BUILDING REGULATION COMPLIANCE
Calculation Type: New Build (As Built)

Property Reference	Pippin Barn	**Issued on Date**	18/12/2023
Assessment Reference	001	**Prop Type Ref**	2660
Property	Pippin Barn, Felderland Lane, Worth, DEAL, CT14 0BN		

SAP Rating	93 A	**DER**	7.45	**TER**	22.81
Environmental	93 A	**% DER<TER**	67.33		
CO_2 Emissions (t/year)	0.59	**DFEE**	44.14	**TFEE**	64.34
General Requirements Compliance	Pass	**% DFEE<TFEE**	31.39		

Assessor Details	Mr. Nick Gill, Nick Gill, Tel: 01444 657 756, info@pebble-energy.com	**Assessor ID**	AW10-0001
Client			

SUMARY FOR INPUT DATA FOR New Build (As Built)

Criterion 1 – Achieving the TER and TFEE rate

1a TER and DER

Fuel for main heating	Electricity		
Fuel factor	1.55 (electricity)		
Target Carbon Dioxide Emission Rate (TER)	22.81	$kgCO_2/m^2$	
Dwelling Carbon Dioxide Emission Rate (DER)	7.45	$kgCO_2/m^2$	Pass
	-15.36 (-67.3%)	$kgCO_2/m^2$	

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	64.34	$kWh/m^2/yr$	
Dwelling Fabric Energy Efficiency (DFEE)	44.14	$kWh/m^2/yr$	
	-20.2 (-31.4%)	$kWh/m^2/yr$	Pass

Criterion 2 – Limits on design flexibility

Limiting Fabric Standards

2 Fabric U-values

Element	Average	Highest	
External wall	0.14 (max. 0.30)	0.14 (max. 0.70)	Pass
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	Pass
Roof	0.15 (max. 0.20)	0.19 (max. 0.35)	Pass
Openings	0.70 (max. 2.00)	0.70 (max. 3.30)	Pass

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	1.93 (measured in this dwelling)	$m^3/(h.m^2)$ @ 50 Pa	
Maximum	10.0	$m^3/(h.m^2)$ @ 50 Pa	Pass

Limiting System Efficiencies

4 Heating efficiency

Main heating system	Other system - Electric Ceiling heating	
Secondary heating system	None	

This report has been produced by an accredited Elmhurst member whose work is subject to quality assurance audits. The data used to produce the report has been verified by the Elmhurst members' portal.

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

BUILDING REGULATION COMPLIANCE
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5 Cylinder insulation

Hot water storage	Measured cylinder loss: 1.75 kWh/day Permitted by DBSCG 2.86	Pass
Primary pipework insulated	No primary pipework	

6 Controls

Space heating controls	Time and temperature zone control	Pass
Hot water controls	Cylinderstat	Pass

7 Low energy lights

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

8 Mechanical ventilation

Continuous supply and extract system			
Specific fan power	0.79		
Maximum	1.5		Pass
MVHR efficiency	93	%	
Minimum	70	%	Pass

Criterion 3 – Limiting the effects of heat gains in summer

9 Summertime temperature

Overheating risk (South East England)	Slight	Pass

Based on:

Overshading	More than average
Windows facing North	9.56 m², No overhang
Windows facing East	2.10 m², No overhang
Windows facing South	57.12 m², No overhang
Windows facing West	18.48 m², No overhang
Air change rate	0.00 ach
Blinds/curtains	Dark-coloured curtain or roller blind, closed 100% of daylight hours

Criterion 4 – Building performance consistent with DER and DFEE rate

Air permeability and pressure testing

3 Air permeability

Air permeability at 50 pascals	1.93 (measured in this dwelling)	m³/(h.m²) @ 50 Pa	
Maximum	10.0	m³/(h.m²) @ 50 Pa	Pass

10 Key features

External wall U-value	0.14	W/m²K
Door U-value	0.70	W/m²K
Door U-value	0.70	W/m²K
Window U-value	0.70	W/m²K
Window U-value	0.70	W/m²K
Air permeability	1.9	m³/m²h
Photovoltaic array	9.14	kW

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

Property Reference	Pippin Barn	**Issued on Date**	18/12/2023
Assessment Reference	001	**Prop Type Ref**	2660
Property	Pippin Barn, Felderland Lane, Worth, DEAL, CT14 0BN		

SAP Rating	93 A	**DER**	7.45	**TER**	22.81
Environmental	93 A	**% DER<TER**	67.33		
CO_2 Emissions (t/year)	0.59	**DFEE**	44.14	**TFEE**	64.34
General Requirements Compliance	Pass	**% DFEE<TFEE**	31.39		

Assessor Details	Mr. Nick Gill, Nick Gill, Tel: 01444 657 756, info@pebble-energy.com	**Assessor ID**	AW10-0001
Client			

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

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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England
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DWELLING AS BUILT

Detached House, total floor area 320 m²

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

1a TER and DER
Fuel for main heating:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 22.81 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 7.45 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)64.3 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)44.1 kWh/m²/yrOK

---
2 Fabric U-values

Element	Average	Highest	
External wall	0.14 (max. 0.30)	0.14 (max. 0.70)	OK
Floor	0.13 (max. 0.25)	0.13 (max. 0.70)	OK
Roof	0.15 (max. 0.20)	0.19 (max. 0.35)	OK
Openings	0.70 (max. 2.00)	0.70 (max. 3.30)	OK

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

---
3 Air permeability
Air permeability at 50 pascals: 1.93 (measured in this dwelling)
Maximum 10.0 OK

---
4 Heating efficiency
Main heating system: Other system - Electric
Ceiling heating

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage Measured cylinder loss: 1.75 kWh/day
Permitted by DBSCG 2.86 OK
Primary pipework insulated: No primary pipework

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

Hot water controls: Cylinderstat OK

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

---
8 Mechanical ventilation
Continuous supply and extract system
Specific fan power: 0.79
Maximum 1.5 OK
MVHR efficiency: 93%
Minimum: 70% OK

---
9 Summertime temperature
Overheating risk (South East England): Slight OK
Based on:
Overshading: More than average
Windows facing North: 9.56 m², No overhang
Windows facing East: 2.10 m², No overhang
Windows facing South: 57.12 m², No overhang
Windows facing West: 18.48 m², No overhang
Air change rate: 0.00 ach
Blinds/curtains: Dark-coloured curtain or roller blind, closed 100% of daylight hours

---
10 Key features
External wall U-value 0.14 W/m²K
Door U-value 0.70 W/m²K
Door U-value 0.70 W/m²K
Window U-value 0.70 W/m²K
Window U-value 0.70 W/m²K
Air permeability 1.9 m³/m²h
Photovoltaic array 9.14 kW

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

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	176.1000 (1b)	x	2.4800 (2b)	=	436.7280	(1b) - (3b)
First floor	143.6200 (1c)	x	3.1500 (2c)	=	452.4030	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	319.7200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	889.1310	(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		1.9300	
Infiltration rate		0.0965	(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) =	0.0820	(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	0.1046	0.1025	0.1005	0.0902	0.0882	0.0779	0.0779	0.0759	0.0820	0.0882	0.0923	0.0964	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation:	0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	79.0500 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2093	0.2073	0.2052	0.1950	0.1929	0.1827	0.1827	0.1806	0.1868	0.1929	0.1970	0.2011	(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	
G.01			4.5300	0.7000	3.1710			(26a)
G.08			2.1000	0.7000	1.4700			(26)
G.02 (Uw = 0.70)			3.9200	0.6809	2.6693			(27)
G.03a (Uw = 0.70)			83.3400	0.6809	56.7490			(27)
Ground floor			176.1000	0.1300	22.8930			(28a)
External walls	359.5100	93.8900	265.6200	0.1400	37.1868			(29a)
Sloped roof	165.0000		165.0000	0.1400	23.1000			(30)
Balcony deck	32.5000		32.5000	0.1900	6.1750			(30)
Total net area of external elements Aum(A, m2)			733.1100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		153.4141			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	39.1953	(36)
Total fabric heat loss (33) + (36) =	192.6094	(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	61.4207	60.8191	60.2174	57.2090	56.6073	53.5989	53.5989	52.9972	54.8023	56.6073	57.8107	59.0140	(38)
Heat transfer coeff	254.0302	253.4285	252.8268	249.8184	249.2167	246.2083	246.2083	245.6066	247.4117	249.2167	250.4201	251.6234	(39)
Average = Sum(39)m / 12 =												249.6680	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7945	0.7927	0.7908	0.7814	0.7795	0.7701	0.7701	0.7682	0.7738	0.7795	0.7832	0.7870	(40)
HLP (average)												0.7809	(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	3.1576 (42)
Average daily hot water use (litres/day)	109.1922 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	120.1114	115.7437	111.3760	107.0083	102.6407	98.2730	98.2730	102.6407	107.0083	111.3760	115.7437	120.1114	(44)
Energy conte	178.1218	155.7864	160.7576	140.1524	134.4796	116.0456	107.5333	123.3961	124.8698	145.5237	158.8505	172.5014	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1718.0184	(45)
Distribution loss (46)m = 0.15 x (45)m													
	26.7183	23.3680	24.1136	21.0229	20.1719	17.4068	16.1300	18.5094	18.7305	21.8286	23.8276	25.8752	(46)
Water storage loss:													
Store volume												300.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7500	(48)
Temperature factor from Table 2b												0.6000	(49)
Enter (49) or (54) in (55)												1.0500	(55)
Total storage loss													
	32.5500	29.4000	32.5500	31.5000	32.5500	31.5000	32.5500	32.5500	31.5000	32.5500	31.5000	32.5500	(56)
If cylinder contains dedicated solar storage													
	32.5500	29.4000	32.5500	31.5000	32.5500	31.5000	32.5500	32.5500	31.5000	32.5500	31.5000	32.5500	(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)
Total heat required for water heating calculated for each month													
	210.6718	185.1864	193.3076	171.6524	167.0296	147.5456	140.0833	155.9461	156.3698	178.0737	190.3505	205.0514	(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													
	210.6718	185.1864	193.3076	171.6524	167.0296	147.5456	140.0833	155.9461	156.3698	178.0737	190.3505	205.0514	(64)
										Total per year (kWh/year) = Sum(64)m =		2101.2684	(64)
Heat gains from water heating, kWh/month													
	85.2655	75.3190	79.4919	71.8007	70.7545	63.7852	61.7948	67.0692	66.7192	74.4266	78.0178	83.3967	(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	157.8783	157.8783	157.8783	157.8783	157.8783	157.8783	157.8783	157.8783	157.8783	157.8783	157.8783	157.8783	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	42.7064	37.9315	30.8479	23.3539	17.4573	14.7382	15.9251	20.7001	27.7836	35.2777	41.1743	43.8934	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	474.0440	478.9631	466.5672	440.1777	406.8656	375.5570	354.6409	349.7218	362.1178	388.5073	421.8193	453.1280	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	38.7878	38.7878	38.7878	38.7878	38.7878	38.7878	38.7878	38.7878	38.7878	38.7878	38.7878	38.7878	(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)													
	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	(71)
Water heating gains (Table 5)													
	114.6041	112.0818	106.8440	99.7232	95.1001	88.5905	83.0576	90.1468	92.6656	100.0358	108.3581	112.0924	(72)
Total internal gains													
	701.7181	699.3399	674.6226	633.6182	589.7865	549.2492	523.9871	530.9322	552.9305	594.1843	641.7152	679.4772	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	3.9200	10.6334	0.5700	0.8000	0.5400	9.2376	(74)
North	5.6400	10.6334	0.5700	0.7000	0.5400	11.6295	(74)
East	2.1000	19.6403	0.5700	0.7000	0.5400	7.9979	(76)
South	57.1200	46.7521	0.5700	0.7000	0.5400	517.8430	(78)
West	18.4800	19.6403	0.5700	0.7000	0.5400	70.3815	(80)

Solar gains	617.0895	1041.2982	1400.5904	1698.1076	1870.3018	1843.4431	1782.7791	1655.9436	1503.6713	1144.1530	737.2927	529.3153	(83)
Total gains	1318.8076	1740.6381	2075.2130	2331.7258	2460.0883	2392.6923	2306.7662	2186.8757	2056.6018	1738.3373	1379.0079	1208.7924	(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	34.9609	35.0439	35.1273	35.5503	35.6361	36.0715	36.0715	36.1599	35.8961	35.6361	35.4649	35.2952	
alpha	3.3307	3.3363	3.3418	3.3700	3.3757	3.4048	3.4048	3.4107	3.3931	3.3757	3.3643	3.3530	
util living area													
	0.9858	0.9657	0.9292	0.8595	0.7480	0.5941	0.4499	0.4889	0.6959	0.8965	0.9727	0.9892	(86)
MIT	19.5128	19.7716	20.0875	20.4305	20.6904	20.8463	20.8988	20.8916	20.7875	20.4232	19.8927	19.4663	(87)
Th 2	20.2581	20.2597	20.2613	20.2695	20.2711	20.2793	20.2793	20.2810	20.2761	20.2711	20.2679	20.2646	(88)
util rest of house													
	0.9839	0.9611	0.9197	0.8406	0.7143	0.5414	0.3826	0.4210	0.6474	0.8784	0.9683	0.9877	(89)
MIT 2	18.2100	18.5863	19.0420	19.5329	19.8873	20.0905	20.1469	20.1422	20.0209	19.5321	18.7707	18.1469	(90)
Living area fraction									fLA = Living area / (4) =			0.2909	(91)
MIT	18.5889	18.9311	19.3461	19.7940	20.1209	20.3104	20.3656	20.3602	20.2439	19.7913	19.0971	18.5307	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5889	18.9311	19.3461	19.7940	20.1209	20.3104	20.3656	20.3602	20.2439	19.7913	19.0971	18.5307	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9779	0.9507	0.9057	0.8268	0.7068	0.5437	0.3909	0.4287	0.6451	0.8645	0.9592	0.9828	(94)
Useful gains	1289.6323	1654.7904	1879.5264	1927.8206	1738.7688	1300.9973	901.7805	937.5924	1326.6206	1502.7473	1322.8020	1188.0334	(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													
	3629.8210	3555.8790	3247.8494	2721.5173	2098.6358	1405.9398	927.1312	972.6414	1520.0626	2290.6289	3004.3082	3605.9423	(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													
	1741.1004	1277.5315	1018.0323	571.4617	267.7411	0.0000	0.0000	0.0000	0.0000	586.1839	1210.6844	1798.9242	(98)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Space heating			8471.6594 (98)
Space heating per m2		(98) / (4) =	26.4971 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	100.0000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	8471.6594 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1741.1004	1277.5315	1018.0323	571.4617	267.7411	0.0000	0.0000	0.0000	0.0000	586.1839	1210.6844	1798.9242	(98)
Space heating efficiency (main heating system 1)													
	100.0000	100.0000	100.0000	100.0000	100.0000	0.0000	0.0000	0.0000	0.0000	100.0000	100.0000	100.0000	(210)
Space heating fuel (main heating system)													
	1741.1004	1277.5315	1018.0323	571.4617	267.7411	0.0000	0.0000	0.0000	0.0000	586.1839	1210.6844	1798.9242	(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													
	210.6718	185.1864	193.3076	171.6524	167.0296	147.5456	140.0833	155.9461	156.3698	178.0737	190.3505	205.0514	(64)
Efficiency of water heater												100.0000	(216)
(217)m	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	(217)
Fuel for water heating, kWh/month													
	210.6718	185.1864	193.3076	171.6524	167.0296	147.5456	140.0833	155.9461	156.3698	178.0737	190.3505	205.0514	(219)
Water heating fuel used												2101.2684	(219)
Annual totals kWh/year													
Space heating fuel - main system												8471.6594	(211)
Space heating fuel - secondary												0.0000	(215)

Electricity for pumps and fans:		
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.9875)		
mechanical ventilation fans (SFP = 0.9875)		1071.1806 (230a)
Total electricity for the above, kWh/year		1071.1806 (231)
Electricity for lighting (calculated in Appendix L)		754.2087 (232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 9.14 * 1068 * 1.00) =	-7809.7314	-7809.7314 (233)
Total delivered energy for all uses		4588.5857 (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	8471.6594	0.5190	4396.7913	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2101.2684	0.5190	1090.5583	(264)
Space and water heating			5487.3495	(265)
Pumps and fans	1071.1806	0.5190	555.9427	(267)
Energy for lighting	754.2087	0.5190	391.4343	(268)
Energy saving/generation technologies				
PV Unit	-7809.7314	0.5190	-4053.2506	(269)
Total CO2, kg/year			2381.4760	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			7.4500	(273)

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

DER		7.4500	ZC1
Total Floor Area	TFA	319.7200	
Assumed number of occupants	N	3.1576	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		8.7861	ZC2
CO2 emissions from cooking, equation (L16)		0.6092	ZC3
Total CO2 emissions		16.8453	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		16.8453	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	176.1000 (1b)	x	2.4800 (2b)	=	436.7280	(1b) - (3b)
First floor	143.6200 (1c)	x	3.1500 (2c)	=	452.4030	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	319.7200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	889.1310	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0450	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.2950	(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) =	0.2507	(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	0.3197	0.3134	0.3072	0.2758	0.2695	0.2382	0.2382	0.2319	0.2507	0.2695	0.2821	0.2946	(22b)
Effective ac	0.5511	0.5491	0.5472	0.5380	0.5363	0.5284	0.5284	0.5269	0.5314	0.5363	0.5398	0.5434	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1000	1.0000	2.1000			(26)
TER Semi-glazed door			4.5300	1.2000	5.4360			(26a)
TER Opening Type (Uw = 1.40)			73.3000	1.3258	97.1780			(27)
Ground floor			176.1000	0.1300	22.8930			(28a)
External walls	359.5100	79.9300	279.5800	0.1800	50.3244			(29a)
Sloped roof	165.0000		165.0000	0.1300	21.4500			(30)
Balcony deck	32.5000		32.5000	0.1300	4.2250			(30)
Total net area of external elements Aum(A, m2)			733.1100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		203.6064			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	25.4136	(36)
Total fabric heat loss (33) + (36) =	229.0200	(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	161.7006	161.1183	160.5476	157.8670	157.3655	155.0308	155.0308	154.5985	155.9301	157.3655	158.3801	159.4408	(38)
Heat transfer coeff	390.7206	390.1384	389.5677	386.8871	386.3855	384.0509	384.0509	383.6185	384.9501	386.3855	387.4001	388.4608	(39)
Average = Sum(39)m / 12 =												386.8847	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2221	1.2203	1.2185	1.2101	1.2085	1.2012	1.2012	1.1999	1.2040	1.2085	1.2117	1.2150	(40)
HLP (average)												1.2101	(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	3.1576 (42)
Average daily hot water use (litres/day)	109.1922 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	120.1114	115.7437	111.3760	107.0083	102.6407	98.2730	98.2730	102.6407	107.0083	111.3760	115.7437	120.1114	(44)
Energy conte	178.1218	155.7864	160.7576	140.1524	134.4796	116.0456	107.5333	123.3961	124.8698	145.5237	158.8505	172.5014	(45)
Energy content (annual)										Total = Sum(45)m =		1718.0184	(45)
Distribution loss (46)m = 0.15 x (45)m	26.7183	23.3680	24.1136	21.0229	20.1719	17.4068	16.1300	18.5094	18.7305	21.8286	23.8276	25.8752	(46)
Water storage loss:													
Store volume												300.0000	(47)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

a) If manufacturer declared loss factor is known (kWh/day): 2.1127 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 1.1409 (55)
Total storage loss
35.3664 31.9439 35.3664 34.2256 35.3664 34.2256 35.3664 35.3664 34.2256 35.3664 34.2256 35.3664 (56)
If cylinder contains dedicated solar storage
35.3664 31.9439 35.3664 34.2256 35.3664 34.2256 35.3664 35.3664 34.2256 35.3664 34.2256 35.3664 (57)
Primary loss 23.2624 21.0112 23.2624 22.5120 23.2624 22.5120 23.2624 23.2624 22.5120 23.2624 22.5120 23.2624 (59)
Total heat required for water heating calculated for each month
236.7506 208.7415 219.3864 196.8900 193.1084 172.7832 166.1622 182.0249 181.6074 204.1526 215.5881 231.1302 (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
236.7506 208.7415 219.3864 196.8900 193.1084 172.7832 166.1622 182.0249 181.6074 204.1526 215.5881 231.1302 (64)
Total per year (kWh/year) = Sum(64)m = 2408.3254 (64)
Heat gains from water heating, kWh/month
106.1285 94.1630 100.3550 91.9907 91.6175 83.9752 82.6579 87.9322 86.9093 95.2897 98.2079 104.2598 (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	157.8783	157.8783	157.8783	157.8783	157.8783	157.8783	157.8783	157.8783	157.8783	157.8783	157.8783	157.8783	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	42.9802	38.1746	31.0457	23.5036	17.5692	14.8327	16.0272	20.8328	27.9617	35.5038	41.4382	44.1748	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	474.0440	478.9631	466.5672	440.1777	406.8656	375.5570	354.6409	349.7218	362.1178	388.5073	421.8193	453.1280	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	38.7878	38.7878	38.7878	38.7878	38.7878	38.7878	38.7878	38.7878	38.7878	38.7878	38.7878	38.7878	(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)													
	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	(71)
Water heating gains (Table 5)													
	142.6459	140.1236	134.8857	127.7649	123.1418	116.6323	111.0993	118.1885	120.7073	128.0775	136.3998	140.1341	(72)
Total internal gains													
	733.0336	730.6248	705.8621	664.8096	620.9401	580.3854	555.1309	562.1066	584.1503	625.4522	673.0209	710.8003	(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	8.0300	10.6334	0.6300	0.7000	0.5400	18.3005	(74)
East	1.7600	19.6403	0.6300	0.7000	0.5400	7.4086	(76)
South	47.9900	46.7521	0.6300	0.7000	0.5400	480.8686	(78)
West	15.5200	19.6403	0.6300	0.7000	0.5400	65.3302	(80)

Solar gains	571.9078	964.8044	1296.9481	1571.0372	1728.9405	1703.4599	1647.6774	1531.4954	1391.9383	1059.9075	683.2659	490.5877	(83)
Total gains	1304.9414	1695.4292	2002.8102	2235.8469	2349.8806	2283.8453	2202.8083	2093.6020	1976.0886	1685.3596	1356.2868	1201.3880	(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	56.8252	56.9100	56.9934	57.3883	57.4628	57.8121	57.8121	57.8772	57.6770	57.4628	57.3123	57.1558	
alpha	4.7883	4.7940	4.7996	4.8259	4.8309	4.8541	4.8541	4.8585	4.8451	4.8309	4.8208	4.8104	
util living area													
	0.9996	0.9986	0.9955	0.9850	0.9515	0.8581	0.7045	0.7516	0.9257	0.9912	0.9990	0.9998	(86)
MIT	19.4864	19.6693	19.9396	20.2797	20.6054	20.8550	20.9599	20.9444	20.7595	20.3176	19.8294	19.4541	(87)
Th 2	19.9024	19.9038	19.9053	19.9119	19.9132	19.9190	19.9190	19.9201	19.9168	19.9132	19.9107	19.9080	(88)
util rest of house													
	0.9995	0.9981	0.9938	0.9783	0.9265	0.7799	0.5608	0.6155	0.8763	0.9862	0.9986	0.9997	(89)
MIT 2	17.8675	18.1361	18.5319	19.0297	19.4890	19.8075	19.9023	19.8938	19.7006	19.0889	18.3754	17.8241	(90)
Living area fraction										fLA = Living area / (4) =		0.2909	(91)
MIT	18.3384	18.5821	18.9414	19.3933	19.8138	20.1122	20.2099	20.1994	20.0086	19.4463	18.7984	18.2983	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3384	18.5821	18.9414	19.3933	19.8138	20.1122	20.2099	20.1994	20.0086	19.4463	18.7984	18.2983	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9992	0.9972	0.9915	0.9739	0.9235	0.7963	0.6030	0.6548	0.8816	0.9831	0.9979	0.9995	(94)
Useful gains	1303.9141	1690.6866	1985.8054	2177.5790	2170.2273	1818.5590	1328.2325	1370.9213	1742.0780	1656.8347	1353.4521	1200.7527	(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													
	5485.0836	5337.9081	4846.7626	4059.7317	3135.0434	2116.9700	1386.3856	1457.5246	2274.5080	3418.0835	4531.9472	5476.6238	(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													
	3110.7902	2450.9329	2128.5522	1355.1499	717.8231	0.0000	0.0000	0.0000	0.0000	1310.3691	2288.5164	3181.2480	(98)
Space heating												16543.3818	(98)
Space heating per m2											(98) / (4) =	51.7433	(99)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												17693.4565	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	3110.7902	2450.9329	2128.5522	1355.1499	717.8231	0.0000	0.0000	0.0000	0.0000	1310.3691	2288.5164	3181.2480	(98)
Space heating efficiency (main heating system 1)													
	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)													
	3327.0483	2621.3186	2276.5264	1449.3582	767.7253	0.0000	0.0000	0.0000	0.0000	1401.4643	2447.6111	3402.4043	(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													
	236.7506	208.7415	219.3864	196.8900	193.1084	172.7832	166.1622	182.0249	181.6074	204.1526	215.5881	231.1302	(64)
Efficiency of water heater												79.8000	(216)
(217)m	89.6498	89.5575	89.3802	88.9864	87.9987	79.8000	79.8000	79.8000	79.8000	88.8933	89.4672	89.6855	(217)
Fuel for water heating, kWh/month													
	264.0836	233.0809	245.4531	221.2586	219.4447	216.5203	208.2233	228.1014	227.5782	229.6602	240.9689	257.7120	(219)
Water heating fuel used												2792.0850	(219)
Annual totals kWh/year													
Space heating fuel - main system												17693.4565	(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)												759.0440	(232)
Total delivered energy for all uses												21319.5855	(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	17693.4565	0.2160	3821.7866	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2792.0850	0.2160	603.0904	(264)
Space and water heating			4424.8770	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	759.0440	0.5190	393.9438	(268)
Total CO2, kg/m2/year			4857.7458	(272)
Emissions per m2 for space and water heating			13.8399	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			1.2322	(272b)
Emissions per m2 for pumps and fans			0.1217	(272c)
Target Carbon Dioxide Emission Rate (TER) = (13.8399 * 1.55) + 1.2322 + 0.1217, rounded to 2 d.p.			22.8100	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	176.1000	(1b)	x 2.4800	(2b) =	436.7280	(1b) - (3b)
First floor	143.6200	(1c)	x 3.1500	(2c) =	452.4030	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	319.7200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		889.1310	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0450	(8)
Pressure test		Yes	
Measured/design AP50		1.9300	
Infiltration rate		0.1415	(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) =	0.1203	(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	0.1533	0.1503	0.1473	0.1323	0.1293	0.1143	0.1143	0.1112	0.1203	0.1293	0.1353	0.1413	(22b)
Effective ac	0.5118	0.5113	0.5109	0.5088	0.5084	0.5065	0.5065	0.5062	0.5072	0.5084	0.5092	0.5100	(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	
G.01			4.5300	0.7000	3.1710			(26a)
G.08			2.1000	0.7000	1.4700			(26)
G.02 (Uw = 0.70)			3.9200	0.6809	2.6693			(27)
G.03a (Uw = 0.70)			83.3400	0.6809	56.7490			(27)
Ground floor			176.1000	0.1300	22.8930			(28a)
External walls	359.5100	93.8900	265.6200	0.1400	37.1868			(29a)
Sloped roof	165.0000		165.0000	0.1400	23.1000			(30)
Balcony deck	32.5000		32.5000	0.1900	6.1750			(30)
Total net area of external elements Aum(A, m2)			733.1100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		153.4141			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							39.1953	(36)
Total fabric heat loss					(33) + (36) =		192.6094	(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	150.1560	150.0221	149.8908	149.2741	149.1587	148.6216	148.6216	148.5222	148.8285	149.1587	149.3921	149.6362	(38)
Heat transfer coeff	342.7655	342.6315	342.5002	341.8835	341.7682	341.2311	341.2311	341.1316	341.4379	341.7682	342.0016	342.2456	(39)
Average = Sum(39)m / 12 =												341.8830	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.0721	1.0717	1.0713	1.0693	1.0690	1.0673	1.0673	1.0670	1.0679	1.0690	1.0697	1.0705	(40)
HLP (average)												1.0693	(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	3.1576	(42)
Average daily hot water use (litres/day)	109.1922	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	120.1114	115.7437	111.3760	107.0083	102.6407	98.2730	98.2730	102.6407	107.0083	111.3760	115.7437	120.1114	(44)
Energy conte	178.1218	155.7864	160.7576	140.1524	134.4796	116.0456	107.5333	123.3961	124.8698	145.5237	158.8505	172.5014	(45)
Energy content (annual)										Total = Sum(45)m =		1718.0184	(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:													

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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
37.8509 33.1046 34.1610 29.7824 28.5769 24.6597 22.8508 26.2217 26.5348 30.9238 33.7557 36.6565 (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	157.8783	157.8783	157.8783	157.8783	157.8783	157.8783	157.8783	157.8783	157.8783	157.8783	157.8783	157.8783	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	42.7064	37.9315	30.8479	23.3539	17.4573	14.7382	15.9251	20.7001	27.7836	35.2777	41.1743	43.8934	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	474.0440	478.9631	466.5672	440.1777	406.8656	375.5570	354.6409	349.7218	362.1178	388.5073	421.8193	453.1280	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	38.7878	38.7878	38.7878	38.7878	38.7878	38.7878	38.7878	38.7878	38.7878	38.7878	38.7878	38.7878	(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)													
	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	(71)
Water heating gains (Table 5)													
	50.8748	49.2628	45.9153	41.3644	38.4098	34.2496	30.7135	35.2442	36.8539	41.5642	46.8830	49.2696	(72)
Total internal gains													
	637.9888	636.5209	613.6939	575.2594	533.0962	494.9083	471.6430	476.0296	497.1188	535.7127	580.2401	616.6544	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	3.9200	10.6334	0.5700	0.8000	0.5400	9.2376	(74)
North	5.6400	10.6334	0.5700	0.7000	0.5400	11.6295	(74)
East	2.1000	19.6403	0.5700	0.7000	0.5400	7.9979	(76)
South	57.1200	46.7521	0.5700	0.7000	0.5400	517.8430	(78)
West	18.4800	19.6403	0.5700	0.7000	0.5400	70.3815	(80)

Solar gains	617.0895	1041.2982	1400.5904	1698.1076	1870.3018	1843.4431	1782.7791	1655.9436	1503.6713	1144.1530	737.2927	529.3153	(83)
Total gains	1255.0783	1677.8191	2014.2843	2273.3670	2403.3980	2338.3514	2254.4222	2131.9731	2000.7902	1679.8657	1317.5328	1145.9696	(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	25.9102	25.9203	25.9302	25.9770	25.9858	26.0267	26.0267	26.0343	26.0109	25.9858	25.9680	25.9495	
alpha	2.7273	2.7280	2.7287	2.7318	2.7324	2.7351	2.7351	2.7356	2.7341	2.7324	2.7312	2.7300	
util living area													
	0.9875	0.9726	0.9475	0.9017	0.8246	0.7068	0.5723	0.6128	0.7889	0.9275	0.9781	0.9902	(86)
MIT	18.4244	18.7688	19.2435	19.8003	20.3120	20.6944	20.8785	20.8488	20.5528	19.8523	19.0083	18.3481	(87)
Th 2	20.0237	20.0240	20.0244	20.0260	20.0263	20.0276	20.0276	20.0279	20.0271	20.0263	20.0257	20.0250	(88)
util rest of house													
	0.9855	0.9683	0.9390	0.8845	0.7905	0.6423	0.4734	0.5172	0.7364	0.9114	0.9740	0.9886	(89)
MIT 2	17.6388	17.9808	18.4500	18.9952	19.4825	19.8262	19.9688	19.9503	19.7105	19.0543	18.2224	17.5638	(90)
Living area fraction										fLA = Living area / (4) =		0.2909	(91)
MIT	17.8673	18.2100	18.6808	19.2294	19.7238	20.0788	20.2334	20.2116	19.9555	19.2864	18.4510	17.7919	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.8673	18.2100	18.6808	19.2294	19.7238	20.0788	20.2334	20.2116	19.9555	19.2864	18.4510	17.7919	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9793	0.9577	0.9240	0.8674	0.7783	0.6461	0.4959	0.5369	0.7319	0.8960	0.9648	0.9835	(94)
Useful gains	1229.1367	1606.7919	1861.2940	1971.9621	1870.6619	1510.7103	1118.0335	1144.5743	1464.4210	1505.1156	1271.2172	1127.0181	(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													
	4650.4188	4560.4300	4171.9176	3531.4490	2742.2833	1869.5229	1239.8229	1300.2693	1999.2952	2968.7490	3882.0480	4651.7805	(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													
	2545.4339	1984.8448	1719.1040	1122.8306	648.4863	0.0000	0.0000	0.0000	0.0000	1088.9433	1879.7982	2622.4233	(98)
Space heating												13611.8643	(98)
Space heating per m2											(98) / (4) =	42.5743	(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	3207.5720	2525.1098	2592.6001	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7246	0.7952	0.7690	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	2324.2330	2007.8419	1993.8156	0.0000	0.0000	0.0000	0.0000	(102)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	3141.5306	3031.1054	2875.8150	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	588.4543	761.3080	656.2076	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												2005.9699 (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	147.1136	190.3270	164.0519	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												501.4925 (107)
Space cooling per m2												1.5685 (108)
Energy for space heating												42.5743 (99)
Energy for space cooling												1.5685 (108)
Total												44.1429 (109)
Dwelling Fabric Energy Efficiency (DFEE)												44.1 (109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	176.1000 (1b)	x	2.4800 (2b)	=	436.7280	(1b) - (3b)
First floor	143.6200 (1c)	x	3.1500 (2c)	=	452.4030	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	319.7200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	889.1310	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.0450	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.2950	(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) =	0.2507	(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	0.3197	0.3134	0.3072	0.2758	0.2695	0.2382	0.2382	0.2319	0.2507	0.2695	0.2821	0.2946	(22b)
Effective ac	0.5511	0.5491	0.5472	0.5380	0.5363	0.5284	0.5284	0.5269	0.5314	0.5363	0.5398	0.5434	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
TER Opaque door			2.1000	1.0000	2.1000			(26)
TER Semi-glazed door			4.5300	1.2000	5.4360			(26a)
TER Opening Type (Uw = 1.40)			73.3000	1.3258	97.1780			(27)
Ground floor			176.1000	0.1300	22.8930			(28a)
External walls	359.5100	79.9300	279.5800	0.1800	50.3244			(29a)
Sloped roof	165.0000		165.0000	0.1300	21.4500			(30)
Balcony deck	32.5000		32.5000	0.1300	4.2250			(30)
Total net area of external elements Aum(A, m2)			733.1100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		203.6064			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	25.4136	(36)
Total fabric heat loss (33) + (36) =	229.0200	(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	161.7006	161.1183	160.5476	157.8670	157.3655	155.0308	155.0308	154.5985	155.9301	157.3655	158.3801	159.4408	(38)
Heat transfer coeff	390.7206	390.1384	389.5677	386.8871	386.3855	384.0509	384.0509	383.6185	384.9501	386.3855	387.4001	388.4608	(39)
Average = Sum(39)m / 12 =												386.8847	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.2221	1.2203	1.2185	1.2101	1.2085	1.2012	1.2012	1.1999	1.2040	1.2085	1.2117	1.2150	(40)
HLP (average)												1.2101	(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	3.1576 (42)
Average daily hot water use (litres/day)	109.1922 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	120.1114	115.7437	111.3760	107.0083	102.6407	98.2730	98.2730	102.6407	107.0083	111.3760	115.7437	120.1114	(44)
Energy conte	178.1218	155.7864	160.7576	140.1524	134.4796	116.0456	107.5333	123.3961	124.8698	145.5237	158.8505	172.5014	(45)
Energy content (annual)										Total = Sum(45)m =		1718.0184	(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													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(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													
	37.8509	33.1046	34.1610	29.7824	28.5769	24.6597	22.8508	26.2217	26.5348	30.9238	33.7557	36.6565	(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	157.8783	157.8783	157.8783	157.8783	157.8783	157.8783	157.8783	157.8783	157.8783	157.8783	157.8783	157.8783	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	42.9802	38.1746	31.0457	23.5036	17.5692	14.8327	16.0272	20.8328	27.9617	35.5038	41.4382	44.1748	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	474.0440	478.9631	466.5672	440.1777	406.8656	375.5570	354.6409	349.7218	362.1178	388.5073	421.8193	453.1280	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	38.7878	38.7878	38.7878	38.7878	38.7878	38.7878	38.7878	38.7878	38.7878	38.7878	38.7878	38.7878	(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)													
	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	(71)
Water heating gains (Table 5)													
	50.8748	49.2628	45.9153	41.3644	38.4098	34.2496	30.7135	35.2442	36.8539	41.5642	46.8830	49.2696	(72)
Total internal gains													
	638.2626	636.7641	613.8917	575.4092	533.2081	495.0027	471.7451	476.1623	497.2969	535.9389	580.5040	616.9358	(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	8.0300	10.6334	0.6300	0.7000	0.5400	18.3005	(74)
East	1.7600	19.6403	0.6300	0.7000	0.5400	7.4086	(76)
South	47.9900	46.7521	0.6300	0.7000	0.5400	480.8686	(78)
West	15.5200	19.6403	0.6300	0.7000	0.5400	65.3302	(80)

Solar gains	571.9078	964.8044	1296.9481	1571.0372	1728.9405	1703.4599	1647.6774	1531.4954	1391.9383	1059.9075	683.2659	490.5877	(83)
Total gains	1210.1704	1601.5685	1910.8398	2146.4464	2262.1486	2198.4626	2119.4225	2007.6577	1889.2352	1595.8463	1263.7700	1107.5235	(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	56.8252	56.9100	56.9934	57.3883	57.4628	57.8121	57.8121	57.8772	57.6770	57.4628	57.3123	57.1558	
alpha	4.7883	4.7940	4.7996	4.8259	4.8309	4.8541	4.8541	4.8585	4.8451	4.8309	4.8208	4.8104	
util living area													
	0.9997	0.9989	0.9964	0.9873	0.9575	0.8719	0.7240	0.7718	0.9358	0.9930	0.9993	0.9998	(86)
MIT	19.4589	19.6422	19.9135	20.2555	20.5852	20.8425	20.9548	20.9374	20.7417	20.2926	19.8026	19.4269	(87)
Th 2	19.9024	19.9038	19.9053	19.9119	19.9132	19.9190	19.9190	19.9201	19.9168	19.9132	19.9107	19.9080	(88)
util rest of house													
	0.9997	0.9985	0.9949	0.9815	0.9350	0.7974	0.5800	0.6371	0.8910	0.9889	0.9990	0.9998	(89)
MIT 2	18.4856	18.6699	18.9417	19.2862	19.6056	19.8347	19.9058	19.8993	19.7551	19.3260	18.8358	18.4580	(90)
Living area fraction									fLA = Living area / (4) =			0.2909	(91)
MIT	18.7687	18.9528	19.2244	19.5681	19.8905	20.1279	20.2110	20.2013	20.0421	19.6072	19.1170	18.7398	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7687	18.9528	19.2244	19.5681	19.8905	20.1279	20.2110	20.2013	20.0421	19.6072	19.1170	18.7398	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9995	0.9981	0.9936	0.9791	0.9344	0.8144	0.6228	0.6767	0.8976	0.9873	0.9986	0.9997	(94)
Useful gains	1209.5778	1598.4584	1898.6921	2101.5382	2113.7709	1790.3790	1320.0515	1358.5096	1695.7890	1575.6456	1262.0546	1107.1719	(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													
	5653.2331	5482.5210	4957.0068	4127.3662	3164.7009	2122.9772	1386.7899	1458.2413	2287.4054	3480.2458	4655.3941	5648.1608	(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													
	3306.0795	2610.0901	2275.3861	1458.5961	781.8919	0.0000	0.0000	0.0000	0.0000	1417.0226	2443.2045	3378.4957	(98)
Space heating												17670.7665	(98)
Space heating per m2										(98) / (4) =		55.2695	(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	3610.0780	2841.9763	2915.5006	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7380	0.8312	0.7984	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	2664.3213	2362.3870	2327.8723	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2960.3071	2856.2287	2714.8251	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)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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Space cooling kWh
              0.0000     0.0000     0.0000     0.0000     0.0000   213.1097   367.4183   287.8929     0.0000     0.0000     0.0000     0.0000 (104)
Space cooling                                                                                                                          868.4209 (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    53.2774    91.8546    71.9732     0.0000     0.0000     0.0000     0.0000 (107)
Space cooling                                                                                                                          217.1052 (107)
Space cooling per m2                                                                                                                     0.6790 (108)
Energy for space heating                                                                                                                55.2695 (99)
Energy for space cooling                                                                                                                 0.6790 (108)
Total                                                                                                                                   55.9486 (109)
Target Fabric Energy Efficiency (TFEE)                                                                                                  64.3 (109)


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CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	176.1000 (1b)	x	2.4800 (2b)	=	436.7280	(1b) - (3b)
First floor	143.6200 (1c)	x	3.1500 (2c)	=	452.4030	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	319.7200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	889.1310	(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		1.9300	
Infiltration rate		0.0965	(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) =	0.0820	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	6.5000	5.9000	5.6000	4.9000	4.9000	4.4000	4.8000	4.7000	5.1000	5.6000	5.7000	6.1000	(22)
Wind factor	1.6250	1.4750	1.4000	1.2250	1.2250	1.1000	1.2000	1.1750	1.2750	1.4000	1.4250	1.5250	(22a)
Adj infilt rate	0.1333	0.1210	0.1148	0.1005	0.1005	0.0902	0.0984	0.0964	0.1046	0.1148	0.1169	0.1251	(22b)

Balanced mechanical ventilation with heat recovery
If mechanical ventilation: 0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = 79.0500 (23c)

Effective ac	0.2380	0.2257	0.2196	0.2052	0.2052	0.1950	0.2032	0.2011	0.2093	0.2196	0.2216	0.2298	(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	
G.01			4.5300	0.7000	3.1710			(26a)
G.08			2.1000	0.7000	1.4700			(26)
G.02 (Uw = 0.70)			3.9200	0.6809	2.6693			(27)
G.03a (Uw = 0.70)			83.3400	0.6809	56.7490			(27)
Ground floor			176.1000	0.1300	22.8930			(28a)
External walls	359.5100	93.8900	265.6200	0.1400	37.1868			(29a)
Sloped roof	165.0000		165.0000	0.1400	23.1000			(30)
Balcony deck	32.5000		32.5000	0.1900	6.1750			(30)
Total net area of external elements Aum(A, m2)			733.1100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		153.4141			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	39.1953	(36)
Total fabric heat loss (33) + (36) =	192.6094	(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	69.8443	66.2342	64.4291	60.2174	60.2174	57.2090	59.6157	59.0140	61.4207	64.4291	65.0308	67.4375	(38)
Heat transfer coeff	262.4537	258.8436	257.0386	252.8268	252.8268	249.8184	252.2251	251.6234	254.0302	257.0386	257.6403	260.0470	(39)
Average = Sum(39)m / 12 =												255.5344	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8209	0.8096	0.8039	0.7908	0.7908	0.7814	0.7889	0.7870	0.7945	0.8039	0.8058	0.8134	(40)
HLP (average)												0.7992	(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	3.1576	(42)
Average daily hot water use (litres/day)	109.1922	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	120.1114	115.7437	111.3760	107.0083	102.6407	98.2730	98.2730	102.6407	107.0083	111.3760	115.7437	120.1114	(44)
Energy conte	178.1218	155.7864	160.7576	140.1524	134.4796	116.0456	107.5333	123.3961	124.8698	145.5237	158.8505	172.5014	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1718.0184	(45)
Distribution loss (46)m = 0.15 x (45)m													
	26.7183	23.3680	24.1136	21.0229	20.1719	17.4068	16.1300	18.5094	18.7305	21.8286	23.8276	25.8752	(46)
Water storage loss:													
Store volume												300.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7500	(48)
Temperature factor from Table 2b												0.6000	(49)
Enter (49) or (54) in (55)												1.0500	(55)
Total storage loss													
	32.5500	29.4000	32.5500	31.5000	32.5500	31.5000	32.5500	32.5500	31.5000	32.5500	31.5000	32.5500	(56)
If cylinder contains dedicated solar storage													
	32.5500	29.4000	32.5500	31.5000	32.5500	31.5000	32.5500	32.5500	31.5000	32.5500	31.5000	32.5500	(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)
Total heat required for water heating calculated for each month													
	210.6718	185.1864	193.3076	171.6524	167.0296	147.5456	140.0833	155.9461	156.3698	178.0737	190.3505	205.0514	(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													
	210.6718	185.1864	193.3076	171.6524	167.0296	147.5456	140.0833	155.9461	156.3698	178.0737	190.3505	205.0514	(64)
											Total per year (kWh/year) = Sum(64)m =	2101.2684	(64)
RHI water heating demand												2101	(64)
Heat gains from water heating, kWh/month													
	85.2655	75.3190	79.4919	71.8007	70.7545	63.7852	61.7948	67.0692	66.7192	74.4266	78.0178	83.3967	(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	189.4540	189.4540	189.4540	189.4540	189.4540	189.4540	189.4540	189.4540	189.4540	189.4540	189.4540	189.4540	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	106.7660	94.8287	77.1198	58.3847	43.6432	36.8455	39.8128	51.7502	69.4590	88.1942	102.9356	109.7334	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	707.5284	714.8704	696.3689	656.9816	607.2621	560.5328	529.3148	521.9729	540.4743	579.8617	629.5811	676.3104	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	57.1030	57.1030	57.1030	57.1030	57.1030	57.1030	57.1030	57.1030	57.1030	57.1030	57.1030	57.1030	(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)													
	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	(71)
Water heating gains (Table 5)													
	114.6041	112.0818	106.8440	99.7232	95.1001	88.5905	83.0576	90.1468	92.6656	100.0358	108.3581	112.0924	(72)
Total internal gains													
	1049.1529	1042.0351	1000.5870	935.3437	866.2597	806.2231	772.4395	784.1241	822.8532	888.3459	961.1291	1018.3904	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	3.9200	13.1177	0.5700	0.8000	0.5400	11.3958	(74)
North	5.6400	13.1177	0.5700	0.7000	0.5400	14.3465	(74)
East	2.1000	24.4891	0.5700	0.7000	0.5400	9.9724	(76)
South	57.1200	55.4171	0.5700	0.7000	0.5400	613.8206	(78)
West	18.4800	24.4891	0.5700	0.7000	0.5400	87.7574	(80)

Solar gains	737.2927	1071.4904	1478.1208	1974.1714	2077.8378	2157.0046	2073.5260	1909.4942	1703.1396	1291.4854	862.2063	593.3553	(83)
Total gains	1786.4456	2113.5256	2478.7079	2909.5151	2944.0975	2963.2277	2845.9655	2693.6183	2525.9928	2179.8313	1823.3354	1611.7457	(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	33.8388	34.3107	34.5517	35.1273	35.1273	35.5503	35.2110	35.2952	34.9609	34.5517	34.4710	34.1519	
alpha	3.2559	3.2874	3.3034	3.3418	3.3418	3.3700	3.3474	3.3530	3.3307	3.3034	3.2981	3.2768	
util living area													
	0.9603	0.9365	0.8790	0.7626	0.6270	0.4515	0.2975	0.2953	0.5002	0.7773	0.9229	0.9680	(86)
MIT	19.8044	19.9768	20.2913	20.6139	20.7985	20.8906	20.9142	20.9148	20.8795	20.6604	20.2233	19.7826	(87)
Th 2	20.2353	20.2450	20.2499	20.2613	20.2613	20.2695	20.2630	20.2646	20.2581	20.2499	20.2483	20.2418	(88)
util rest of house													
	0.9548	0.9282	0.8637	0.7356	0.5858	0.3982	0.2346	0.2289	0.4393	0.7422	0.9105	0.9633	(89)
MIT 2	18.6164	18.8702	19.3199	19.7717	20.0120	20.1267	20.1421	20.1444	20.1057	19.8337	19.2300	18.5905	(90)
Living area fraction										fLA = Living area / (4) =		0.2909	(91)
MIT	18.9620	19.1921	19.6025	20.0166	20.2408	20.3489	20.3667	20.3685	20.3308	20.0741	19.5189	18.9373	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9620	19.1921	19.6025	20.0166	20.2408	20.3489	20.3667	20.3685	20.3308	20.0741	19.5189	18.9373	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9432	0.9143	0.8487	0.7260	0.5846	0.4042	0.2435	0.2384	0.4454	0.7332	0.8962	0.9531	(94)
Useful gains	1684.9947	1932.3942	2103.5958	2112.2563	1721.1365	1197.6055	693.0598	642.1852	1125.1840	1598.2629	1634.0005	1536.0873	(95)
Ext temp.	5.5000	5.7000	7.4000	9.7000	12.7000	15.4000	17.6000	17.8000	15.7000	12.3000	8.8000	5.8000	(96)
Heat loss rate W													
	3533.1416	3492.3371	3136.5066	2608.3223	1906.5153	1236.3216	697.8355	646.2928	1176.3572	1998.2536	2761.6276	3416.3144	(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													

CALCULATION OF HEAT DEMAND 09 Jan 2014

	1375.0213	1048.2816	768.4856	357.1675	137.9219	0.0000	0.0000	0.0000	0.0000	297.5931	811.8915	1398.8889 (98)
Space heating												6195.2515 (98)
RHI space heating demand												6195 (98)

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

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	176.1000	(1b)	x 2.4800	(2b) =	436.7280	(1b) - (3b)
First floor	143.6200	(1c)	x 3.1500	(2c) =	452.4030	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	319.7200					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	889.1310	(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				1.9300	
Infiltration rate				0.0965	(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) =	0.0820	(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	0.1046	0.1025	0.1005	0.0902	0.0882	0.0779	0.0779	0.0759	0.0820	0.0882	0.0923	0.0964	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation:	0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	79.0500 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2093	0.2073	0.2052	0.1950	0.1929	0.1827	0.1827	0.1806	0.1868	0.1929	0.1970	0.2011	(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	
G.01			4.5300	0.7000	3.1710			(26a)
G.08			2.1000	0.7000	1.4700			(26)
G.02 (Uw = 0.70)			3.9200	0.6809	2.6693			(27)
G.03a (Uw = 0.70)			83.3400	0.6809	56.7490			(27)
Ground floor			176.1000	0.1300	22.8930			(28a)
External walls	359.5100	93.8900	265.6200	0.1400	37.1868			(29a)
Sloped roof	165.0000		165.0000	0.1400	23.1000			(30)
Balcony deck	32.5000		32.5000	0.1900	6.1750			(30)
Total net area of external elements Aum(A, m2)			733.1100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	153.4141			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	39.1953	(36)
Total fabric heat loss (33) + (36) =	192.6094	(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	61.4207	60.8191	60.2174	57.2090	56.6073	53.5989	53.5989	52.9972	54.8023	56.6073	57.8107	59.0140	(38)
Heat transfer coeff	254.0302	253.4285	252.8268	249.8184	249.2167	246.2083	246.2083	245.6066	247.4117	249.2167	250.4201	251.6234	(39)
Average = Sum(39)m / 12 =												249.6680	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7945	0.7927	0.7908	0.7814	0.7795	0.7701	0.7701	0.7682	0.7738	0.7795	0.7832	0.7870	(40)
HLP (average)												0.7809	(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	3.1576 (42)
Average daily hot water use (litres/day)	109.1922 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	120.1114	115.7437	111.3760	107.0083	102.6407	98.2730	98.2730	102.6407	107.0083	111.3760	115.7437	120.1114	(44)
Energy conte	178.1218	155.7864	160.7576	140.1524	134.4796	116.0456	107.5333	123.3961	124.8698	145.5237	158.8505	172.5014	(45)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1718.0184	(45)
Distribution loss (46)m = 0.15 x (45)m													
	26.7183	23.3680	24.1136	21.0229	20.1719	17.4068	16.1300	18.5094	18.7305	21.8286	23.8276	25.8752	(46)
Water storage loss:													
Store volume												300.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7500	(48)
Temperature factor from Table 2b												0.6000	(49)
Enter (49) or (54) in (55)												1.0500	(55)
Total storage loss													
	32.5500	29.4000	32.5500	31.5000	32.5500	31.5000	32.5500	32.5500	31.5000	32.5500	31.5000	32.5500	(56)
If cylinder contains dedicated solar storage													
	32.5500	29.4000	32.5500	31.5000	32.5500	31.5000	32.5500	32.5500	31.5000	32.5500	31.5000	32.5500	(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)
Total heat required for water heating calculated for each month													
	210.6718	185.1864	193.3076	171.6524	167.0296	147.5456	140.0833	155.9461	156.3698	178.0737	190.3505	205.0514	(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													
	210.6718	185.1864	193.3076	171.6524	167.0296	147.5456	140.0833	155.9461	156.3698	178.0737	190.3505	205.0514	(64)
											Total per year (kWh/year) = Sum(64)m =	2101.2684	(64)
Heat gains from water heating, kWh/month													
	85.2655	75.3190	79.4919	71.8007	70.7545	63.7852	61.7948	67.0692	66.7192	74.4266	78.0178	83.3967	(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	189.4540	189.4540	189.4540	189.4540	189.4540	189.4540	189.4540	189.4540	189.4540	189.4540	189.4540	189.4540	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	106.7660	94.8287	77.1198	58.3847	43.6432	36.8455	39.8128	51.7502	69.4590	88.1942	102.9356	109.7334	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	707.5284	714.8704	696.3689	656.9816	607.2621	560.5328	529.3148	521.9729	540.4743	579.8617	629.5811	676.3104	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	57.1030	57.1030	57.1030	57.1030	57.1030	57.1030	57.1030	57.1030	57.1030	57.1030	57.1030	57.1030	(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)													
	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	(71)
Water heating gains (Table 5)													
	114.6041	112.0818	106.8440	99.7232	95.1001	88.5905	83.0576	90.1468	92.6656	100.0358	108.3581	112.0924	(72)
Total internal gains													
	1049.1529	1042.0351	1000.5870	935.3437	866.2597	806.2231	772.4395	784.1241	822.8532	888.3459	961.1291	1018.3904	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	3.9200	10.6334	0.5700	0.8000	0.5400	9.2376	(74)
North	5.6400	10.6334	0.5700	0.7000	0.5400	11.6295	(74)
East	2.1000	19.6403	0.5700	0.7000	0.5400	7.9979	(76)
South	57.1200	46.7521	0.5700	0.7000	0.5400	517.8430	(78)
West	18.4800	19.6403	0.5700	0.7000	0.5400	70.3815	(80)

Solar gains	617.0895	1041.2982	1400.5904	1698.1076	1870.3018	1843.4431	1782.7791	1655.9436	1503.6713	1144.1530	737.2927	529.3153	(83)
Total gains	1666.2424	2083.3333	2401.1774	2633.4513	2736.5615	2649.6662	2555.2186	2440.0677	2326.5245	2032.4990	1698.4218	1547.7057	(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	34.9609	35.0439	35.1273	35.5503	35.6361	36.0715	36.0715	36.1599	35.8961	35.6361	35.4649	35.2952	
alpha	3.3307	3.3363	3.3418	3.3700	3.3757	3.4048	3.4048	3.4107	3.3931	3.3757	3.3643	3.3530	
util living area													
	0.9725	0.9451	0.9002	0.8212	0.7037	0.5490	0.4105	0.4444	0.6418	0.8549	0.9521	0.9779	(86)
MIT	19.6659	19.9093	20.1992	20.5067	20.7317	20.8623	20.9042	20.8990	20.8174	20.5094	20.0251	19.6186	(87)
Th 2	20.2581	20.2597	20.2613	20.2695	20.2711	20.2793	20.2793	20.2810	20.2761	20.2711	20.2679	20.2646	(88)
util rest of house													
	0.9689	0.9381	0.8879	0.7994	0.6684	0.4976	0.3478	0.3808	0.5925	0.8323	0.9449	0.9749	(89)
MIT 2	18.4318	18.7836	19.1986	19.6350	19.9380	20.1070	20.1511	20.1482	20.0541	19.6481	18.9603	18.3681	(90)
Living area fraction									fLA = Living area / (4) =			0.2909	(91)
MIT	18.7908	19.1110	19.4896	19.8886	20.1689	20.3267	20.3701	20.3666	20.2761	19.8987	19.2700	18.7318	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7908	19.1110	19.4896	19.8886	20.1689	20.3267	20.3701	20.3666	20.2761	19.8987	19.2700	18.7318	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9596	0.9251	0.8730	0.7869	0.6631	0.5011	0.3558	0.3886	0.5925	0.8192	0.9328	0.9669	(94)
Useful gains	1598.9910	1927.3944	2096.1495	2072.3000	1814.7496	1327.8622	909.2151	948.2242	1378.5034	1665.0539	1584.3552	1496.5240	(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													
	3681.0883	3601.4740	3284.1279	2745.1439	2110.5821	1409.9594	928.2416	974.2263	1528.0487	2317.3793	3047.6083	3656.5541	(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													
	1549.0804	1124.9815	883.8560	484.4476	220.0994	0.0000	0.0000	0.0000	0.0000	485.3302	1053.5422	1607.0624	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Space heating		7408.3996 (98)
Space heating per m2	(98) / (4) =	23.1715 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)		0.0000 (201)
Fraction of space heat from main system(s)		1.0000 (202)
Efficiency of main space heating system 1 (in %)		100.0000 (206)
Efficiency of secondary/supplementary heating system, %		0.0000 (208)
Space heating requirement		7408.3996 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1549.0804	1124.9815	883.8560	484.4476	220.0994	0.0000	0.0000	0.0000	0.0000	485.3302	1053.5422	1607.0624	(98)
Space heating efficiency (main heating system 1)													
	100.0000	100.0000	100.0000	100.0000	100.0000	0.0000	0.0000	0.0000	0.0000	100.0000	100.0000	100.0000	(210)
Space heating fuel (main heating system)													
	1549.0804	1124.9815	883.8560	484.4476	220.0994	0.0000	0.0000	0.0000	0.0000	485.3302	1053.5422	1607.0624	(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													
	210.6718	185.1864	193.3076	171.6524	167.0296	147.5456	140.0833	155.9461	156.3698	178.0737	190.3505	205.0514	(64)
Efficiency of water heater												100.0000	(216)
(217)m	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	(217)
Fuel for water heating, kWh/month													
	210.6718	185.1864	193.3076	171.6524	167.0296	147.5456	140.0833	155.9461	156.3698	178.0737	190.3505	205.0514	(219)
Water heating fuel used												2101.2684	(219)
Annual totals kWh/year													
Space heating fuel - main system												7408.3996	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.9875)													
mechanical ventilation fans (SFP = 0.9875)												1071.1806	(230a)
Total electricity for the above, kWh/year												1071.1806	(231)
Electricity for lighting (calculated in Appendix L)												754.2087	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 9.14 * 1068 * 1.00) =										-7809.7314		-7809.7314	(233)
Total delivered energy for all uses												3525.3259	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	7408.3996	13.1900	977.1679	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2101.2684	13.1900	277.1573	(247)
Mechanical ventilation fans	1071.1806	13.1900	141.2887	(249)
Pumps and fans for heating	0.0000	0.0000	0.0000	(249)
Energy for lighting	754.2087	13.1900	99.4801	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-7809.7314	13.1900	-1030.1036	(252)
Total energy cost			464.9905	(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] =	0.5355 (257)
SAP value		92.5302
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	7408.3996	0.5190	3844.9594	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2101.2684	0.5190	1090.5583	(264)
Space and water heating			4935.5177	(265)
Pumps and fans	1071.1806	0.5190	555.9427	(267)
Energy for lighting	754.2087	0.5190	391.4343	(268)
Energy saving/generation technologies				
PV Unit	-7809.7314	0.5190	-4053.2506	(269)
Total kg/year			1829.6441	(272)
CO2 emissions per m2			5.7200	(273)
EI value			93.2778	

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EI rating	93 (274)
EI band	A

Calculation of stars for heating and DHW

Main heating energy efficiency	13.19 × (1 + 0.29 × 0.25) / 1.0000 = 14.146, stars = 1
Main heating environmental impact	0.519 × (1 + 0.29 × 0.25) / 1.0000 = 0.5566, stars = 1
Water heating energy efficiency	13.19 / 1.0000 = 13.190, stars = 1
Water heating environmental impact	0.519 / 1.0000 = 0.5190, stars = 2

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

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	176.1000 (1b)	x	2.4800 (2b)	=	436.7280	(1b) - (3b)
First floor	143.6200 (1c)	x	3.1500 (2c)	=	452.4030	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	319.7200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	889.1310	(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		1.9300	
Infiltration rate		0.0965	(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) =	0.0820	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	6.5000	5.9000	5.6000	4.9000	4.9000	4.4000	4.8000	4.7000	5.1000	5.6000	5.7000	6.1000	(22)
Wind factor	1.6250	1.4750	1.4000	1.2250	1.2250	1.1000	1.2000	1.1750	1.2750	1.4000	1.4250	1.5250	(22a)
Adj infilt rate	0.1333	0.1210	0.1148	0.1005	0.1005	0.0902	0.0984	0.0964	0.1046	0.1148	0.1169	0.1251	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation:	0.5000	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	79.0500	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2380	0.2257	0.2196	0.2052	0.2052	0.1950	0.2032	0.2011	0.2093	0.2196	0.2216	0.2298	(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	
G.01			4.5300	0.7000	3.1710			(26a)
G.08			2.1000	0.7000	1.4700			(26)
G.02 (Uw = 0.70)			3.9200	0.6809	2.6693			(27)
G.03a (Uw = 0.70)			83.3400	0.6809	56.7490			(27)
Ground floor			176.1000	0.1300	22.8930			(28a)
External walls	359.5100	93.8900	265.6200	0.1400	37.1868			(29a)
Sloped roof	165.0000		165.0000	0.1400	23.1000			(30)
Balcony deck	32.5000		32.5000	0.1900	6.1750			(30)
Total net area of external elements Aum(A, m2)			733.1100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		153.4141			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	39.1953	(36)
Total fabric heat loss (33) + (36) =	192.6094	(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	69.8443	66.2342	64.4291	60.2174	60.2174	57.2090	59.6157	59.0140	61.4207	64.4291	65.0308	67.4375	(38)
Heat transfer coeff	262.4537	258.8436	257.0386	252.8268	252.8268	249.8184	252.2251	251.6234	254.0302	257.0386	257.6403	260.0470	(39)
Average = Sum(39)m / 12 =												255.5344	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8209	0.8096	0.8039	0.7908	0.7908	0.7814	0.7889	0.7870	0.7945	0.8039	0.8058	0.8134	(40)
HLP (average)												0.7992	(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	3.1576	(42)
Average daily hot water use (litres/day)	109.1922	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	120.1114	115.7437	111.3760	107.0083	102.6407	98.2730	98.2730	102.6407	107.0083	111.3760	115.7437	120.1114	(44)
Energy conte	178.1218	155.7864	160.7576	140.1524	134.4796	116.0456	107.5333	123.3961	124.8698	145.5237	158.8505	172.5014	(45)

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

Energy content (annual)											Total = Sum(45)m =	1718.0184	(45)
Distribution loss (46)m = 0.15 x (45)m													
	26.7183	23.3680	24.1136	21.0229	20.1719	17.4068	16.1300	18.5094	18.7305	21.8286	23.8276	25.8752	(46)
Water storage loss:													
Store volume												300.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7500	(48)
Temperature factor from Table 2b												0.6000	(49)
Enter (49) or (54) in (55)												1.0500	(55)
Total storage loss													
	32.5500	29.4000	32.5500	31.5000	32.5500	31.5000	32.5500	32.5500	31.5000	32.5500	31.5000	32.5500	(56)
If cylinder contains dedicated solar storage													
	32.5500	29.4000	32.5500	31.5000	32.5500	31.5000	32.5500	32.5500	31.5000	32.5500	31.5000	32.5500	(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)
Total heat required for water heating calculated for each month													
	210.6718	185.1864	193.3076	171.6524	167.0296	147.5456	140.0833	155.9461	156.3698	178.0737	190.3505	205.0514	(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													
	210.6718	185.1864	193.3076	171.6524	167.0296	147.5456	140.0833	155.9461	156.3698	178.0737	190.3505	205.0514	(64)
											Total per year (kWh/year) = Sum(64)m =	2101.2684	(64)
Heat gains from water heating, kWh/month													
	85.2655	75.3190	79.4919	71.8007	70.7545	63.7852	61.7948	67.0692	66.7192	74.4266	78.0178	83.3967	(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	189.4540	189.4540	189.4540	189.4540	189.4540	189.4540	189.4540	189.4540	189.4540	189.4540	189.4540	189.4540	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	106.7660	94.8287	77.1198	58.3847	43.6432	36.8455	39.8128	51.7502	69.4590	88.1942	102.9356	109.7334	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	707.5284	714.8704	696.3689	656.9816	607.2621	560.5328	529.3148	521.9729	540.4743	579.8617	629.5811	676.3104	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	57.1030	57.1030	57.1030	57.1030	57.1030	57.1030	57.1030	57.1030	57.1030	57.1030	57.1030	57.1030	(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)													
	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	(71)
Water heating gains (Table 5)													
	114.6041	112.0818	106.8440	99.7232	95.1001	88.5905	83.0576	90.1468	92.6656	100.0358	108.3581	112.0924	(72)
Total internal gains													
	1049.1529	1042.0351	1000.5870	935.3437	866.2597	806.2231	772.4395	784.1241	822.8532	888.3459	961.1291	1018.3904	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	3.9200	13.1177	0.5700	0.8000	0.5400	11.3958	(74)
North	5.6400	13.1177	0.5700	0.7000	0.5400	14.3465	(74)
East	2.1000	24.4891	0.5700	0.7000	0.5400	9.9724	(76)
South	57.1200	55.4171	0.5700	0.7000	0.5400	613.8206	(78)
West	18.4800	24.4891	0.5700	0.7000	0.5400	87.7574	(80)

Solar gains	737.2927	1071.4904	1478.1208	1974.1714	2077.8378	2157.0046	2073.5260	1909.4942	1703.1396	1291.4854	862.2063	593.3553	(83)
Total gains	1786.4456	2113.5256	2478.7079	2909.5151	2944.0975	2963.2277	2845.9655	2693.6183	2525.9928	2179.8313	1823.3354	1611.7457	(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	33.8388	34.3107	34.5517	35.1273	35.1273	35.5503	35.2110	35.2952	34.9609	34.5517	34.4710	34.1519	
alpha	3.2559	3.2874	3.3034	3.3418	3.3418	3.3700	3.3474	3.3530	3.3307	3.3034	3.2981	3.2768	
util living area													
	0.9603	0.9365	0.8790	0.7626	0.6270	0.4515	0.2975	0.2953	0.5002	0.7773	0.9229	0.9680	(86)
MIT	19.8044	19.9768	20.2913	20.6139	20.7985	20.8906	20.9142	20.9148	20.8795	20.6604	20.2233	19.7826	(87)
Th 2	20.2353	20.2450	20.2499	20.2613	20.2613	20.2695	20.2630	20.2646	20.2581	20.2499	20.2483	20.2418	(88)
util rest of house													
	0.9548	0.9282	0.8637	0.7356	0.5858	0.3982	0.2346	0.2289	0.4393	0.7422	0.9105	0.9633	(89)
MIT 2	18.6164	18.8702	19.3199	19.7717	20.0120	20.1267	20.1421	20.1444	20.1057	19.8337	19.2300	18.5905	(90)
Living area fraction									fLA = Living area / (4) =			0.2909	(91)
MIT	18.9620	19.1921	19.6025	20.0166	20.2408	20.3489	20.3667	20.3685	20.3308	20.0741	19.5189	18.9373	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9620	19.1921	19.6025	20.0166	20.2408	20.3489	20.3667	20.3685	20.3308	20.0741	19.5189	18.9373	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9432	0.9143	0.8487	0.7260	0.5846	0.4042	0.2435	0.2384	0.4454	0.7332	0.8962	0.9531	(94)
Useful gains	1684.9947	1932.3942	2103.5958	2112.2563	1721.1365	1197.6055	693.0598	642.1852	1125.1840	1598.2629	1634.0005	1536.0873	(95)
Ext temp.	5.5000	5.7000	7.4000	9.7000	12.7000	15.4000	17.6000	17.8000	15.7000	12.3000	8.8000	5.8000	(96)
Heat loss rate W													
	3533.1416	3492.3371	3136.5066	2608.3223	1906.5153	1236.3216	697.8355	646.2928	1176.3572	1998.2536	2761.6276	3416.3144	(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													
	1375.0213	1048.2816	768.4856	357.1675	137.9219	0.0000	0.0000	0.0000	0.0000	297.5931	811.8915	1398.8889	(98)

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

Space heating		6195.2515 (98)
Space heating per m2	(98) / (4) =	19.3771 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)		0.0000 (201)
Fraction of space heat from main system(s)		1.0000 (202)
Efficiency of main space heating system 1 (in %)		100.0000 (206)
Efficiency of secondary/supplementary heating system, %		0.0000 (208)
Space heating requirement		6195.2515 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1375.0213	1048.2816	768.4856	357.1675	137.9219	0.0000	0.0000	0.0000	0.0000	297.5931	811.8915	1398.8889	(98)
Space heating efficiency (main heating system 1)													
	100.0000	100.0000	100.0000	100.0000	100.0000	0.0000	0.0000	0.0000	0.0000	100.0000	100.0000	100.0000	(210)
Space heating fuel (main heating system)													
	1375.0213	1048.2816	768.4856	357.1675	137.9219	0.0000	0.0000	0.0000	0.0000	297.5931	811.8915	1398.8889	(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													
	210.6718	185.1864	193.3076	171.6524	167.0296	147.5456	140.0833	155.9461	156.3698	178.0737	190.3505	205.0514	(64)
Efficiency of water heater												100.0000	(216)
(217)m	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	(217)
Fuel for water heating, kWh/month													
	210.6718	185.1864	193.3076	171.6524	167.0296	147.5456	140.0833	155.9461	156.3698	178.0737	190.3505	205.0514	(219)
Water heating fuel used												2101.2684	(219)
Annual totals kWh/year													
Space heating fuel - main system												6195.2515	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.9875)													
mechanical ventilation fans (SFP = 0.9875)												1071.1806	(230a)
Total electricity for the above, kWh/year												1071.1806	(231)
Electricity for lighting (calculated in Appendix L)												754.2087	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 9.14 * 1228 * 1.00) =										-8978.7847		-8978.7847	(233)
Total delivered energy for all uses												1143.1244	(238)

10a. Fuel costs - using BEDF prices (533)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	6195.2515	36.7200	2274.8963	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2101.2684	36.7200	771.5857	(247)
Mechanical ventilation fans	1071.1806	36.7200	393.3375	(249)
Pumps and fans for heating	0.0000	0.0000	0.0000	(249)
Energy for lighting	754.2087	36.7200	276.9454	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-8978.7847	36.7200	-3297.0098	(252)
Total energy cost			419.7553	(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	6195.2515	0.5190	3215.3355	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2101.2684	0.5190	1090.5583	(264)
Space and water heating			4305.8938	(265)
Pumps and fans	1071.1806	0.5190	555.9427	(267)
Energy for lighting	754.2087	0.5190	391.4343	(268)
Energy saving/generation technologies				
PV Unit	-8978.7847	0.5190	-4659.9893	(269)
Total kg/year			593.2815	(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	6195.2515	3.0700	19019.4221	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2101.2684	3.0700	6450.8939	(264)
Space and water heating			25470.3160	(265)
Pumps and fans	1071.1806	3.0700	3288.5244	(267)

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

Energy for lighting	754.2087	3.0700	2315.4206 (268)
Energy saving/generation technologies			
PV Unit	-8978.7847	3.0700	-27564.8691 (269)
Primary energy kWh/year			3509.3918 (272)
Primary energy kWh/m2/year			10.9765 (273)

SAP 2012 EPC IMPROVEMENTS

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

(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	Recommended
L2	Not considered
Q3	Not considered
O3	Not considered

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 2.1	-£ 384	-542 kg (91.4%)
V2 Wind turbine	+ 7.6	-£1313	-1856 kg (3649.2%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£384	1.70 kg/m²	A 95	A 95
Wind turbine	£1313	5.80 kg/m²	A 102	A 102
Total Savings	£1697	7.50 kg/m²		

Potential energy efficiency rating: A 102
Potential environmental impact rating: A 102

Fuel prices for cost data on this page from database revision number 533 TEST (30 Nov 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£3717	£3333	£384
Space heating	£2668	£2677	-£9
Water heating	£772	£379	£393
Lighting	£277	£277	£0
Generated (PV)	-£3297	-£3297	£0
Generated (wind)	-£0	-£1313	£1313
Total cost of fuels	£420	-£1277	£1697
Total cost of uses	£420	-£1277	£1697
Delivered energy	4 kWh/m²	-11 kWh/m²	14 kWh/m²
Carbon dioxide emissions	0.6 tonnes	-1.8 tonnes	2.4 tonnes
CO2 emissions per m²	2 kg/m²	-6 kg/m²	8 kg/m²
Primary energy	11 kWh/m²	-33 kWh/m²	44 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	176.1000	(1b)	x 2.4800	(2b) =	436.7280	(1b) - (3b)
First floor	143.6200	(1c)	x 3.1500	(2c) =	452.4030	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	319.7200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		889.1310	(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			1.9300	
Infiltration rate			0.0965	(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) =		0.0820	(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	0.1046	0.1025	0.1005	0.0902	0.0882	0.0779	0.0779	0.0759	0.0820	0.0882	0.0923	0.0964	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation:	0.5000 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	79.0500 (23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2093	0.2073	0.2052	0.1950	0.1929	0.1827	0.1827	0.1806	0.1868	0.1929	0.1970	0.2011	(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	
G.01			4.5300	0.7000	3.1710			(26a)
G.08			2.1000	0.7000	1.4700			(26)
G.02 (Uw = 0.70)			3.9200	0.6809	2.6693			(27)
G.03a (Uw = 0.70)			83.3400	0.6809	56.7490			(27)
Ground floor			176.1000	0.1300	22.8930			(28a)
External walls	359.5100	93.8900	265.6200	0.1400	37.1868			(29a)
Sloped roof	165.0000		165.0000	0.1400	23.1000			(30)
Balcony deck	32.5000		32.5000	0.1900	6.1750			(30)
Total net area of external elements Aum(A, m2)			733.1100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		153.4141			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	39.1953	(36)
Total fabric heat loss (33) + (36) =	192.6094	(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	61.4207	60.8191	60.2174	57.2090	56.6073	53.5989	53.5989	52.9972	54.8023	56.6073	57.8107	59.0140	(38)
Heat transfer coeff	254.0302	253.4285	252.8268	249.8184	249.2167	246.2083	246.2083	245.6066	247.4117	249.2167	250.4201	251.6234	(39)
Average = Sum(39)m / 12 =												249.6680	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.7945	0.7927	0.7908	0.7814	0.7795	0.7701	0.7701	0.7682	0.7738	0.7795	0.7832	0.7870	(40)
HLP (average)												0.7809	(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	3.1576 (42)
Average daily hot water use (litres/day)	109.1922 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	120.1114	115.7437	111.3760	107.0083	102.6407	98.2730	98.2730	102.6407	107.0083	111.3760	115.7437	120.1114	(44)
Energy conte	178.1218	155.7864	160.7576	140.1524	134.4796	116.0456	107.5333	123.3961	124.8698	145.5237	158.8505	172.5014	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1718.0184 (45)
Distribution loss (46)m = 0.15 x (45)m													
	26.7183	23.3680	24.1136	21.0229	20.1719	17.4068	16.1300	18.5094	18.7305	21.8286	23.8276		25.8752 (46)
Water storage loss:													
Store volume													300.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):													1.7500 (48)
Temperature factor from Table 2b													0.6000 (49)
Enter (49) or (54) in (55)													1.0500 (55)
Total storage loss													
	32.5500	29.4000	32.5500	31.5000	32.5500	31.5000	32.5500	32.5500	31.5000	32.5500	31.5000		32.5500 (56)
If cylinder contains dedicated solar storage													
	24.4125	22.0500	24.4125	23.6250	24.4125	23.6250	24.4125	24.4125	23.6250	24.4125	23.6250		24.4125 (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)
Total heat required for water heating calculated for each month													
	202.5343	177.8364	185.1701	163.7774	158.8921	139.6706	131.9458	147.8086	148.4948	169.9362	182.4755		196.9139 (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													1.0556 (H8)
Utilisation factor													0.6122 (H9)
Collector performance factor													0.8793 (H10)
Dedicated solar storage volume													75.0000 (H11)
Effective solar volume													142.5000 (H13)
Daily hot water demand													109.1922 (H14)
Volume ratio Veff/V													1.3050 (H15)
Solar storage volume factor													1.0000 (H16)
Solar input													-976.2871 (H17)
Solar input	-28.3104	-47.2419	-80.4583	-107.8300	-133.2149	-130.9715	-129.2406	-112.9182	-88.4376	-60.3925	-33.5802		-23.6910 (63)
												Solar input (sum of months) = Sum(63)m =	-976.2871 (63)
Output from w/h													
	174.2239	130.5945	104.7118	55.9474	25.6772	8.6992	2.7052	34.8904	60.0572	109.5438	148.8954		173.2230 (64)
												Total per year (kWh/year) = Sum(64)m =	1029.1688 (64)
Heat gains from water heating, kWh/month													
	78.7555	69.4390	72.9819	65.5007	64.2445	57.4852	55.2848	60.5592	60.4192	67.9166	71.7178		76.8867 (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	189.4540	189.4540	189.4540	189.4540	189.4540	189.4540	189.4540	189.4540	189.4540	189.4540	189.4540	189.4540	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	106.7660	94.8287	77.1198	58.3847	43.6432	36.8455	39.8128	51.7502	69.4590	88.1942	102.9356	109.7334	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	707.5284	714.8704	696.3689	656.9816	607.2621	560.5328	529.3148	521.9729	540.4743	579.8617	629.5811	676.3104	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	57.1030	57.1030	57.1030	57.1030	57.1030	57.1030	57.1030	57.1030	57.1030	57.1030	57.1030	57.1030	(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)													
	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	(71)
Water heating gains (Table 5)													
	105.8541	103.3318	98.0940	90.9732	86.3501	79.8405	74.3076	81.3968	83.9156	91.2858	99.6081	103.3424	(72)
Total internal gains													
	1040.4029	1033.2851	991.8370	926.5937	857.5097	797.4731	763.6895	775.3741	814.1032	879.5959	952.3791	1009.6404	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	3.9200	10.6334	0.5700	0.8000	0.5400	9.2376	(74)
North	5.6400	10.6334	0.5700	0.7000	0.5400	11.6295	(74)
East	2.1000	19.6403	0.5700	0.7000	0.5400	7.9979	(76)
South	57.1200	46.7521	0.5700	0.7000	0.5400	517.8430	(78)
West	18.4800	19.6403	0.5700	0.7000	0.5400	70.3815	(80)

Solar gains	617.0895	1041.2982	1400.5904	1698.1076	1870.3018	1843.4431	1782.7791	1655.9436	1503.6713	1144.1530	737.2927	529.3153	(83)
Total gains	1657.4924	2074.5833	2392.4274	2624.7013	2727.8115	2640.9162	2546.4686	2431.3177	2317.7745	2023.7490	1689.6718	1538.9557	(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	34.9609	35.0439	35.1273	35.5503	35.6361	36.0715	36.0715	36.1599	35.8961	35.6361	35.4649	35.2952	
alpha	3.3307	3.3363	3.3418	3.3700	3.3757	3.4048	3.4048	3.4107	3.3931	3.3757	3.3643	3.3530	
util living area													
	0.9729	0.9456	0.9010	0.8223	0.7051	0.5504	0.4118	0.4458	0.6435	0.8562	0.9528	0.9783	(86)
MIT	19.6621	19.9059	20.1964	20.5046	20.7305	20.8619	20.9040	20.8988	20.8166	20.5071	20.0216	19.6148	(87)
Th 2	20.2581	20.2597	20.2613	20.2695	20.2711	20.2793	20.2793	20.2810	20.2761	20.2711	20.2679	20.2646	(88)
util rest of house													
	0.9693	0.9388	0.8888	0.8006	0.6698	0.4990	0.3489	0.3821	0.5942	0.8337	0.9456	0.9753	(89)
MIT 2	18.4263	18.7787	19.1946	19.6323	19.9366	20.1065	20.1510	20.1481	20.0532	19.6450	18.9553	18.3625	(90)
Living area fraction										fLA = Living area / (4) =		0.2909	(91)

MIT	18.7858	19.1066	19.4860	19.8860	20.1675	20.3262	20.3700	20.3664	20.2752	19.8957	19.2655	18.7268	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7858	19.1066	19.4860	19.8860	20.1675	20.3262	20.3700	20.3664	20.2752	19.8957	19.2655	18.7268	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9602	0.9258	0.8739	0.7881	0.6645	0.5025	0.3570	0.3899	0.5941	0.8206	0.9336	0.9674	(94)
Useful gains	1591.4617	1920.7528	2090.6806	2068.4399	1812.5911	1327.0717	908.9959	947.9184	1377.0524	1660.6398	1577.5323	1488.7965	(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	3679.8348	3600.3606	3283.2134	2744.5163	2110.2453	1409.8418	928.2089	974.1808	1527.8272	2316.6556	3046.4751	3655.2803	(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	1553.7496	1128.6964	887.2444	486.7750	221.4547	0.0000	0.0000	0.0000	0.0000	488.0757	1057.6389	1611.8640	(98)
Space heating												7435.4988	(98)
Space heating per m2											(98) / (4) =	23.2563	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												100.0000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												7435.4988	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1553.7496	1128.6964	887.2444	486.7750	221.4547	0.0000	0.0000	0.0000	0.0000	488.0757	1057.6389	1611.8640	(98)
Space heating efficiency (main heating system 1)	100.0000	100.0000	100.0000	100.0000	100.0000	0.0000	0.0000	0.0000	0.0000	100.0000	100.0000	100.0000	(210)
Space heating fuel (main heating system)	1553.7496	1128.6964	887.2444	486.7750	221.4547	0.0000	0.0000	0.0000	0.0000	488.0757	1057.6389	1611.8640	(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	174.2239	130.5945	104.7118	55.9474	25.6772	8.6992	2.7052	34.8904	60.0572	109.5438	148.8954	173.2230	(64)
Efficiency of water heater												100.0000	(216)
(217)m	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	(217)
Fuel for water heating, kWh/month	174.2239	130.5945	104.7118	55.9474	25.6772	8.6992	2.7052	34.8904	60.0572	109.5438	148.8954	173.2230	(219)
Water heating fuel used												1029.1688	(219)
Annual totals kWh/year													
Space heating fuel - main system												7435.4988	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.9875)													
mechanical ventilation fans (SFP = 0.9875)												1071.1806	(230a)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												1121.1806	(231)
Electricity for lighting (calculated in Appendix L)												754.2087	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 9.14 * 1068 * 1.00) =										-7809.7314		-7809.7314	(233)
Wind generation												-3575.5408	(234)
Total delivered energy for all uses												-1045.2153	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	7435.4988	13.1900	980.7423	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1029.1688	13.1900	135.7474	(247)
Mechanical ventilation fans	1071.1806	13.1900	141.2887	(249)
Pumps and fans for heating	0.0000	0.0000	0.0000	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	754.2087	13.1900	99.4801	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-7809.7314	13.1900	-1030.1036	(252)
Wind Turbine	-3575.5408	13.1900	-471.6138	(252)
Total energy cost			-137.8639	(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] =	-0.1588	(257)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

SAP value	102.2147	
SAP rating (Section 12)	102	(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	7435.4988	0.5190	3859.0239	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1029.1688	0.5190	534.1386	(264)
Space and water heating			4393.1625	(265)
Pumps and fans	1121.1806	0.5190	581.8927	(267)
Energy for lighting	754.2087	0.5190	391.4343	(268)
Energy saving/generation technologies				
PV Unit	-7809.7314	0.5190	-4053.2506	(269)
Wind Turbine	-3575.5408	0.5190	-1855.7056	(269)
Total kg/year			-542.4667	(272)
CO2 emissions per m2			-1.7000	(273)
EI value			101.9931	
EI rating			102	(274)
EI band			A	

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	176.1000 (1b)	x	2.4800 (2b)	=	436.7280	(1b) - (3b)
First floor	143.6200 (1c)	x	3.1500 (2c)	=	452.4030	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	319.7200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	889.1310	(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		1.9300	
Infiltration rate		0.0965	(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) =	0.0820	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	6.5000	5.9000	5.6000	4.9000	4.9000	4.4000	4.8000	4.7000	5.1000	5.6000	5.7000	6.1000	(22)
Wind factor	1.6250	1.4750	1.4000	1.2250	1.2250	1.1000	1.2000	1.1750	1.2750	1.4000	1.4250	1.5250	(22a)
Adj infilt rate	0.1333	0.1210	0.1148	0.1005	0.1005	0.0902	0.0984	0.0964	0.1046	0.1148	0.1169	0.1251	(22b)

Balanced mechanical ventilation with heat recovery

If mechanical ventilation:	0.5000	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	79.0500	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Effective ac	0.2380	0.2257	0.2196	0.2052	0.2052	0.1950	0.2032	0.2011	0.2093	0.2196	0.2216	0.2298	(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	
G.01			4.5300	0.7000	3.1710			(26a)
G.08			2.1000	0.7000	1.4700			(26)
G.02 (Uw = 0.70)			3.9200	0.6809	2.6693			(27)
G.03a (Uw = 0.70)			83.3400	0.6809	56.7490			(27)
Ground floor			176.1000	0.1300	22.8930			(28a)
External walls	359.5100	93.8900	265.6200	0.1400	37.1868			(29a)
Sloped roof	165.0000		165.0000	0.1400	23.1000			(30)
Balcony deck	32.5000		32.5000	0.1900	6.1750			(30)
Total net area of external elements Aum(A, m2)			733.1100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		153.4141			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	100.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	39.1953	(36)
Total fabric heat loss (33) + (36) =	192.6094	(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	69.8443	66.2342	64.4291	60.2174	60.2174	57.2090	59.6157	59.0140	61.4207	64.4291	65.0308	67.4375	(38)
Heat transfer coeff	262.4537	258.8436	257.0386	252.8268	252.8268	249.8184	252.2251	251.6234	254.0302	257.0386	257.6403	260.0470	(39)
Average = Sum(39)m / 12 =												255.5344	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	0.8209	0.8096	0.8039	0.7908	0.7908	0.7814	0.7889	0.7870	0.7945	0.8039	0.8058	0.8134	(40)
HLP (average)												0.7992	(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	3.1576	(42)
Average daily hot water use (litres/day)	109.1922	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	120.1114	115.7437	111.3760	107.0083	102.6407	98.2730	98.2730	102.6407	107.0083	111.3760	115.7437	120.1114	(44)
Energy conte	178.1218	155.7864	160.7576	140.1524	134.4796	116.0456	107.5333	123.3961	124.8698	145.5237	158.8505	172.5014	(45)

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

Energy content (annual)												Total = Sum(45)m =	1718.0184 (45)
Distribution loss (46)m = 0.15 x (45)m													
	26.7183	23.3680	24.1136	21.0229	20.1719	17.4068	16.1300	18.5094	18.7305	21.8286	23.8276	25.8752	(46)
Water storage loss:													
Store volume												300.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7500	(48)
Temperature factor from Table 2b												0.6000	(49)
Enter (49) or (54) in (55)												1.0500	(55)
Total storage loss													
	32.5500	29.4000	32.5500	31.5000	32.5500	31.5000	32.5500	32.5500	31.5000	32.5500	31.5000	32.5500	(56)
If cylinder contains dedicated solar storage													
	24.4125	22.0500	24.4125	23.6250	24.4125	23.6250	24.4125	24.4125	23.6250	24.4125	23.6250	24.4125	(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)
Total heat required for water heating calculated for each month													
	202.5343	177.8364	185.1701	163.7774	158.8921	139.6706	131.9458	147.8086	148.4948	169.9362	182.4755	196.9139	(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												1251.9631	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												2103.2981	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2243	(H8)
Utilisation factor												0.5582	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												142.5000	(H13)
Daily hot water demand												109.1922	(H14)
Volume ratio Veff/V												1.3050	(H15)
Solar storage volume factor												1.0000	(H16)
Solar input												-1032.2813	(H17)
Solar input	-31.6363	-45.5643	-79.6017	-116.9739	-137.2372	-141.6517	-139.1389	-121.1897	-93.7839	-63.9296	-36.7559	-24.8184	(63)
											Solar input (sum of months) = Sum(63)m =	-1032.2813	(63)
Output from w/h													
	170.8980	132.2722	105.5684	46.8035	21.6549	0.0000	0.0000	26.6189	54.7110	106.0067	145.7196	172.0955	(64)
											Total per year (kWh/year) = Sum(64)m =	982.3486	(64)
Heat gains from water heating, kWh/month													
	78.7555	69.4390	72.9819	65.5007	64.2445	57.4852	55.2848	60.5592	60.4192	67.9166	71.7178	76.8867	(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	189.4540	189.4540	189.4540	189.4540	189.4540	189.4540	189.4540	189.4540	189.4540	189.4540	189.4540	189.4540	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	106.7660	94.8287	77.1198	58.3847	43.6432	36.8455	39.8128	51.7502	69.4590	88.1942	102.9356	109.7334	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	707.5284	714.8704	696.3689	656.9816	607.2621	560.5328	529.3148	521.9729	540.4743	579.8617	629.5811	676.3104	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	57.1030	57.1030	57.1030	57.1030	57.1030	57.1030	57.1030	57.1030	57.1030	57.1030	57.1030	57.1030	(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)													
	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	-126.3026	(71)
Water heating gains (Table 5)													
	105.8541	103.3318	98.0940	90.9732	86.3501	79.8405	74.3076	81.3968	83.9156	91.2858	99.6081	103.3424	(72)
Total internal gains													
	1040.4029	1033.2851	991.8370	926.5937	857.5097	797.4731	763.6895	775.3741	814.1032	879.5959	952.3791	1009.6404	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	3.9200	13.1177	0.5700	0.8000	0.5400	11.3958	(74)
North	5.6400	13.1177	0.5700	0.7000	0.5400	14.3465	(74)
East	2.1000	24.4891	0.5700	0.7000	0.5400	9.9724	(76)
South	57.1200	55.4171	0.5700	0.7000	0.5400	613.8206	(78)
West	18.4800	24.4891	0.5700	0.7000	0.5400	87.7574	(80)

Solar gains	737.2927	1071.4904	1478.1208	1974.1714	2077.8378	2157.0046	2073.5260	1909.4942	1703.1396	1291.4854	862.2063	593.3553	(83)
Total gains	1777.6956	2104.7756	2469.9579	2900.7651	2935.3475	2954.4777	2837.2155	2684.8683	2517.2428	2171.0813	1814.5854	1602.9957	(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	33.8388	34.3107	34.5517	35.1273	35.1273	35.5503	35.2110	35.2952	34.9609	34.5517	34.4710	34.1519	
alpha	3.2559	3.2874	3.3034	3.3418	3.3418	3.3700	3.3474	3.3530	3.3307	3.3034	3.2981	3.2768	
util living area													
	0.9608	0.9372	0.8799	0.7638	0.6283	0.4526	0.2984	0.2962	0.5017	0.7788	0.9238	0.9685	(86)
MIT	19.8009	19.9735	20.2887	20.6123	20.7977	20.8904	20.9142	20.9148	20.8792	20.6587	20.2202	19.7790	(87)
Th 2	20.2353	20.2450	20.2499	20.2613	20.2613	20.2695	20.2630	20.2646	20.2581	20.2499	20.2483	20.2418	(88)
util rest of house													
	0.9554	0.9289	0.8647	0.7368	0.5871	0.3993	0.2353	0.2297	0.4406	0.7439	0.9115	0.9638	(89)
MIT 2	18.6113	18.8656	19.3164	19.7696	20.0111	20.1265	20.1421	20.1444	20.1054	19.8316	19.2257	18.5853	(90)
Living area fraction										fLA = Living area / (4) =		0.2909	(91)

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MIT	18.9573	19.1879	19.5992	20.0148	20.2399	20.3487	20.3667	20.3685	20.3305	20.0722	19.5150	18.9325	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9573	19.1879	19.5992	20.0148	20.2399	20.3487	20.3667	20.3685	20.3305	20.0722	19.5150	18.9325	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9439	0.9151	0.8496	0.7272	0.5859	0.4052	0.2443	0.2392	0.4468	0.7347	0.8972	0.9537	(94)
Useful gains	1677.8793	1925.9923	2098.5944	2109.2949	1719.7278	1197.2416	693.0070	642.1368	1124.6479	1595.1731	1628.0121	1528.7219	(95)
Ext temp.	5.5000	5.7000	7.4000	9.7000	12.7000	15.4000	17.6000	17.8000	15.7000	12.3000	8.8000	5.8000	(96)
Heat loss rate W	3531.9230	3491.2464	3135.6632	2607.8460	1906.2984	1236.2676	697.8272	646.2851	1176.2759	1997.7476	2760.6098	3415.0648	(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	1379.4086	1051.8507	771.5792	358.9568	138.8085	0.0000	0.0000	0.0000	0.0000	299.5155	815.4704	1403.4391	(98)
Space heating												6219.0288	(98)
Space heating per m2											(98) / (4) =	19.4515	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	100.0000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	6219.0288	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1379.4086	1051.8507	771.5792	358.9568	138.8085	0.0000	0.0000	0.0000	0.0000	299.5155	815.4704	1403.4391	(98)
Space heating efficiency (main heating system 1)	100.0000	100.0000	100.0000	100.0000	100.0000	0.0000	0.0000	0.0000	0.0000	100.0000	100.0000	100.0000	(210)
Space heating fuel (main heating system)	1379.4086	1051.8507	771.5792	358.9568	138.8085	0.0000	0.0000	0.0000	0.0000	299.5155	815.4704	1403.4391	(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	170.8980	132.2722	105.5684	46.8035	21.6549	0.0000	0.0000	26.6189	54.7110	106.0067	145.7196	172.0955	(64)
Efficiency of water heater												100.0000	(216)
(217)m	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	100.0000	(217)
Fuel for water heating, kWh/month	170.8980	132.2722	105.5684	46.8035	21.6549	0.0000	0.0000	26.6189	54.7110	106.0067	145.7196	172.0955	(219)
Water heating fuel used												982.3486	(219)
Annual totals kWh/year													
Space heating fuel - main system												6219.0288	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
(BalancedWithHeatRecovery, Database: in-use factor = 1.2500, SFP = 0.9875)													
mechanical ventilation fans (SFP = 0.9875)												1071.1806	(230a)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												1121.1806	(231)
Electricity for lighting (calculated in Appendix L)												754.2087	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 9.14 * 1228 * 1.00) =										-8978.7847		-8978.7847	(233)
Wind generation												-3575.5408	(234)
Total delivered energy for all uses												-3477.5588	(238)

10a. Fuel costs - using BEDF prices (533)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	6219.0288	36.7200	2283.6274	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	982.3486	36.7200	360.7184	(247)
Mechanical ventilation fans	1071.1806	36.7200	393.3375	(249)
Pumps and fans for heating	0.0000	0.0000	0.0000	(249)
Pump for solar water heating	50.0000	36.7200	18.3600	(249)
Energy for lighting	754.2087	36.7200	276.9454	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-8978.7847	36.7200	-3297.0098	(252)
Wind Turbine	-3575.5408	36.7200	-1312.9386	(252)
Total energy cost			-1276.9596	(255)

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	

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

Space heating - main system 1	6219.0288	0.5190	3227.6760 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	982.3486	0.5190	509.8389 (264)
Space and water heating			3737.5149 (265)
Pumps and fans	1121.1806	0.5190	581.8927 (267)
Energy for lighting	754.2087	0.5190	391.4343 (268)
Energy saving/generation technologies			
PV Unit	-8978.7847	0.5190	-4659.9893 (269)
Wind Turbine	-3575.5408	0.5190	-1855.7056 (269)
Total kg/year			-1804.8530 (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	6219.0288	3.0700	19092.4185 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	982.3486	3.0700	3015.8102 (264)
Space and water heating			22108.2287 (265)
Pumps and fans	1121.1806	3.0700	3442.0244 (267)
Energy for lighting	754.2087	3.0700	2315.4206 (268)
Energy saving/generation technologies			
PV Unit	-8978.7847	3.0700	-27564.8691 (269)
Wind Turbine	-3575.5408	3.0700	-10976.9101 (269)
Primary energy kWh/year			-10676.1056 (272)
Primary energy kWh/m2/year			-33.3920 (273)

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

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	2
Cross ventilation possible	Yes
SAP Region	South East England
Front of dwelling faces	North
Overshading	More than average
Thermal mass parameter	100.0
Night ventilation	No
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient	1173.65 (P1)
Transmission heat loss coefficient	192.61 (37)
Summer heat loss coefficient	1366.26 (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
West	0.000	1.000	None

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer
North	0.850	0.70	1.000	0.595 (P8)
East	0.850	0.70	1.000	0.595 (P8)
South	0.850	0.70	1.000	0.595 (P8)
West	0.850	0.70	1.000	0.595 (P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	3.9200	86.6589	0.5700	0.8000	0.5950	82.9513
North	5.6400	86.6589	0.5700	0.7000	0.5950	104.4298
East	2.1000	124.7972	0.5700	0.7000	0.5950	55.9959
South	57.1200	118.3991	0.5700	0.7000	0.5950	1445.0033
West	18.4800	124.7972	0.5700	0.7000	0.5950	492.7643
total:						2181.1447

	Jun	Jul	Aug	
Solar gains	2285	2181	2034	(P3)
Internal gains	806	772	784	
Total summer gains	3091	2954	2818	(P5)
Summer gain/loss ratio	2.26	2.16	2.06	(P6)
Summer external temperature	15.40	17.40	17.50	
Thermal mass temperature increment (TMP = 100.0)	1.30	1.30	1.30	
Threshold temperature	18.96	20.86	20.86	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight