fans:
(MEVDecentralised, Database: total watage = 5.3360, total flow = 29.0000, SFP = 0.1840)
mechanical ventilation fans (SFP = 0.1840) 54.9527 (230a)
central heating pump 30.0000 (230c)
main heating flue fan 45.0000 (230e)
pump for solar water heating 50.0000 (230g)
Total electricity for the above, kWh/year 179.9527 (231)
Electricity for lighting (calculated in Appendix L) 412.4489 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV Unit 0 (0.80 * 2.00 * 1080 * 1.00) = -1727.2394 -1727.2394 (233)
Total delivered energy for all uses 3636.8045 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2919.0754	3.4800	101.5838	(240)
Space heating - secondary	446.5936	4.2300	18.8909	(242)
Water heating (other fuel)	1405.9732	3.4800	48.9279	(247)
Mechanical ventilation fans	54.9527	13.1900	7.2483	(249)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	412.4489	13.1900	54.4020	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			139.7175	(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] = 0.4162 (257)
SAP value 94.1943
SAP rating (Section 12) 94 (258)
SAP band A

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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	2919.0754	0.2160	630.5203	(261)
Space heating - secondary	446.5936	0.0190	8.4853	(263)
Water heating (other fuel)	1405.9732	0.2160	303.6902	(264)
Space and water heating			942.6958	(265)
Pumps and fans	179.9527	0.5190	93.3955	(267)
Energy for lighting	412.4489	0.5190	214.0610	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			353.7150	(272)
CO2 emissions per m2			3.6800	(273)
EI value			96.6385	
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	48.0000	(1b)	x 2.4300	(2b) =	116.6400	(1b) - (3b)
First floor	48.0000	(1c)	x 2.6700	(2c) =	128.1600	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	96.0000					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	244.8000	(5)

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	0.0000	/ (5) =	0.0000	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.2500	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.2125	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.0000	5.0000	4.9000	4.3000	4.2000	3.9000	3.7000	3.5000	3.9000	4.2000	4.5000	4.7000	(22)
Wind factor	1.2500	1.2500	1.2250	1.0750	1.0500	0.9750	0.9250	0.8750	0.9750	1.0500	1.1250	1.1750	(22a)
Adj infilt rate	0.2656	0.2656	0.2603	0.2284	0.2231	0.2072	0.1966	0.1859	0.2072	0.2231	0.2391	0.2497	(22b)

Mechanical extract ventilation - decentralised
If mechanical ventilation: 0.5000 (23a)

Effective ac	0.5156	0.5156	0.5103	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	0.5000	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Opening Type 1			2.1200	1.8000	3.8160			(26a)
Opening Type 2 (Uw = 1.60)			13.9400	1.5038	20.9624			(27)
Heat Loss Floor 1			48.0000	0.1300	6.2400	75.0000	3600.0000	(28a)
External Wall 1	102.0000	16.0600	85.9400	0.1800	15.4692	110.0000	9453.4000	(29a)
External Roof 2	48.0000		48.0000	0.1300	6.2400	9.0000	432.0000	(30)
Total net area of external elements Aum(A, m2)			198.0000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	52.7276			(33)
Party Wall 1			40.8000	0.0000	0.0000	70.0000	2856.0000	(32)
Internal Wall 2			85.1000			9.0000	765.9000	(32c)
Internal Wall 2			20.4100			9.0000	183.6900	(32c)
Internal Floor 1			48.0000			18.0000	864.0000	(32d)
Internal Ceiling 1			48.0000			18.0000	864.0000	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	19018.9900 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		198.1145 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		17.0076 (36)
Total fabric heat loss	(33) + (36) =	69.7352 (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	41.6543	41.6543	41.2251	40.3920	40.3920	40.3920	40.3920	40.3920	40.3920	40.3920	40.3920	40.3920	(38)
Heat transfer coeff	111.3895	111.3895	110.9603	110.1272	110.1272	110.1272	110.1272	110.1272	110.1272	110.1272	110.1272	110.1272	(39)

Average = Sum(39)m / 12 = 110.4070 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1603	1.1603	1.1558	1.1472	1.1472	1.1472	1.1472	1.1472	1.1472	1.1472	1.1472	1.1472	(40)
HLP (average)												1.1501	(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 2.6993 (42)
Average daily hot water use (litres/day) 98.3080 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

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

	108.1388	104.2065	100.2741	96.3418	92.4095	88.4772	88.4772	92.4095	96.3418	100.2741	104.2065	108.1388	(44)
Energy conte	160.3667	140.2577	144.7334	126.1821	121.0747	104.4783	96.8145	111.0960	112.4229	131.0180	143.0164	155.3066	(45)
Energy content (annual)										Total = Sum(45)m =		1546.7672	(45)
Distribution loss (46)m = 0.15 x (45)m													
	24.0550	21.0387	21.7100	18.9273	18.1612	15.6717	14.5222	16.6644	16.8634	19.6527	21.4525	23.2960	(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	50.9589	46.0274	50.9589	47.5110	47.0909	43.6326	45.0870	47.0909	47.5110	50.9589	49.3151	50.9589	(61)
Total heat required for water heating calculated for each month													
	211.3256	186.2851	195.6923	173.6931	168.1656	148.1109	141.9015	158.1869	159.9339	181.9769	192.3315	206.2655	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1036.8233	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1741.8631	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.1261	(H8)
Utilisation factor												0.5885	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												98.3080	(H14)
Volume ratio Veff/V												0.7629	(H15)
Solar storage volume factor												0.9459	(H16)
Solar input												-852.5971	(H17)
Solar input	-23.9813	-40.1163	-71.3844	-96.6007	-118.4315	-115.2904	-113.5589	-97.9001	-77.4174	-51.1671	-27.0765	-19.6724	(63)
								Solar input (sum of months) = Sum(63)m =				-852.5971	(63)
Output from w/h													
	187.3443	146.1688	124.3079	77.0924	49.7341	32.8205	28.3426	60.2868	82.5165	130.8098	165.2550	186.5931	(64)
								Total per year (kWh/year) = Sum(64)m =				1271.2716	(64)
Heat gains from water heating, kWh/month													
	66.0616	58.1425	60.8636	53.8333	52.0301	45.6472	43.4626	48.7121	49.2584	56.3032	59.8817	64.3792	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	161.9570	161.9570	161.9570	161.9570	161.9570	161.9570	161.9570	161.9570	161.9570	161.9570	161.9570	161.9570	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	58.3864	51.8583	42.1740	31.9284	23.8669	20.1494	21.7722	28.3003	37.9846	48.2301	56.2917	60.0092	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	372.6781	376.5453	366.8000	346.0534	319.8646	295.2507	278.8072	274.9400	284.6853	305.4319	331.6207	356.2345	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.8950	53.8950	53.8950	53.8950	53.8950	53.8950	53.8950	53.8950	53.8950	53.8950	53.8950	53.8950	(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)													
	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	-107.9713	(71)
Water heating gains (Table 5)													
	88.7925	86.5216	81.8059	74.7685	69.9329	63.3988	58.4174	65.4733	68.4144	75.6764	83.1691	86.5311	(72)
Total internal gains													
	630.7377	625.8059	601.6605	563.6310	524.5450	489.6797	469.8774	479.5942	501.9649	540.2190	581.9621	613.6555	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.3300	9.8938	0.7600	0.7500	0.7700	16.9223	(74)
East	0.8700	18.2144	0.7600	0.7500	0.7700	6.2595	(76)
South	8.7400	43.9264	0.7600	0.7500	0.7700	151.6508	(78)

Solar gains	174.8327	293.8884	410.4666	502.6376	552.8980	542.0889	522.1762	475.3763	434.3949	321.2844	198.4575	147.2918	(83)
Total gains	805.5704	919.6943	1012.1272	1066.2685	1077.4430	1031.7685	992.0536	954.9705	936.3598	861.5034	780.4196	760.9472	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)

Utilisation factor for gains for living area, ni1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	47.4287	47.4287	47.6121	47.9723	47.9723	47.9723	47.9723	47.9723	47.9723	47.9723	47.9723	47.9723	
alpha	4.1619	4.1619	4.1741	4.1982	4.1982	4.1982	4.1982	4.1982	4.1982	4.1982	4.1982	4.1982	
util living area													
	0.9847	0.9739	0.9519	0.9094	0.8278	0.7090	0.6037	0.6386	0.7927	0.9267	0.9752	0.9877	(86)
MIT	19.9323	20.0610	20.2721	20.5104	20.7226	20.8526	20.9005	20.8908	20.7943	20.5244	20.1822	19.9030	(87)
Th 2	19.9519	19.9519	19.9555	19.9625	19.9625	19.9625	19.9625	19.9625	19.9625	19.9625	19.9625	19.9625	(88)
util rest of house													
	0.9810	0.9678	0.9405	0.8873	0.7849	0.6371	0.5109	0.5474	0.7329	0.9045	0.9684	0.9847	(89)
MIT 2	18.5340	18.7192	19.0233	19.3621	19.6438	19.7982	19.8453	19.8375	19.7361	19.3883	18.9047	18.4998	(90)
Living area fraction									fLA = Living area / (4) =			0.1788	(91)
MIT	18.7839	18.9590	19.2465	19.5673	19.8366	19.9867	20.0340	20.0258	19.9253	19.5914	19.1331	18.7506	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.6339	18.8090	19.0965	19.4173	19.6866	19.8367	19.8840	19.8758	19.7753	19.4414	18.9831	18.6006	(93)

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

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9747	0.9591	0.9288	0.8734	0.7718	0.6276	0.5034	0.5392	0.7205	0.8906	0.9597	0.9793	(94)
Useful gains	785.2199	882.0797	940.0430	931.2496	831.6243	647.5075	499.3817	514.8910	674.6654	767.2626	748.9877	745.1783	(95)
Ext temp.	3.6000	4.0000	5.5000	7.8000	10.7000	13.5000	15.2000	15.0000	12.8000	9.5000	6.3000	3.5000	(96)
Heat loss rate W	1674.6230	1649.5694	1508.6743	1279.3842	989.6704	697.8389	515.8306	536.9574	768.1678	1094.8131	1396.7518	1662.9869	(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	661.7158	515.7530	423.0617	250.6569	117.5863	0.0000	0.0000	0.0000	0.0000	243.6976	466.3901	682.8496	(98)

Space heating 3361.7110 (98)
Space heating per m2 (98) / (4) = 35.0178 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11) 0.1000 (201)
Fraction of space heat from main system(s) 0.9000 (202)
Efficiency of main space heating system 1 (in %) 89.5000 (206)
Efficiency of secondary/supplementary heating system, % 65.0000 (208)
Space heating requirement 3380.4915 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	661.7158	515.7530	423.0617	250.6569	117.5863	0.0000	0.0000	0.0000	0.0000	243.6976	466.3901	682.8496	(98)
Space heating efficiency (main heating system 1)	89.5000	89.5000	89.5000	89.5000	0.0000	0.0000	0.0000	0.0000	0.0000	89.5000	89.5000	89.5000	(210)
Space heating fuel (main heating system)	665.4126	518.6343	425.4251	252.0572	118.2432	0.0000	0.0000	0.0000	0.0000	245.0590	468.9957	686.6644	(211)
Water heating requirement	101.8024	79.3466	65.0864	38.5626	18.0902	0.0000	0.0000	0.0000	0.0000	37.4919	71.7523	105.0538	(215)

Water heating
Water heating requirement

	187.3443	146.1688	124.3079	77.0924	49.7341	32.8205	28.3426	60.2868	82.5165	130.8098	165.2550	186.5931	(64)
Efficiency of water heater												89.5000	(216)
(217)m	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	89.5000	(217)
Fuel for water heating, kWh/month	209.3232	163.3171	138.8915	86.1367	55.5688	36.6709	31.6677	67.3595	92.1972	146.1562	184.6425	208.4839	(219)

Water heating fuel used 1420.4152 (219)
Annual totals kWh/year
Space heating fuel - main system 3380.4915 (211)
Space heating fuel - secondary 517.1863 (215)

Electricity for pumps and fans:
(MEVDecentralised, Database: total watage = 5.3360, total flow = 29.0000, SFP = 0.1840)
mechanical ventilation fans (SFP = 0.1840) 54.9527 (230a)
central heating pump 30.0000 (230c)
main heating flue fan 45.0000 (230e)
pump for solar water heating 50.0000 (230g)
Total electricity for the above, kWh/year 179.9527 (231)
Electricity for lighting (calculated in Appendix L) 412.4489 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV Unit 0 (0.80 * 2.00 * 1037 * 1.00) = -1658.9172 -1658.9172 (233)
Total delivered energy for all uses 4251.5774 (238)

10a. Fuel costs - using BEDF prices (500)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3380.4915	3.6300	122.7118	(240)
Space heating - secondary	517.1863	5.1600	26.6868	(242)
Water heating (other fuel)	1420.4152	3.6300	51.5611	(247)
Mechanical ventilation fans	54.9527	19.4400	10.6828	(249)
Pumps and fans for heating	75.0000	19.4400	14.5800	(249)
Pump for solar water heating	50.0000	19.4400	9.7200	(249)
Energy for lighting	412.4489	19.4400	80.1801	(250)
Additional standing charges			95.0000	(251)
Energy saving/generation technologies				
PV Unit	-1658.9172	19.4400	-322.4935	(252)
Total energy cost			88.6291	(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	3380.4915	0.2160	730.1862	(261)
Space heating - secondary	517.1863	0.0190	9.8265	(263)
Water heating (other fuel)	1420.4152	0.2160	306.8097	(264)
Space and water heating			1046.8224	(265)

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

Pumps and fans	179.9527	0.5190	93.3955 (267)
Energy for lighting	412.4489	0.5190	214.0610 (268)
Energy saving/generation technologies			
PV Unit	-1658.9172	0.5190	-860.9780 (269)
Total kg/year			493.3008 (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	3380.4915	1.2200	4124.1997	(261)
Space heating - secondary	517.1863	1.0400	537.8738	(263)
Water heating (other fuel)	1420.4152	1.2200	1732.9065	(264)
Space and water heating			6394.9799	(265)
Pumps and fans	179.9527	3.0700	552.4548	(267)
Energy for lighting	412.4489	3.0700	1266.2182	(268)
Energy saving/generation technologies				
PV Unit	-1658.9172	3.0700	-5092.8758	(269)
Primary energy kWh/year			3120.7771	(272)
Primary energy kWh/m2/year			32.5081	(273)

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

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	No
SAP Region	North East England
Front of dwelling faces	North
Overshading	Average or unknown
Thermal mass parameter	198.1 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	2.50 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	201.96 (P1)
Transmission heat loss coefficient	69.74 (37)
Summer heat loss coefficient	271.70 (P2)

Overhangs

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

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North	0.800	0.90	1.000	0.720	(P8)
East	0.800	0.90	1.000	0.720	(P8)
South	0.800	0.90	1.000	0.720	(P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	4.3300	74.6426	0.7600	0.7500	0.7200	119.3781
East	0.8700	111.2086	0.7600	0.7500	0.7200	35.7361
South	8.7400	110.4126	0.7600	0.7500	0.7200	356.4347
total:						511.5490

	Jun	Jul	Aug	
Solar gains	522	512	468	(P3)
Internal gains	487	467	477	
Total summer gains	1008	978	944	(P5)
Summer gain/loss ratio	3.71	3.60	3.48	(P6)
Summer external temperature	13.80	15.80	15.60	
Thermal mass temperature increment (TMP = 198.1)	0.61	0.61	0.61	
Threshold temperature	18.12	20.01	19.69	(P7)
Likelihood of high internal temperature	Not significant	Not significant	Not significant	

Assessment of likelihood of high internal temperature: Not significant