elmhurst energy

SAP Report Submission for Building Regulations Compliance

Client: Foreman Homes

Project: Plot 115

Contact: Tobias Whiting
Abacus Energy (UK) Ltd
toby@abacusenergyuk.com

Report Issue Date: 28/03/2023

EXCELLENCE IN ENERGY ASSESSMENT

PREDICTED ENERGY ASSESSMENT

Design SAP
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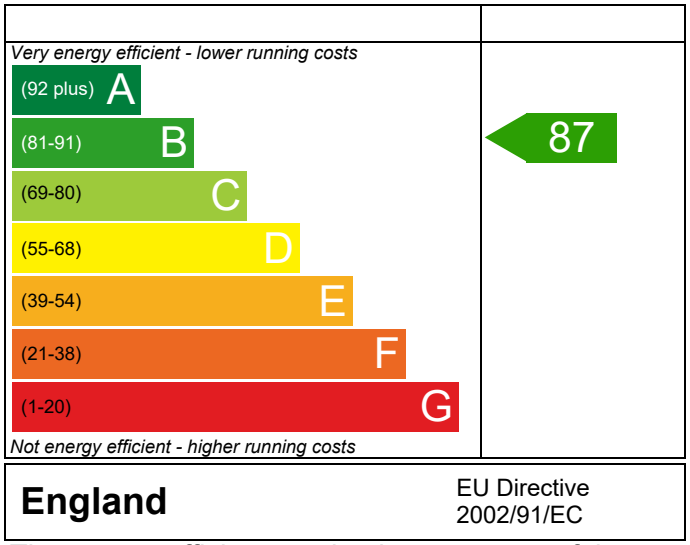
Plot 115

Dwelling type:	House, Semi-Detached
Date of assessment:	28/03/2023
Produced by:	Abacus Energy (UK) Ltd
Total floor area:	84.52 m²
DRRN:	6227-1971-8071

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

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

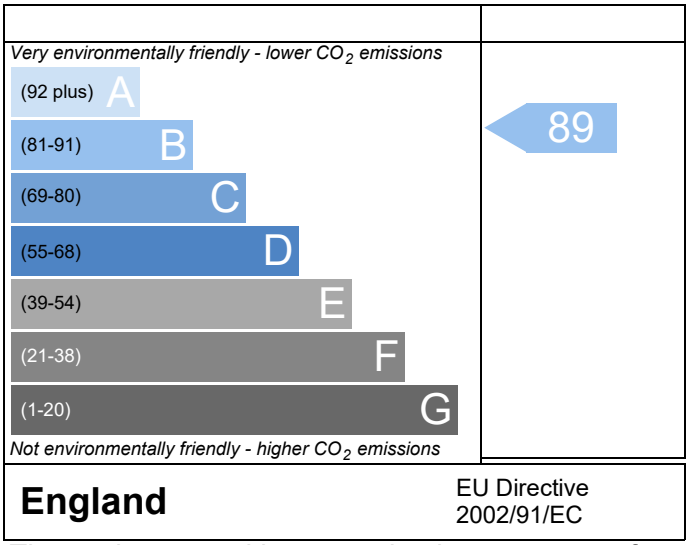
Energy Efficiency Rating



England EU Directive 2002/91/EC

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

Environmental Impact (CO_2) Rating



England EU Directive 2002/91/EC

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

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.

elmhurst energy APPROVED ENERGY ASSESSOR

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

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

Design SAP
elmhurst energy

Property Reference	SAP 0879 Plot 115	**Issued on Date**	28/03/2023
Assessment Reference	Rev A	**Prop Type Ref**	3B AFF (HA/SO)
Property	Plot 115		

SAP Rating	87 B	**DER**	13.83	**TER**	17.86
Environmental	89 B	**% DER<TER**	22.56		
CO_2 Emissions (t/year)	0.87	**DFEE**	42.45	**TFEE**	50.75
General Requirements Compliance	Pass	**% DFEE<TFEE**	16.35		

Assessor Details	Mr. Tobias Whiting, Abacus Energy (UK) Ltd, Tel: 07798936079, toby@abacusenergyuk.com	**Assessor ID**	E477-0001
Client	Foreman Homes, FORE		

SUMARY FOR INPUT DATA FOR New Build (As Designed)

Criterion 1 – Achieving the TER and TFEE rate

1a TER and DER

Fuel for main heating	Mains gas		
Fuel factor	1.00 (mains gas)		
Target Carbon Dioxide Emission Rate (TER)	17.86	$kgCO_2/m^2$	
Dwelling Carbon Dioxide Emission Rate (DER)	13.83	$kgCO_2/m^2$	Pass
	-4.03 (-22.6%)	$kgCO_2/m^2$	

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	50.75	$kWh/m^2/yr$	
Dwelling Fabric Energy Efficiency (DFEE)	42.45	$kWh/m^2/yr$	
	-8.3 (-16.3%)	$kWh/m^2/yr$	Pass

Criterion 2 – Limits on design flexibility

Limiting Fabric Standards

2 Fabric U-values

Element	Average	Highest	
External wall	0.24 (max. 0.30)	0.26 (max. 0.70)	Pass
Party wall	0.00 (max. 0.20)	-	Pass
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	Pass
Roof	0.10 (max. 0.20)	0.10 (max. 0.35)	Pass
Openings	1.19 (max. 2.00)	1.20 (max. 3.30)	Pass

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)	$m^3/(h.m^2)$ @ 50 Pa	
Maximum	10.0	$m^3/(h.m^2)$ @ 50 Pa	Pass

Limiting System Efficiencies

4 Heating efficiency

Main heating system	Boiler system with radiators or underfloor - Mains gas Data from database Worcester Greenstar 32CDi Compact ErP Combi boiler Efficiency: 89.8% SEDBUK2009 Minimum: 88.0%		Pass
Secondary heating system	None		

5 Cylinder insulation

Hot water storage	No cylinder		

6 Controls

Space heating controls	Programmer, room thermostat and TRVs		Pass
Hot water controls	No cylinder		
Boiler interlock	Yes		Pass

7 Low energy lights

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

8 Mechanical ventilation

Not applicable

Criterion 3 – Limiting the effects of heat gains in summer

9 Summertime temperature

Overheating risk (Southern England)	Slight		Pass

Based on:

Overshading	Average		
Windows facing North Windows facing East Windows facing West	3.07 m², No overhang 4.15 m², No overhang 7.08 m², No overhang		
Air change rate	4.00 ach		
Blinds/curtains	None		

Criterion 4 – Building performance consistent with DER and DFEE rate

Party Walls

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

Air permeability and pressure testing

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)	m³/(h.m²) @ 50 Pa	
Maximum	10.0	m³/(h.m²) @ 50 Pa	Pass

10 Key features

Party wall U-value	0.00	W/m²K
Roof U-value	0.10	W/m²K
Floor U-value	0.12	W/m²K
Door U-value	1.10	W/m²K
Photovoltaic array	0.75	kW

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RECOMMENDATIONS

Design SAP
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	Typical cost	Typical savings per year	Energy efficiency	Environmental impact	Result
Low energy lights			0	0	Already installed
Solar water heating	£4,000 - £6,000	£80	B 89	B 91	Recommended
Photovoltaic			0	0	Already installed
Wind turbine			0	0	Not applicable
Totals	**£4,000 - £6,000**	**£80**	**B 89**	**B 91**	

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THERMAL BRIDGING
Calculation Type: New Build (As Designed)

Design SAP
elmhurst energy

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Assessment Reference	Rev A	**Prop Type Ref**	3B AFF (HA/SO)
Property	Plot 115		

SAP Rating	87 B	**DER**	13.83	**TER**	17.86
Environmental	89 B	**% DER<TER**	22.56		
CO_2 Emissions (t/year)	0.87	**DFEE**	42.45	**TFEE**	50.75
General Requirements Compliance	Pass	**% DFEE<TFEE**	16.35		

Assessor Details	Mr. Tobias Whiting, Abacus Energy (UK) Ltd, Tel: 07798936079, toby@abacusenergyuk.com	**Assessor ID**	E477-0001
Client	Foreman Homes, FORE		

	Junction detail	Source Type	Psi (W/mK)	Length (m)	Result	Reference
External wall	E2 Other lintels (including other steel lintels)	Independently assessed	0.077	2.74	0.21	Birtley Supatherm
External wall	E2 Other lintels (including other steel lintels)	Independently assessed	0.070	0.91	0.06	Birtley Supatherm
External wall	E2 Other lintels (including other steel lintels)	Independently assessed	0.071	1.02	0.07	Birtley Supatherm
External wall	E2 Other lintels (including other steel lintels)	Independently assessed	0.064	4.99	0.32	Birtley Supatherm
External wall	E2 Other lintels (including other steel lintels)	Independently assessed	0.070	1.36	0.10	Birtley Supatherm
External wall	E2 Other lintels (including other steel lintels)	Independently assessed	0.064	1.81	0.12	Birtley Supatherm
External wall	E3 Sill	Independently assessed	0.021	10.90	0.23	Knauf P5
External wall	E4 Jamb	Independently assessed	0.016	24.15	0.39	Knauf P6
External wall	E5 Ground floor (normal)	Table K1 - Approved	0.160	18.36	2.94	
External wall	E6 Intermediate floor within a dwelling	Independently assessed	0.000	18.36	0.00	CD0029
External wall	E10 Eaves (insulation at ceiling level)	Table K1 - Approved	0.060	9.77	0.59	
External wall	E12 Gable (insulation at ceiling level)	Independently assessed	0.044	17.44	0.77	Knauf P21
External wall	E16 Corner (normal)	Independently assessed	0.039	10.60	0.41	Knauf P23
External wall	E18 Party wall between dwellings	Table K1 - Approved	0.060	8.80	0.53	
Party wall	P6 Party wall - Ground floor (inverted)	Table K1 - Default	0.070	8.72	0.61	
Party wall	P2 Party wall - Intermediate floor within a dwelling	Table K1 - Default	0.000	8.72	0.00	

Total: **7.34** **W/mK:**

Y-Value: **0.042** **W/m²K:**

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

Design SAP
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Property Reference	SAP 0879 Plot 115	**Issued on Date**	28/03/2023
Assessment Reference	Rev A	**Prop Type Ref**	3B AFF (HA/SO)
Property	Plot 115		

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Environmental	89 B	**% DER<TER**	22.56		
CO_2 Emissions (t/year)	0.87	**DFEE**	42.45	**TFEE**	50.75
General Requirements Compliance	Pass	**% DFEE<TFEE**	16.35		

Assessor Details	Mr. Tobias Whiting, Abacus Energy (UK) Ltd, Tel: 07798936079, toby@abacusenergyuk.com	**Assessor ID**	E477-0001
Client	Foreman Homes, FORE		

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

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

DWELLING AS DESIGNED

Semi-Detached House, total floor area 85 m²

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

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 17.86 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 13.83 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)50.8 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)42.5 kWh/m²/yrOK

2 Fabric U-values

Element	Average	Highest	
External wall	0.24 (max. 0.30)	0.26 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.12 (max. 0.70)	OK
Roof	0.10 (max. 0.20)	0.10 (max. 0.35)	OK
Openings	1.19 (max. 2.00)	1.20 (max. 3.30)	OK

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

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

4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Worcester Greenstar 32CDi Compact ErP
Combi boiler
Efficiency: 89.8% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

5 Cylinder insulation
Hot water storage: No cylinder

6 Controls
Space heating controls: Programmer, room thermostat and TRVs OK

Hot water controls: No cylinder

Boiler interlock: Yes OK

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

8 Mechanical ventilation
Not applicable

9 Summertime temperature
Overheating risk (Southern England): Slight OK
Based on:
Overshading: Average
Windows facing North: 3.07 m², No overhang
Windows facing East: 4.15 m², No overhang
Windows facing West: 7.08 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

10 Key features
Party wall U-value 0.00 W/m²K
Roof U-value 0.10 W/m²K
Floor U-value 0.12 W/m²K
Door U-value 1.10 W/m²K
Photovoltaic array 0.75 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	42.2600	(1b)	x 2.3900	(2b) =	101.0014	(1b) - (3b)
First floor	42.2600	(1c)	x 2.4200	(2c) =	102.2692	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	84.5200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		203.2706	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1476	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3976	(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) =	0.3379	(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	0.4309	0.4224	0.4140	0.3717	0.3633	0.3211	0.3211	0.3126	0.3379	0.3633	0.3802	0.3971	(22b)
Effective ac	0.5928	0.5892	0.5857	0.5691	0.5660	0.5515	0.5515	0.5489	0.5571	0.5660	0.5723	0.5788	(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	
Front Door			2.1500	1.1000	2.3650			(26)
Windows & Fully Glazed Do (Uw = 1.20)			14.3000	1.1450	16.3740			(27)
Ground Floor			42.2600	0.1200	5.0712	90.0000	3803.4000	(28a)
Brick and Block	88.3100	16.4500	71.8600	0.2400	17.2464	42.2200	3033.9292	(29a)
Step Party Wall	2.6200		2.6200	0.2600	0.6812	110.0000	288.2000	(29a)
External Roof 1	42.2600		42.2600	0.1000	4.2260	9.1000	384.5660	(30)
Total net area of external elements Aum(A, m2)			175.4500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	45.9638			(33)
Party Wall 1			40.9700	0.0000	0.0000	45.0000	1843.6500	(32)
GF Timber Stud			76.4600			9.0000	688.1400	(32c)
FF Timber Stud			83.4400			9.0000	750.9600	(32c)
Internal Floor 1			46.2600			18.0000	832.6800	(32d)
Internal Ceiling 1			46.2600			18.0000	832.6800	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12458.2052 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.3995 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		7.3358 (36)
Total fabric heat loss	(33) + (36) =	53.2996 (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	39.7667	39.5249	39.2878	38.1746	37.9663	36.9967	36.9967	36.8172	37.3702	37.9663	38.3877	38.8282	(38)
Heat transfer coeff	93.0663	92.8245	92.5875	91.4742	91.2659	90.2963	90.2963	90.1168	90.6698	91.2659	91.6873	92.1278	(39)
Average = Sum(39)m / 12 =												91.4732	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1011	1.0983	1.0955	1.0823	1.0798	1.0683	1.0683	1.0662	1.0728	1.0798	1.0848	1.0900	(40)
HLP (average)												1.0823	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.5431 (42)
Average daily hot water use (litres/day)		94.5975 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	104.0573	100.2734	96.4895	92.7056	88.9217	85.1378	85.1378	88.9217	92.7056	96.4895	100.2734	104.0573	(44)
Energy conte	154.3139	134.9639	139.2707	121.4196	116.5050	100.5349	93.1604	106.9029	108.1797	126.0730	137.6185	149.4448	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1488.3871 (45)
Distribution loss (46)m = 0.15 x (45)m													
	23.1471	20.2446	20.8906	18.2129	17.4757	15.0802	13.9741	16.0354	16.2269	18.9109	20.6428	22.4167	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	25.3185	22.8670	25.2766	24.4140	25.1935	24.3412	25.1279	25.1704	24.3809	25.2422	24.4815	25.3057	(61)
Total heat required for water heating calculated for each month													
	179.6324	157.8309	164.5473	145.8336	141.6984	124.8761	118.2883	132.0733	132.5605	151.3152	162.1000	174.7505	(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													
	179.6324	157.8309	164.5473	145.8336	141.6984	124.8761	118.2883	132.0733	132.5605	151.3152	162.1000	174.7505	(64)
								Total per year (kWh/year) = Sum(64)m =				1785.5066	(64)
Heat gains from water heating, kWh/month													
	57.6390	50.5922	52.6267	46.4755	45.0363	39.5132	37.2578	41.8378	42.0650	48.2298	51.8785	56.0168	(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	127.1526	127.1526	127.1526	127.1526	127.1526	127.1526	127.1526	127.1526	127.1526	127.1526	127.1526	127.1526	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	21.0398	18.6874	15.1976	11.5056	8.6006	7.2609	7.8457	10.1982	13.6879	17.3800	20.2850	21.6246	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	228.6276	231.0001	225.0216	212.2941	196.2280	181.1281	171.0405	168.6680	174.6465	187.3739	203.4401	218.5400	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.7153	35.7153	35.7153	35.7153	35.7153	35.7153	35.7153	35.7153	35.7153	35.7153	35.7153	35.7153	(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)	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	(71)
Water heating gains (Table 5)	77.4718	75.2861	70.7347	64.5493	60.5326	54.8794	50.0777	56.2336	58.4236	64.8250	72.0535	75.2914	(72)
Total internal gains	391.2850	389.1194	375.0998	352.4948	329.5070	307.4143	293.1097	299.2456	310.9038	333.7247	359.9244	379.6018	(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	3.0700	10.6334	0.6300	0.7000	0.7700	9.9766	(74)
East	4.1500	19.6403	0.6300	0.7000	0.7700	24.9096	(76)
West	7.0800	19.6403	0.6300	0.7000	0.7700	42.4964	(80)

Solar gains	77.3826	150.9263	249.5529	368.7469	458.2387	472.3732	448.3367	380.5175	291.5130	179.1589	96.3548	63.7484	(83)
Total gains	468.6677	540.0457	624.6527	721.2418	787.7457	779.7874	741.4464	679.7631	602.4168	512.8837	456.2792	443.3502	(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	37.1844	37.2813	37.3767	37.8316	37.9179	38.3251	38.3251	38.4014	38.1672	37.9179	37.7437	37.5632	
alpha	3.4790	3.4854	3.4918	3.5221	3.5279	3.5550	3.5550	3.5601	3.5445	3.5279	3.5162	3.5042	
util living area													
	0.9892	0.9814	0.9618	0.9099	0.8073	0.6523	0.5071	0.5641	0.7945	0.9442	0.9825	0.9910	(86)
MIT	19.1822	19.3912	19.7618	20.2451	20.6431	20.8835	20.9642	20.9477	20.7530	20.2205	19.6168	19.1470	(87)
Th 2	19.9999	20.0023	20.0046	20.0153	20.0174	20.0268	20.0268	20.0285	20.0231	20.0174	20.0133	20.0090	(88)
util rest of house													
	0.9869	0.9776	0.9536	0.8900	0.7645	0.5775	0.4062	0.4619	0.7332	0.9278	0.9782	0.9892	(89)
MIT 2	18.3355	18.5445	18.9116	19.3873	19.7544	19.9600	20.0129	20.0066	19.8629	19.3742	18.7783	18.3072	(90)
Living area fraction									fLA = Living area / (4) =			0.1745	(91)
MIT	18.4832	18.6922	19.0600	19.5370	19.9095	20.1212	20.1789	20.1709	20.0183	19.5219	18.9246	18.4538	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4832	18.6922	19.0600	19.5370	19.9095	20.1212	20.1789	20.1709	20.0183	19.5219	18.9246	18.4538	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9822	0.9709	0.9437	0.8785	0.7592	0.5853	0.4227	0.4778	0.7328	0.9173	0.9718	0.9851	(94)
Useful gains	460.3479	524.3036	589.4869	633.6071	598.0773	456.3898	313.4227	324.7837	441.4623	470.4876	443.4208	436.7640	(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													
	1319.9818	1280.2577	1162.8987	973.0119	749.2442	498.5413	323.1655	339.8191	536.6074	814.2626	1084.1658	1313.1691	(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													
	639.5676	508.0011	426.6184	244.3714	112.4682	0.0000	0.0000	0.0000	0.0000	255.7686	461.3364	652.0454	(98)
Space heating												3300.1772	(98)
Space heating per m2											(98) / (4) =	39.0461	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.7000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3638.5637	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	639.5676	508.0011	426.6184	244.3714	112.4682	0.0000	0.0000	0.0000	0.0000	255.7686	461.3364	652.0454	(98)
Space heating efficiency (main heating system 1)													
	90.7000	90.7000	90.7000	90.7000	90.7000	0.0000	0.0000	0.0000	0.0000	90.7000	90.7000	90.7000	(210)
Space heating fuel (main heating system)													
	705.1462	560.0894	470.3621	269.4283	124.0003	0.0000	0.0000	0.0000	0.0000	281.9941	508.6399	718.9034	(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													
	179.6324	157.8309	164.5473	145.8336	141.6984	124.8761	118.2883	132.0733	132.5605	151.3152	162.1000	174.7505	(64)
Efficiency of water heater												87.2000	(216)
(217)m	89.9087	89.8452	89.6979	89.3595	88.7148	87.2000	87.2000	87.2000	87.2000	89.3667	89.7632	89.9370	(217)
Fuel for water heating, kWh/month													
	199.7943	175.6698	183.4461	163.1987	159.7235	143.2066	135.6517	151.4602	152.0190	169.3194	180.5862	194.3032	(219)
Water heating fuel used												2008.3787	(219)
Annual totals kWh/year													
Space heating fuel - main system												3638.5637	(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)												371.5703	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.75 * 908 * 1.00) =										-544.7125		-544.7125	(233)
Total delivered energy for all uses												5548.8001	(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	3638.5637	0.2160	785.9297	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2008.3787	0.2160	433.8098	(264)
Space and water heating			1219.7396	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	371.5703	0.5190	192.8450	(268)
Energy saving/generation technologies				
PV Unit	-544.7125	0.5190	-282.7058	(269)
Total CO2, kg/year			1168.8037	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			13.8300	(273)

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

DER		13.8300	ZC1
Total Floor Area	TFA	84.5200	
Assumed number of occupants	N	2.5431	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.0293	ZC2
CO2 emissions from cooking, equation (L16)		2.1301	ZC3
Total CO2 emissions		31.9894	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		31.9894	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	42.2600	(1b)	x 2.3900	(2b) =	101.0014	(1b) - (3b)
First floor	42.2600	(1c)	x 2.4200	(2c) =	102.2692	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	84.5200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		203.2706	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1476	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3976	(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) =	0.3379	(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	0.4309	0.4224	0.4140	0.3717	0.3633	0.3211	0.3211	0.3126	0.3379	0.3633	0.3802	0.3971	(22b)
Effective ac	0.5928	0.5892	0.5857	0.5691	0.5660	0.5515	0.5515	0.5489	0.5571	0.5660	0.5723	0.5788	(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			2.1500	1.0000	2.1500			(26)
TER Opening Type (Uw = 1.40)			14.3000	1.3258	18.9583			(27)
Ground Floor			42.2600	0.1300	5.4938			(28a)
Brick and Block	88.3100	16.4500	71.8600	0.1800	12.9348			(29a)
Step Party Wall	2.6200		2.6200	0.1800	0.4716			(29a)
External Roof 1	42.2600		42.2600	0.1300	5.4938			(30)
Total net area of external elements Aum(A, m2)			175.4500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		45.5023			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.0566	(36)
Total fabric heat loss					(33) + (36) =		54.5589	(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	39.7667	39.5249	39.2878	38.1746	37.9663	36.9967	36.9967	36.8172	37.3702	37.9663	38.3877	38.8282	(38)
Heat transfer coeff	94.3256	94.0838	93.8468	92.7335	92.5252	91.5556	91.5556	91.3761	91.9291	92.5252	92.9466	93.3871	(39)
Average = Sum(39)m / 12 =												92.7325	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1160	1.1132	1.1103	1.0972	1.0947	1.0832	1.0832	1.0811	1.0877	1.0947	1.0997	1.1049	(40)
HLP (average)												1.0972	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.5431	(42)
Average daily hot water use (litres/day)	94.5975	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	104.0573	100.2734	96.4895	92.7056	88.9217	85.1378	85.1378	88.9217	92.7056	96.4895	100.2734	104.0573	(44)
Energy conte	154.3139	134.9639	139.2707	121.4196	116.5050	100.5349	93.1604	106.9029	108.1797	126.0730	137.6185	149.4448	(45)
Energy content (annual)										Total = Sum(45)m =		1488.3871	(45)
Distribution loss (46)m = 0.15 x (45)m	23.1471	20.2446	20.8906	18.2129	17.4757	15.0802	13.9741	16.0354	16.2269	18.9109	20.6428	22.4167	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	50.9589	46.0274	49.1700	45.7178	45.3135	41.9857	43.3853	45.3135	45.7178	49.1700	49.3151	50.9589 (61)
Total heat required for water heating calculated for each month												
	205.2728	180.9913	188.4407	167.1374	161.8185	142.5207	136.5457	152.2164	153.8975	175.2429	186.9336	200.4037 (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												
	205.2728	180.9913	188.4407	167.1374	161.8185	142.5207	136.5457	152.2164	153.8975	175.2429	186.9336	200.4037 (64)
								Total per year (kWh/year) = Sum(64)m =				2051.4210 (64)
Heat gains from water heating, kWh/month												
	64.0491	56.3824	58.6000	51.8015	50.0663	43.9243	41.8221	46.8736	47.3992	54.2118	58.0869	62.4301 (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	127.1526	127.1526	127.1526	127.1526	127.1526	127.1526	127.1526	127.1526	127.1526	127.1526	127.1526	127.1526	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	21.0398	18.6874	15.1976	11.5056	8.6006	7.2609	7.8457	10.1982	13.6879	17.3800	20.2850	21.6246	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	228.6276	231.0001	225.0216	212.2941	196.2280	181.1281	171.0405	168.6680	174.6465	187.3739	203.4401	218.5400	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	35.7153	35.7153	35.7153	35.7153	35.7153	35.7153	35.7153	35.7153	35.7153	35.7153	35.7153	35.7153	(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)													
	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	(71)
Water heating gains (Table 5)													
	86.0875	83.9023	78.7634	71.9465	67.2934	61.0060	56.2126	63.0021	65.8322	72.8653	80.6763	83.9114	(72)
Total internal gains													
	399.9008	397.7356	383.1284	359.8920	336.2677	313.5408	299.2445	306.0141	318.3124	341.7650	368.5472	388.2218	(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	3.0700	10.6334	0.6300	0.7000	0.7700	9.9766	(74)
East	4.1500	19.6403	0.6300	0.7000	0.7700	24.9096	(76)
West	7.0800	19.6403	0.6300	0.7000	0.7700	42.4964	(80)

Solar gains	77.3826	150.9263	249.5529	368.7469	458.2387	472.3732	448.3367	380.5175	291.5130	179.1589	96.3548	63.7484	(83)
Total gains	477.2834	548.6619	632.6814	728.6389	794.5064	785.9140	747.5813	686.5316	609.8255	520.9239	464.9020	451.9703	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	62.2254	62.3853	62.5428	63.2937	63.4361	64.1079	64.1079	64.2339	63.8475	63.4361	63.1486	62.8507	
alpha	5.1484	5.1590	5.1695	5.2196	5.2291	5.2739	5.2739	5.2823	5.2565	5.2291	5.2099	5.1900	
util living area													
	0.9985	0.9966	0.9897	0.9605	0.8710	0.6977	0.5291	0.5936	0.8562	0.9811	0.9969	0.9989	(86)
MIT	19.7716	19.9172	20.1778	20.5263	20.8109	20.9576	20.9918	20.9856	20.8739	20.4935	20.0709	19.7481	(87)
Th 2	19.9878	19.9901	19.9924	20.0031	20.0052	20.0145	20.0145	20.0163	20.0109	20.0052	20.0011	19.9968	(88)
util rest of house													
	0.9980	0.9954	0.9860	0.9456	0.8251	0.6091	0.4157	0.4760	0.7881	0.9714	0.9956	0.9985	(89)
MIT 2	18.3446	18.5588	18.9393	19.4434	19.8196	19.9864	20.0115	20.0103	19.9075	19.4064	18.7918	18.3166	(90)
Living area fraction									fLA = Living area / (4) =			0.1745	(91)
MIT	18.5936	18.7958	19.1554	19.6323	19.9926	20.1559	20.1826	20.1805	20.0762	19.5961	19.0150	18.5664	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5936	18.7958	19.1554	19.6323	19.9926	20.1559	20.1826	20.1805	20.0762	19.5961	19.0150	18.5664	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9969	0.9934	0.9816	0.9385	0.8245	0.6226	0.4355	0.4964	0.7933	0.9659	0.9937	0.9977	(94)
Useful gains	475.8116	545.0343	621.0436	683.8624	655.0485	489.3204	325.6038	340.8246	483.7835	503.1576	461.9577	450.9115	(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													
	1348.2515	1307.3738	1187.6685	995.2477	767.2749	508.6766	328.0062	345.4467	549.3862	832.3695	1107.4574	1341.6390	(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													
	649.0953	512.2921	421.5689	224.1974	83.4964	0.0000	0.0000	0.0000	0.0000	244.9337	464.7597	662.7012	(98)
Space heating												3263.0448	(98)
Space heating per m2											(98) / (4) =	38.6068	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3493.6239	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	649.0953	512.2921	421.5689	224.1974	83.4964	0.0000	0.0000	0.0000	0.0000	244.9337	464.7597	662.7012	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	694.9629	548.4926	451.3586	240.0401	89.3965	0.0000	0.0000	0.0000	0.0000	262.2416	497.6014	709.5302	(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													
	205.2728	180.9913	188.4407	167.1374	161.8185	142.5207	136.5457	152.2164	153.8975	175.2429	186.9336	200.4037	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.7483	87.5260	87.0189	85.7913	83.4743	80.3000	80.3000	80.3000	80.3000	85.8941	87.2521	87.8348	(217)
Fuel for water heating, kWh/month													
	233.9338	206.7858	216.5514	194.8185	193.8542	177.4853	170.0444	189.5597	191.6531	204.0220	214.2454	228.1597	(219)
Water heating fuel used												2421.1132	(219)
Annual totals kWh/year													
Space heating fuel - main system												3493.6239	(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)												371.5703	(232)
Total delivered energy for all uses												6361.3074	(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	3493.6239	0.2160	754.6228	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2421.1132	0.2160	522.9605	(264)
Space and water heating			1277.5832	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	371.5703	0.5190	192.8450	(268)
Total CO2, kg/m2/year			1509.3532	(272)
Emissions per m2 for space and water heating			15.1158	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.2816	(272b)
Emissions per m2 for pumps and fans			0.4605	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.1158 * 1.00) + 2.2816 + 0.4605, rounded to 2 d.p.			17.8600	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	42.2600	(1b)	x 2.3900	(2b) =	101.0014	(1b) - (3b)
First floor	42.2600	(1c)	x 2.4200	(2c) =	102.2692	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	84.5200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		203.2706	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =		30.0000 / (5) =	0.1476	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3976	(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) =	0.3379	(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	0.4309	0.4224	0.4140	0.3717	0.3633	0.3211	0.3211	0.3126	0.3379	0.3633	0.3802	0.3971	(22b)
Effective ac	0.5928	0.5892	0.5857	0.5691	0.5660	0.5515	0.5515	0.5489	0.5571	0.5660	0.5723	0.5788	(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	
Front Door			2.1500	1.1000	2.3650			(26)
Windows & Fully Glazed Do (Uw = 1.20)			14.3000	1.1450	16.3740			(27)
Ground Floor			42.2600	0.1200	5.0712	90.0000	3803.4000	(28a)
Brick and Block	88.3100	16.4500	71.8600	0.2400	17.2464	42.2200	3033.9292	(29a)
Step Party Wall	2.6200		2.6200	0.2600	0.6812	110.0000	288.2000	(29a)
External Roof 1	42.2600		42.2600	0.1000	4.2260	9.1000	384.5660	(30)
Total net area of external elements Aum(A, m2)			175.4500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	45.9638			(33)
Party Wall 1			40.9700	0.0000	0.0000	45.0000	1843.6500	(32)
GF Timber Stud			76.4600			9.0000	688.1400	(32c)
FF Timber Stud			83.4400			9.0000	750.9600	(32c)
Internal Floor 1			46.2600			18.0000	832.6800	(32d)
Internal Ceiling 1			46.2600			9.0000	416.3400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12041.8652 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		142.4736 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		7.3358 (36)
Total fabric heat loss	(33) + (36) =	53.2996 (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	39.7667	39.5249	39.2878	38.1746	37.9663	36.9967	36.9967	36.8172	37.3702	37.9663	38.3877	38.8282	(38)
Heat transfer coeff	93.0663	92.8245	92.5875	91.4742	91.2659	90.2963	90.2963	90.1168	90.6698	91.2659	91.6873	92.1278	(39)
Average = Sum(39)m / 12 =												91.4732	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1011	1.0983	1.0955	1.0823	1.0798	1.0683	1.0683	1.0662	1.0728	1.0798	1.0848	1.0900	(40)
HLP (average)												1.0823	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.5431	(42)
Average daily hot water use (litres/day)	94.5975	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	104.0573	100.2734	96.4895	92.7056	88.9217	85.1378	85.1378	88.9217	92.7056	96.4895	100.2734	104.0573	(44)
Energy conte	154.3139	134.9639	139.2707	121.4196	116.5050	100.5349	93.1604	106.9029	108.1797	126.0730	137.6185	149.4448	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1488.3871 (45)
Distribution loss (46)m = 0.15 x (45)m

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)

Water storage loss:
Total storage loss

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

If cylinder contains dedicated solar storage

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss 0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)

Heat gains from water heating, kWh/month

32.7917	28.6798	29.5950	25.8017	24.7573	21.3637	19.7966	22.7169	22.9882	26.7905	29.2439	31.7570	(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	127.1526	127.1526	127.1526	127.1526	127.1526	127.1526	127.1526	127.1526	127.1526	127.1526	127.1526	127.1526	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

21.0398	18.6874	15.1976	11.5056	8.6006	7.2609	7.8457	10.1982	13.6879	17.3800	20.2850	21.6246	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

228.6276	231.0001	225.0216	212.2941	196.2280	181.1281	171.0405	168.6680	174.6465	187.3739	203.4401	218.5400	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

35.7153	35.7153	35.7153	35.7153	35.7153	35.7153	35.7153	35.7153	35.7153	35.7153	35.7153	35.7153	(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)

-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	(71)

Water heating gains (Table 5)

44.0749	42.6783	39.7783	35.8356	33.2759	29.6718	26.6083	30.5334	31.9280	36.0087	40.6166	42.6842	(72)

Total internal gains

354.8881	353.5116	341.1433	320.7811	299.2503	279.2066	266.6403	270.5454	281.4083	301.9085	325.4874	343.9945	(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	3.0700	10.6334	0.6300	0.7000	0.7700	9.9766	(74)
East	4.1500	19.6403	0.6300	0.7000	0.7700	24.9096	(76)
West	7.0800	19.6403	0.6300	0.7000	0.7700	42.4964	(80)

Solar gains 77.3826	150.9263	249.5529	368.7469	458.2387	472.3732	448.3367	380.5175	291.5130	179.1589	96.3548	63.7484	(83)
Total gains 432.2708	504.4379	590.6962	689.5281	757.4890	751.5798	714.9770	651.0629	572.9213	481.0674	421.8423	407.7430	(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, n1,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	35.9417	36.0354	36.1276	36.5673	36.6507	37.0443	37.0443	37.1181	36.8917	36.6507	36.4823	36.3079	
alpha	3.3961	3.4024	3.4085	3.4378	3.4434	3.4696	3.4696	3.4745	3.4594	3.4434	3.4322	3.4205	
util living area	0.9906	0.9834	0.9650	0.9156	0.8168	0.6656	0.5210	0.5811	0.8086	0.9501	0.9848	0.9923	(86)
MIT	19.0783	19.2947	19.6795	20.1841	20.6051	20.8662	20.9573	20.9377	20.7207	20.1551	19.5273	19.0430	(87)
Th 2	19.9999	20.0023	20.0046	20.0153	20.0174	20.0268	20.0268	20.0285	20.0231	20.0174	20.0133	20.0090	(88)
util rest of house	0.9887	0.9800	0.9575	0.8969	0.7758	0.5916	0.4190	0.4783	0.7500	0.9354	0.9812	0.9907	(89)
MIT 2	18.2357	18.4522	18.8340	19.3320	19.7230	19.9486	20.0098	20.0017	19.8385	19.3143	18.6930	18.2072	(90)
Living area fraction									fLA = Living area / (4) =			0.1745	(91)
MIT	18.3827	18.5992	18.9816	19.4807	19.8769	20.1088	20.1752	20.1650	19.9924	19.4610	18.8386	18.3530	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3827	18.5992	18.9816	19.4807	19.8769	20.1088	20.1752	20.1650	19.9924	19.4610	18.8386	18.3530	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9844	0.9736	0.9477	0.8848	0.7691	0.5984	0.4354	0.4937	0.7479	0.9248	0.9752	0.9870	(94)
Useful gains	425.5211	491.1148	559.7752	610.0758	582.6089	449.7079	311.2756	321.4460	428.5032	444.8826	411.3740	402.4559	(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	1310.6266	1271.6252	1155.6378	967.8586	746.2739	497.4212	322.8259	339.2895	534.2672	808.7106	1076.2773	1303.8870	(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	658.5185	524.5030	443.3218	257.6037	121.7668	0.0000	0.0000	0.0000	0.0000	270.6880	478.7303	670.6647	(98)
Space heating												3425.7968	(98)
Space heating per m2											(98) / (4) =	40.5324	(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	848.7854	668.1927	684.8874	0.0000	0.0000	0.0000	0.0000	(100)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8264	0.8840	0.8542	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	701.4136	590.6501	585.0188	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	973.9515	929.1992	856.1953	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	196.2273	251.8806	201.7553	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												649.8632 (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	49.0568	62.9701	50.4388	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												162.4658 (107)
Space cooling per m2												1.9222 (108)
Energy for space heating												40.5324 (99)
Energy for space cooling												1.9222 (108)
Total												42.4546 (109)
Dwelling Fabric Energy Efficiency (DFEE)												42.5 (109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	42.2600	(1b)	x 2.3900	(2b) =	101.0014	(1b) - (3b)
First floor	42.2600	(1c)	x 2.4200	(2c) =	102.2692	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	84.5200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		203.2706	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1476	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3976	(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) =	0.3379	(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	0.4309	0.4224	0.4140	0.3717	0.3633	0.3211	0.3211	0.3126	0.3379	0.3633	0.3802	0.3971	(22b)
Effective ac	0.5928	0.5892	0.5857	0.5691	0.5660	0.5515	0.5515	0.5489	0.5571	0.5660	0.5723	0.5788	(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			2.1500	1.0000	2.1500			(26)
TER Opening Type (Uw = 1.40)			14.3000	1.3258	18.9583			(27)
Ground Floor			42.2600	0.1300	5.4938			(28a)
Brick and Block	88.3100	16.4500	71.8600	0.1800	12.9348			(29a)
Step Party Wall	2.6200		2.6200	0.1800	0.4716			(29a)
External Roof 1	42.2600		42.2600	0.1300	5.4938			(30)
Total net area of external elements Aum(A, m2)			175.4500					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		45.5023			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.0566	(36)
Total fabric heat loss					(33) + (36) =		54.5589	(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	39.7667	39.5249	39.2878	38.1746	37.9663	36.9967	36.9967	36.8172	37.3702	37.9663	38.3877	38.8282	(38)
Heat transfer coeff	94.3256	94.0838	93.8468	92.7335	92.5252	91.5556	91.5556	91.3761	91.9291	92.5252	92.9466	93.3871	(39)
Average = Sum(39)m / 12 =												92.7325	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1160	1.1132	1.1103	1.0972	1.0947	1.0832	1.0832	1.0811	1.0877	1.0947	1.0997	1.1049	(40)
HLP (average)												1.0972	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												2.5431	(42)
Average daily hot water use (litres/day)												94.5975	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	104.0573	100.2734	96.4895	92.7056	88.9217	85.1378	85.1378	88.9217	92.7056	96.4895	100.2734	104.0573	(44)
Energy conte	154.3139	134.9639	139.2707	121.4196	116.5050	100.5349	93.1604	106.9029	108.1797	126.0730	137.6185	149.4448	(45)
Energy content (annual)										Total = Sum(45)m =		1488.3871	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)

Heat gains from water heating, kWh/month

	32.7917	28.6798	29.5950	25.8017	24.7573	21.3637	19.7966	22.7169	22.9882	26.7905	29.2439	31.7570 (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	127.1526	127.1526	127.1526	127.1526	127.1526	127.1526	127.1526	127.1526	127.1526	127.1526	127.1526	127.1526	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	21.0398	18.6874	15.1976	11.5056	8.6006	7.2609	7.8457	10.1982	13.6879	17.3800	20.2850	21.6246 (67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	228.6276	231.0001	225.0216	212.2941	196.2280	181.1281	171.0405	168.6680	174.6465	187.3739	203.4401	218.5400 (68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	35.7153	35.7153	35.7153	35.7153	35.7153	35.7153	35.7153	35.7153	35.7153	35.7153	35.7153	35.7153 (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)

	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221 (71)

Water heating gains (Table 5)

	44.0749	42.6783	39.7783	35.8356	33.2759	29.6718	26.6083	30.5334	31.9280	36.0087	40.6166	42.6842 (72)

Total internal gains

	354.8881	353.5116	341.1433	320.7811	299.2503	279.2066	266.6403	270.5454	281.4083	301.9085	325.4874	343.9945 (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	3.0700	10.6334	0.6300	0.7000	0.7700	9.9766	(74)
East	4.1500	19.6403	0.6300	0.7000	0.7700	24.9096	(76)
West	7.0800	19.6403	0.6300	0.7000	0.7700	42.4964	(80)

Solar gains	77.3826	150.9263	249.5529	368.7469	458.2387	472.3732	448.3367	380.5175	291.5130	179.1589	96.3548	63.7484 (83)
Total gains	432.2708	504.4379	590.6962	689.5281	757.4890	751.5798	714.9770	651.0629	572.9213	481.0674	421.8423	407.7430 (84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	62.2254	62.3853	62.5428	63.2937	63.4361	64.1079	64.1079	64.2339	63.8475	63.4361	63.1486	62.8507	
alpha	5.1484	5.1590	5.1695	5.2196	5.2291	5.2739	5.2739	5.2823	5.2565	5.2291	5.2099	5.1900	
util living area	0.9991	0.9977	0.9924	0.9681	0.8879	0.7211	0.5512	0.6214	0.8797	0.9865	0.9980	0.9993	(86)
MIT	19.7216	19.8685	20.1330	20.4900	20.7890	20.9505	20.9901	20.9822	20.8535	20.4526	20.0233	19.6988	(87)
Th 2	19.9878	19.9901	19.9924	20.0031	20.0052	20.0145	20.0145	20.0163	20.0109	20.0052	20.0011	19.9968	(88)
util rest of house	0.9987	0.9969	0.9895	0.9556	0.8454	0.6326	0.4341	0.5005	0.8171	0.9793	0.9972	0.9991	(89)
MIT 2	18.8160	18.9644	19.2294	19.5872	19.8614	19.9917	20.0120	20.0111	19.9264	19.5572	19.1281	18.8004	(90)
Living area fraction									fLA = Living area / (4) =			0.1745	(91)
MIT	18.9740	19.1222	19.3871	19.7448	20.0233	20.1590	20.1827	20.1806	20.0882	19.7134	19.2843	18.9572	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9740	19.1222	19.3871	19.7448	20.0233	20.1590	20.1827	20.1806	20.0882	19.7134	19.2843	18.9572	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9983	0.9959	0.9873	0.9515	0.8463	0.6466	0.4547	0.5217	0.8229	0.9765	0.9963	0.9987	(94)
Useful gains	431.5271	502.3838	583.1674	656.0992	641.0784	485.9374	325.0798	339.6446	471.4699	469.7431	420.2961	407.2263	(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	1384.1365	1338.0791	1209.4129	1005.6722	770.1168	508.9624	328.0167	345.4559	550.4867	843.2236	1132.4903	1378.1331	(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	708.7414	561.5873	465.9267	251.6925	96.0046	0.0000	0.0000	0.0000	0.0000	277.8695	512.7799	722.3547	(98)
Space heating												3596.9565	(98)
Space heating per m2											(98) / (4) =	42.5575	(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	860.6230	677.5118	694.4583	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8877	0.9406	0.9146	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	764.0087	637.2832	635.1237	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	973.9515	929.1992	856.1953	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	151.1589	217.1855	164.4773	0.0000	0.0000	0.0000	0.0000	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling											532.8216	(104)
Cooled fraction									fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	37.7897	54.2964	41.1193	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling											133.2054	(107)
Space cooling per m2											1.5760	(108)
Energy for space heating											42.5575	(99)
Energy for space cooling											1.5760	(108)
Total											44.1335	(109)
Target Fabric Energy Efficiency (TFEE)											50.8	(109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	42.2600	(1b)	x 2.3900	(2b) =	101.0014	(1b) - (3b)
First floor	42.2600	(1c)	x 2.4200	(2c) =	102.2692	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	84.5200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		203.2706	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000	/ (5) =	0.1476	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3976	(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) =		0.3379	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	4.7000	4.6000	4.3000	4.3000	4.0000	4.0000	3.9000	4.0000	4.5000	4.4000	4.7000	(22)
Wind factor	1.2750	1.1750	1.1500	1.0750	1.0750	1.0000	1.0000	0.9750	1.0000	1.1250	1.1000	1.1750	(22a)
Adj infilt rate	0.4309	0.3971	0.3886	0.3633	0.3633	0.3379	0.3379	0.3295	0.3379	0.3802	0.3717	0.3971	(22b)
Effective ac	0.5928	0.5788	0.5755	0.5660	0.5660	0.5571	0.5571	0.5543	0.5571	0.5723	0.5691	0.5788	(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	
Front Door			2.1500	1.1000	2.3650			(26)
Windows & Fully Glazed Do (Uw = 1.20)			14.3000	1.1450	16.3740			(27)
Ground Floor			42.2600	0.1200	5.0712	90.0000	3803.4000	(28a)
Brick and Block	88.3100	16.4500	71.8600	0.2400	17.2464	42.2200	3033.9292	(29a)
Step Party Wall	2.6200		2.6200	0.2600	0.6812	110.0000	288.2000	(29a)
External Roof 1	42.2600		42.2600	0.1000	4.2260	9.1000	384.5660	(30)
Total net area of external elements Aum(A, m2)			175.4500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	45.9638			(33)
Party Wall 1			40.9700	0.0000	0.0000	45.0000	1843.6500	(32)
GF Timber Stud			76.4600			9.0000	688.1400	(32c)
FF Timber Stud			83.4400			9.0000	750.9600	(32c)
Internal Floor 1			46.2600			18.0000	832.6800	(32d)
Internal Ceiling 1			46.2600			18.0000	832.6800	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12458.2052 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.3995 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		7.3358 (36)
Total fabric heat loss	(33) + (36) =	53.2996 (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	39.7667	38.8282	38.6055	37.9663	37.9663	37.3702	37.3702	37.1811	37.3702	38.3877	38.1746	38.8282	(38)
Heat transfer coeff	93.0663	92.1278	91.9051	91.2659	91.2659	90.6698	90.6698	90.4807	90.6698	91.6873	91.4742	92.1278	(39)
Average = Sum(39)m / 12 =												91.4509	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1011	1.0900	1.0874	1.0798	1.0798	1.0728	1.0728	1.0705	1.0728	1.0848	1.0823	1.0900	(40)
HLP (average)												1.0820	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.5431 (42)
Average daily hot water use (litres/day)		94.5975 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	104.0573	100.2734	96.4895	92.7056	88.9217	85.1378	85.1378	88.9217	92.7056	96.4895	100.2734	104.0573	(44)
Energy conte	154.3139	134.9639	139.2707	121.4196	116.5050	100.5349	93.1604	106.9029	108.1797	126.0730	137.6185	149.4448	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1488.3871 (45)
Distribution loss (46)m = 0.15 x (45)m

	23.1471	20.2446	20.8906	18.2129	17.4757	15.0802	13.9741	16.0354	16.2269	18.9109	20.6428	22.4167 (46)

Water storage loss:
Total storage loss

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (56)

If cylinder contains dedicated solar storage

	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (57)
Combi loss	25.3185	22.8670	25.2766	24.4140	25.1935	24.3412	25.1279	25.1704	24.3809	25.2422	24.4815	25.3057 (61)

Total heat required for water heating calculated for each month

	179.6324	157.8309	164.5473	145.8336	141.6984	124.8761	118.2883	132.0733	132.5605	151.3152	162.1000	174.7505 (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

	179.6324	157.8309	164.5473	145.8336	141.6984	124.8761	118.2883	132.0733	132.5605	151.3152	162.1000	174.7505 (64)

Total per year (kWh/year) = Sum(64)m = 1785.5066 (64)
RHI water heating demand 1786 (64)
Heat gains from water heating, kWh/month

	57.6390	50.5922	52.6267	46.4755	45.0363	39.5132	37.2578	41.8378	42.0650	48.2298	51.8785	56.0168 (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	152.5832	152.5832	152.5832	152.5832	152.5832	152.5832	152.5832	152.5832	152.5832	152.5832	152.5832	152.5832	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

	52.5996	46.7185	37.9941	28.7639	21.5014	18.1524	19.6143	25.4954	34.2198	43.4500	50.7125	54.0615	(67)

Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

	341.2353	344.7762	335.8531	316.8569	292.8776	270.3405	255.2843	251.7433	260.6664	279.6626	303.6419	326.1791	(68)

Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

	52.8014	52.8014	52.8014	52.8014	52.8014	52.8014	52.8014	52.8014	52.8014	52.8014	52.8014	52.8014	(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)

	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	(71)

Water heating gains (Table 5)

	77.4718	75.2861	70.7347	64.5493	60.5326	54.8794	50.0777	56.2336	58.4236	64.8250	72.0535	75.2914	(72)
Total internal gains													
	577.9691	573.4432	551.2444	516.8326	481.5741	450.0347	431.6387	440.1348	459.9722	494.6000	533.0704	562.1944	(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	3.0700	13.8645	0.6300	0.7000	0.7700	13.0082	(74)
East	4.1500	25.9136	0.6300	0.7000	0.7700	32.8661	(76)
West	7.0800	25.9136	0.6300	0.7000	0.7700	56.0704	(80)

Solar gains	101.9447	170.0584	279.3072	418.7476	495.5433	552.1048	511.7574	444.6851	345.4970	213.4611	125.8251	80.1557	(83)
Total gains	679.9138	743.5016	830.5516	935.5802	977.1174	1002.1395	943.3961	884.8198	805.4693	708.0611	658.8954	642.3501	(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	37.1844	37.5632	37.6542	37.9179	37.9179	38.1672	38.1672	38.2470	38.1672	37.7437	37.8316	37.5632	
alpha	3.4790	3.5042	3.5103	3.5279	3.5279	3.5445	3.5445	3.5498	3.5445	3.5162	3.5221	3.5042	
util living area													
	0.9607	0.9468	0.9067	0.8185	0.6769	0.4831	0.3497	0.3708	0.6098	0.8412	0.9351	0.9656	(86)
MIT	19.6689	19.8203	20.1534	20.5396	20.8235	20.9604	20.9906	20.9888	20.9113	20.5849	20.1012	19.6496	(87)
Th 2	19.9999	20.0090	20.0112	20.0174	20.0174	20.0231	20.0231	20.0250	20.0231	20.0133	20.0153	20.0090	(88)
util rest of house													
	0.9530	0.9366	0.8889	0.7854	0.6208	0.4070	0.2600	0.2765	0.5302	0.8019	0.9202	0.9586	(89)
MIT 2	18.8151	18.9693	19.2918	19.6553	19.8995	20.0041	20.0205	20.0218	19.9755	19.7031	19.2511	18.8038	(90)

Living area fraction fLA = Living area / (4) = 0.1745 (91)

MIT	18.9641	19.1178	19.4422	19.8096	20.0607	20.1710	20.1898	20.1905	20.1388	19.8570	19.3994	18.9514	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9641	19.1178	19.4422	19.8096	20.0607	20.1710	20.1898	20.1905	20.1388	19.8570	19.3994	18.9514	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9428	0.9253	0.8768	0.7776	0.6235	0.4189	0.2756	0.2928	0.5403	0.7948	0.9089	0.9492	(94)
Useful gains	641.0372	687.9842	728.2313	727.4699	609.2112	419.7897	259.9923	259.0923	435.1573	562.7523	598.8417	609.7233	(95)
Ext temp.	5.4000	5.7000	7.3000	9.6000	12.6000	15.4000	17.3000	17.3000	15.0000	11.8000	8.4000	5.5000	(96)
Heat loss rate W													
	1262.3611	1236.1517	1115.9263	931.7880	680.9094	432.5867	262.0166	261.5362	465.9351	738.7252	1006.1628	1239.2450	(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													
	462.2650	368.3686	288.4451	147.1090	53.3435	0.0000	0.0000	0.0000	0.0000	130.9238	293.2712	468.3641	(98)
Space heating												2212.0903	(98)
RHI space heating demand												2212	(98)

CALCULATION OF HEAT DEMAND 09 Jan 2014

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	42.2600	(1b)	x 2.3900	(2b) =	101.0014	(1b) - (3b)
First floor	42.2600	(1c)	x 2.4200	(2c) =	102.2692	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	84.5200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		203.2706	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							3 * 10 =	30.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1476	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3976	(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) =	0.3379	(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	0.4309	0.4224	0.4140	0.3717	0.3633	0.3211	0.3211	0.3126	0.3379	0.3633	0.3802	0.3971	(22b)
Effective ac	0.5928	0.5892	0.5857	0.5691	0.5660	0.5515	0.5515	0.5489	0.5571	0.5660	0.5723	0.5788	(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	
Front Door			2.1500	1.1000	2.3650			(26)
Windows & Fully Glazed Do (Uw = 1.20)			14.3000	1.1450	16.3740			(27)
Ground Floor			42.2600	0.1200	5.0712	90.0000	3803.4000	(28a)
Brick and Block	88.3100	16.4500	71.8600	0.2400	17.2464	42.2200	3033.9292	(29a)
Step Party Wall	2.6200		2.6200	0.2600	0.6812	110.0000	288.2000	(29a)
External Roof 1	42.2600		42.2600	0.1000	4.2260	9.1000	384.5660	(30)
Total net area of external elements Aum(A, m2)			175.4500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	45.9638			(33)
Party Wall 1			40.9700	0.0000	0.0000	45.0000	1843.6500	(32)
GF Timber Stud			76.4600			9.0000	688.1400	(32c)
FF Timber Stud			83.4400			9.0000	750.9600	(32c)
Internal Floor 1			46.2600			18.0000	832.6800	(32d)
Internal Ceiling 1			46.2600			18.0000	832.6800	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12458.2052 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.3995 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		7.3358 (36)
Total fabric heat loss	(33) + (36) =	53.2996 (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	39.7667	39.5249	39.2878	38.1746	37.9663	36.9967	36.9967	36.8172	37.3702	37.9663	38.3877	38.8282	(38)
Heat transfer coeff	93.0663	92.8245	92.5875	91.4742	91.2659	90.2963	90.2963	90.1168	90.6698	91.2659	91.6873	92.1278	(39)
Average = Sum(39)m / 12 =												91.4732	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1011	1.0983	1.0955	1.0823	1.0798	1.0683	1.0683	1.0662	1.0728	1.0798	1.0848	1.0900	(40)
HLP (average)												1.0823	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.5431 (42)
Average daily hot water use (litres/day)		94.5975 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	104.0573	100.2734	96.4895	92.7056	88.9217	85.1378	85.1378	88.9217	92.7056	96.4895	100.2734	104.0573	(44)
Energy conte	154.3139	134.9639	139.2707	121.4196	116.5050	100.5349	93.1604	106.9029	108.1797	126.0730	137.6185	149.4448	(45)

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Energy content (annual)												Total = Sum(45)m =	1488.3871 (45)
Distribution loss (46)m = 0.15 x (45)m													
	23.1471	20.2446	20.8906	18.2129	17.4757	15.0802	13.9741	16.0354	16.2269	18.9109	20.6428	22.4167	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	25.3185	22.8670	25.2766	24.4140	25.1935	24.3412	25.1279	25.1704	24.3809	25.2422	24.4815	25.3057	(61)
Total heat required for water heating calculated for each month													
	179.6324	157.8309	164.5473	145.8336	141.6984	124.8761	118.2883	132.0733	132.5605	151.3152	162.1000	174.7505	(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													
	179.6324	157.8309	164.5473	145.8336	141.6984	124.8761	118.2883	132.0733	132.5605	151.3152	162.1000	174.7505	(64)
								Total per year (kWh/year) = Sum(64)m =				1785.5066	(64)
Heat gains from water heating, kWh/month													
	57.6390	50.5922	52.6267	46.4755	45.0363	39.5132	37.2578	41.8378	42.0650	48.2298	51.8785	56.0168	(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	152.5832	152.5832	152.5832	152.5832	152.5832	152.5832	152.5832	152.5832	152.5832	152.5832	152.5832	152.5832	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	52.5996	46.7185	37.9941	28.7639	21.5014	18.1524	19.6143	25.4954	34.2198	43.4500	50.7125	54.0615	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	341.2353	344.7762	335.8531	316.8569	292.8776	270.3405	255.2843	251.7433	260.6664	279.6626	303.6419	326.1791	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.8014	52.8014	52.8014	52.8014	52.8014	52.8014	52.8014	52.8014	52.8014	52.8014	52.8014	52.8014	(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)													
	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	(71)
Water heating gains (Table 5)													
	77.4718	75.2861	70.7347	64.5493	60.5326	54.8794	50.0777	56.2336	58.4236	64.8250	72.0535	75.2914	(72)
Total internal gains													
	577.9691	573.4432	551.2444	516.8326	481.5741	450.0347	431.6387	440.1348	459.9722	494.6000	533.0704	562.1944	(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	3.0700	10.6334	0.6300	0.7000	0.7700	9.9766	(74)
East	4.1500	19.6403	0.6300	0.7000	0.7700	24.9096	(76)
West	7.0800	19.6403	0.6300	0.7000	0.7700	42.4964	(80)

Solar gains	77.3826	150.9263	249.5529	368.7469	458.2387	472.3732	448.3367	380.5175	291.5130	179.1589	96.3548	63.7484	(83)
Total gains	655.3517	724.3696	800.7973	885.5795	939.8128	922.4078	879.9754	820.6523	751.4853	673.7590	629.4252	625.9429	(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	37.1844	37.2813	37.3767	37.8316	37.9179	38.3251	38.3251	38.4014	38.1672	37.9179	37.7437	37.5632	
alpha	3.4790	3.4854	3.4918	3.5221	3.5279	3.5550	3.5550	3.5601	3.5445	3.5279	3.5162	3.5042	
util living area													
	0.9707	0.9570	0.9263	0.8565	0.7379	0.5761	0.4364	0.4821	0.7037	0.8901	0.9558	0.9746	(86)
MIT	19.4698	19.6635	19.9972	20.4164	20.7396	20.9218	20.9777	20.9682	20.8374	20.4141	19.8735	19.4323	(87)
Th 2	19.9999	20.0023	20.0046	20.0153	20.0174	20.0268	20.0268	20.0285	20.0231	20.0174	20.0133	20.0090	(88)
util rest of house													
	0.9651	0.9490	0.9123	0.8293	0.6897	0.5034	0.3460	0.3893	0.6355	0.8629	0.9461	0.9698	(89)
MIT 2	18.6188	18.8105	19.1368	19.5422	19.8315	19.9836	20.0185	20.0158	19.9232	19.5512	19.0280	18.5889	(90)
Living area fraction										fLA = Living area / (4) =		0.1745	(91)
MIT	18.7673	18.9594	19.2870	19.6948	19.9900	20.1473	20.1859	20.1820	20.0827	19.7018	19.1756	18.7361	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7673	18.9594	19.2870	19.6948	19.9900	20.1473	20.1859	20.1820	20.0827	19.7018	19.1756	18.7361	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9563	0.9384	0.9001	0.8192	0.6883	0.5129	0.3612	0.4045	0.6400	0.8526	0.9358	0.9617	(94)
Useful gains	626.7401	679.7734	720.8177	725.4573	646.8460	473.0584	317.8765	331.9365	480.9460	574.4775	588.9884	601.9635	(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													
	1346.4187	1305.0519	1183.9125	987.4450	756.5902	500.9026	323.7922	340.8243	542.4520	830.6809	1107.1756	1339.1755	(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													
	535.4409	420.1872	344.5425	188.6311	81.6497	0.0000	0.0000	0.0000	0.0000	190.6153	373.0948	548.4857	(98)
Space heating												2682.6472	(98)
Space heating per m2											(98) / (4) =	31.7398	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.7000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2957.7147	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	535.4409	420.1872	344.5425	188.6311	81.6497	0.0000	0.0000	0.0000	0.0000	190.6153	373.0948	548.4857	(98)
Space heating efficiency (main heating system 1)													
	90.7000	90.7000	90.7000	90.7000	90.7000	0.0000	0.0000	0.0000	0.0000	90.7000	90.7000	90.7000	(210)
Space heating fuel (main heating system)													
	590.3427	463.2714	379.8705	207.9726	90.0217	0.0000	0.0000	0.0000	0.0000	210.1602	411.3504	604.7252	(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													
	179.6324	157.8309	164.5473	145.8336	141.6984	124.8761	118.2883	132.0733	132.5605	151.3152	162.1000	174.7505	(64)
Efficiency of water heater												87.2000	(216)
(217)m	89.7946	89.7167	89.5384	89.1400	88.4477	87.2000	87.2000	87.2000	87.2000	89.1171	89.6106	89.8288	(217)
Fuel for water heating, kWh/month													
	200.0481	175.9214	183.7729	163.6006	160.2059	143.2066	135.6517	151.4602	152.0190	169.7937	180.8937	194.5372	(219)
Water heating fuel used												2011.1110	(219)
Annual totals kWh/year													
Space heating fuel - main system												2957.7147	(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)												371.5703	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.75 * 908 * 1.00) =										-544.7125		-544.7125	(233)
Total delivered energy for all uses												4870.6834	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2957.7147	3.4800	102.9285	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2011.1110	3.4800	69.9867	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	371.5703	13.1900	49.0101	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-544.7125	13.1900	-71.8476	(252)
Total energy cost			279.9702	(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] =	0.9079	(257)
SAP value		87.3352	
SAP rating (Section 12)		87	(258)
SAP band		B	

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2957.7147	0.2160	638.8664	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2011.1110	0.2160	434.4000	(264)
Space and water heating			1073.2664	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	371.5703	0.5190	192.8450	(268)
Energy saving/generation technologies				
PV Unit	-544.7125	0.5190	-282.7058	(269)
Total kg/year			1022.3305	(272)
CO2 emissions per m2			12.1000	(273)
EI value			89.4231	
EI rating			89	(274)
EI band			B	

Calculation of stars for heating and DHW

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9070 = 3.837, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9070 = 0.2381, stars = 4
Water heating energy efficiency	3.48 / 0.8867 = 3.925, stars = 4
Water heating environmental impact	0.216 / 0.8867 = 0.2436, stars = 4

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	42.2600	(1b)	x 2.3900	(2b) =	101.0014	(1b) - (3b)
First floor	42.2600	(1c)	x 2.4200	(2c) =	102.2692	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	84.5200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		203.2706	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1476	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3976	(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) =	0.3379	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	4.7000	4.6000	4.3000	4.3000	4.0000	4.0000	3.9000	4.0000	4.5000	4.4000	4.7000	(22)
Wind factor	1.2750	1.1750	1.1500	1.0750	1.0750	1.0000	1.0000	0.9750	1.0000	1.1250	1.1000	1.1750	(22a)
Adj infilt rate	0.4309	0.3971	0.3886	0.3633	0.3633	0.3379	0.3379	0.3295	0.3379	0.3802	0.3717	0.3971	(22b)
Effective ac	0.5928	0.5788	0.5755	0.5660	0.5660	0.5571	0.5571	0.5543	0.5571	0.5723	0.5691	0.5788	(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	
Front Door			2.1500	1.1000	2.3650			(26)
Windows & Fully Glazed Do (Uw = 1.20)			14.3000	1.1450	16.3740			(27)
Ground Floor			42.2600	0.1200	5.0712	90.0000	3803.4000	(28a)
Brick and Block	88.3100	16.4500	71.8600	0.2400	17.2464	42.2200	3033.9292	(29a)
Step Party Wall	2.6200		2.6200	0.2600	0.6812	110.0000	288.2000	(29a)
External Roof 1	42.2600		42.2600	0.1000	4.2260	9.1000	384.5660	(30)
Total net area of external elements Aum(A, m2)			175.4500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	45.9638			(33)
Party Wall 1			40.9700	0.0000	0.0000	45.0000	1843.6500	(32)
GF Timber Stud			76.4600			9.0000	688.1400	(32c)
FF Timber Stud			83.4400			9.0000	750.9600	(32c)
Internal Floor 1			46.2600			18.0000	832.6800	(32d)
Internal Ceiling 1			46.2600			18.0000	832.6800	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12458.2052 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.3995 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		7.3358 (36)
Total fabric heat loss	(33) + (36) =	53.2996 (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	39.7667	38.8282	38.6055	37.9663	37.9663	37.3702	37.3702	37.1811	37.3702	38.3877	38.1746	38.8282	(38)
Heat transfer coeff	93.0663	92.1278	91.9051	91.2659	91.2659	90.6698	90.6698	90.4807	90.6698	91.6873	91.4742	92.1278	(39)
Average = Sum(39)m / 12 =												91.4509	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1011	1.0900	1.0874	1.0798	1.0798	1.0728	1.0728	1.0705	1.0728	1.0848	1.0823	1.0900	(40)
HLP (average)												1.0820	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.5431 (42)
Average daily hot water use (litres/day)		94.5975 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	104.0573	100.2734	96.4895	92.7056	88.9217	85.1378	85.1378	88.9217	92.7056	96.4895	100.2734	104.0573	(44)
Energy conte	154.3139	134.9639	139.2707	121.4196	116.5050	100.5349	93.1604	106.9029	108.1797	126.0730	137.6185	149.4448	(45)

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

Energy content (annual)												Total = Sum(45)m =	1488.3871 (45)
Distribution loss (46)m = 0.15 x (45)m													
	23.1471	20.2446	20.8906	18.2129	17.4757	15.0802	13.9741	16.0354	16.2269	18.9109	20.6428	22.4167	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	25.3185	22.8670	25.2766	24.4140	25.1935	24.3412	25.1279	25.1704	24.3809	25.2422	24.4815	25.3057	(61)
Total heat required for water heating calculated for each month													
	179.6324	157.8309	164.5473	145.8336	141.6984	124.8761	118.2883	132.0733	132.5605	151.3152	162.1000	174.7505	(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													
	179.6324	157.8309	164.5473	145.8336	141.6984	124.8761	118.2883	132.0733	132.5605	151.3152	162.1000	174.7505	(64)
								Total per year (kWh/year) = Sum(64)m =				1785.5066	(64)
Heat gains from water heating, kWh/month													
	57.6390	50.5922	52.6267	46.4755	45.0363	39.5132	37.2578	41.8378	42.0650	48.2298	51.8785	56.0168	(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	152.5832	152.5832	152.5832	152.5832	152.5832	152.5832	152.5832	152.5832	152.5832	152.5832	152.5832	152.5832	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	52.5996	46.7185	37.9941	28.7639	21.5014	18.1524	19.6143	25.4954	34.2198	43.4500	50.7125	54.0615	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	341.2353	344.7762	335.8531	316.8569	292.8776	270.3405	255.2843	251.7433	260.6664	279.6626	303.6419	326.1791	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.8014	52.8014	52.8014	52.8014	52.8014	52.8014	52.8014	52.8014	52.8014	52.8014	52.8014	52.8014	(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)													
	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	(71)
Water heating gains (Table 5)													
	77.4718	75.2861	70.7347	64.5493	60.5326	54.8794	50.0777	56.2336	58.4236	64.8250	72.0535	75.2914	(72)
Total internal gains													
	577.9691	573.4432	551.2444	516.8326	481.5741	450.0347	431.6387	440.1348	459.9722	494.6000	533.0704	562.1944	(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	3.0700	13.8645	0.6300	0.7000	0.7700	13.0082	(74)
East	4.1500	25.9136	0.6300	0.7000	0.7700	32.8661	(76)
West	7.0800	25.9136	0.6300	0.7000	0.7700	56.0704	(80)

Solar gains	101.9447	170.0584	279.3072	418.7476	495.5433	552.1048	511.7574	444.6851	345.4970	213.4611	125.8251	80.1557	(83)
Total gains	679.9138	743.5016	830.5516	935.5802	977.1174	1002.1395	943.3961	884.8198	805.4693	708.0611	658.8954	642.3501	(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	37.1844	37.5632	37.6542	37.9179	37.9179	38.1672	38.1672	38.2470	38.1672	37.7437	37.8316	37.5632	
alpha	3.4790	3.5042	3.5103	3.5279	3.5279	3.5445	3.5445	3.5498	3.5445	3.5162	3.5221	3.5042	
util living area													
	0.9607	0.9468	0.9067	0.8185	0.6769	0.4831	0.3497	0.3708	0.6098	0.8412	0.9351	0.9656	(86)
MIT	19.6689	19.8203	20.1534	20.5396	20.8235	20.9604	20.9906	20.9888	20.9113	20.5849	20.1012	19.6496	(87)
Th 2	19.9999	20.0090	20.0112	20.0174	20.0174	20.0231	20.0231	20.0250	20.0231	20.0133	20.0153	20.0090	(88)
util rest of house													
	0.9530	0.9366	0.8889	0.7854	0.6208	0.4070	0.2600	0.2765	0.5302	0.8019	0.9202	0.9586	(89)
MIT 2	18.8151	18.9693	19.2918	19.6553	19.8995	20.0041	20.0205	20.0218	19.9755	19.7031	19.2511	18.8038	(90)
Living area fraction										fLA = Living area / (4) =		0.1745	(91)
MIT	18.9641	19.1178	19.4422	19.8096	20.0607	20.1710	20.1898	20.1905	20.1388	19.8570	19.3994	18.9514	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9641	19.1178	19.4422	19.8096	20.0607	20.1710	20.1898	20.1905	20.1388	19.8570	19.3994	18.9514	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9428	0.9253	0.8768	0.7776	0.6235	0.4189	0.2756	0.2928	0.5403	0.7948	0.9089	0.9492	(94)
Useful gains	641.0372	687.9842	728.2313	727.4699	609.2112	419.7897	259.9923	259.0923	435.1573	562.7523	598.8417	609.7233	(95)
Ext temp.	5.4000	5.7000	7.3000	9.6000	12.6000	15.4000	17.3000	17.3000	15.0000	11.8000	8.4000	5.5000	(96)
Heat loss rate W													
	1262.3611	1236.1517	1115.9263	931.7880	680.9094	432.5867	262.0166	261.5362	465.9351	738.7252	1006.1628	1239.2450	(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													
	462.2650	368.3686	288.4451	147.1090	53.3435	0.0000	0.0000	0.0000	0.0000	130.9238	293.2712	468.3641	(98)
Space heating												2212.0903	(98)
Space heating per m2											(98) / (4) =	26.1724	(99)

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

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.7000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2438.9089	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	462.2650	368.3686	288.4451	147.1090	53.3435	0.0000	0.0000	0.0000	0.0000	130.9238	293.2712	468.3641	(98)
Space heating efficiency (main heating system 1)													
	90.7000	90.7000	90.7000	90.7000	90.7000	0.0000	0.0000	0.0000	0.0000	90.7000	90.7000	90.7000	(210)
Space heating fuel (main heating system)													
	509.6637	406.1395	318.0210	162.1929	58.8132	0.0000	0.0000	0.0000	0.0000	144.3482	323.3420	516.3882	(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													
	179.6324	157.8309	164.5473	145.8336	141.6984	124.8761	118.2883	132.0733	132.5605	151.3152	162.1000	174.7505	(64)
Efficiency of water heater												87.2000	(216)
(217)m	89.6925	89.6210	89.3966	88.9232	88.1301	87.2000	87.2000	87.2000	87.2000	88.7894	89.4223	89.7215	(217)
Fuel for water heating, kWh/month													
	200.2758	176.1092	184.0643	163.9995	160.7832	143.2066	135.6517	151.4602	152.0190	170.4204	181.2746	194.7700	(219)
Water heating fuel used												2014.0345	(219)
Annual totals kWh/year													
Space heating fuel - main system												2438.9089	(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)												371.5703	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.75 * 1054 * 1.00) =										-632.6656		-632.6656	(233)
Total delivered energy for all uses												4266.8480	(238)

10a. Fuel costs - using BEDF prices (513)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2438.9089	9.7400	237.5497	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2014.0345	9.7400	196.1670	(247)
Pumps and fans for heating	75.0000	36.8500	27.6375	(249)
Energy for lighting	371.5703	36.8500	136.9237	(250)
Additional standing charges			104.0000	(251)
Energy saving/generation technologies				
PV Unit	-632.6656	36.8500	-233.1373	(252)
Total energy cost			469.1406	(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	2438.9089	0.2160	526.8043	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2014.0345	0.2160	435.0315	(264)
Space and water heating			961.8358	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	371.5703	0.5190	192.8450	(268)
Energy saving/generation technologies				
PV Unit	-632.6656	0.5190	-328.3535	(269)
Total kg/year			865.2523	(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	2438.9089	1.2200	2975.4688	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2014.0345	1.2200	2457.1221	(264)
Space and water heating			5432.5909	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	371.5703	3.0700	1140.7208	(268)
Energy saving/generation technologies				
PV Unit	-632.6656	3.0700	-1942.2834	(269)
Primary energy kWh/year			4861.2782	(272)
Primary energy kWh/m2/year			57.5163	(273)

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

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 87
Current environmental impact rating: B 89

(For testing purposes):

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.2	-£ 80	-193 kg (22.3%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£80	2.28 kg/m²	B 89	B 91
Total Savings	£80	2.28 kg/m²		

Potential energy efficiency rating: B 89
Potential environmental impact rating: B 91

Fuel prices for cost data on this page from database revision number 513 TEST (28 Feb 2023)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£165	£183	-£18
Mains gas	£538	£439	£99
Space heating	£369	£369	£0
Water heating	£196	£116	£80
Lighting	£137	£137	£0
Generated (PV)	-£233	-£233	£0
Total cost of fuels	£470	£389	£81
Total cost of uses	£469	£389	£80
Delivered energy	50 kWh/m²	39 kWh/m²	11 kWh/m²
Carbon dioxide emissions	0.9 tonnes	0.7 tonnes	0.2 tonnes
CO2 emissions per m²	10 kg/m²	8 kg/m²	2 kg/m²
Primary energy	58 kWh/m²	45 kWh/m²	13 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	42.2600	(1b)	x 2.3900	(2b) =	101.0014	(1b) - (3b)
First floor	42.2600	(1c)	x 2.4200	(2c) =	102.2692	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	84.5200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		203.2706	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40	=	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20	=	0.0000	(6b)
Number of intermittent fans							3 * 10	=	30.0000	(7a)
Number of passive vents							0 * 10	=	0.0000	(7b)
Number of flueless gas fires							0 * 40	=	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =			30.0000 / (5) =	0.1476 (8)
Pressure test				Yes
Measured/design AP50				5.0000
Infiltration rate				0.3976 (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) =		0.3379 (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	0.4309	0.4224	0.4140	0.3717	0.3633	0.3211	0.3211	0.3126	0.3379	0.3633	0.3802	0.3971	(22b)
Effective ac	0.5928	0.5892	0.5857	0.5691	0.5660	0.5515	0.5515	0.5489	0.5571	0.5660	0.5723	0.5788	(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	
Front Door			2.1500	1.1000	2.3650			(26)
Windows & Fully Glazed Do (Uw = 1.20)			14.3000	1.1450	16.3740			(27)
Ground Floor			42.2600	0.1200	5.0712	90.0000	3803.4000	(28a)
Brick and Block	88.3100	16.4500	71.8600	0.2400	17.2464	42.2200	3033.9292	(29a)
Step Party Wall	2.6200		2.6200	0.2600	0.6812	110.0000	288.2000	(29a)
External Roof 1	42.2600		42.2600	0.1000	4.2260	9.1000	384.5660	(30)
Total net area of external elements Aum(A, m2)			175.4500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	45.9638			(33)
Party Wall 1			40.9700	0.0000	0.0000	45.0000	1843.6500	(32)
GF Timber Stud			76.4600			9.0000	688.1400	(32c)
FF Timber Stud			83.4400			9.0000	750.9600	(32c)
Internal Floor 1			46.2600			18.0000	832.6800	(32d)
Internal Ceiling 1			46.2600			18.0000	832.6800	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12458.2052 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.3995 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		7.3358 (36)
Total fabric heat loss	(33) + (36) =	53.2996 (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	39.7667	39.5249	39.2878	38.1746	37.9663	36.9967	36.9967	36.8172	37.3702	37.9663	38.3877	38.8282	(38)
Heat transfer coeff	93.0663	92.8245	92.5875	91.4742	91.2659	90.2963	90.2963	90.1168	90.6698	91.2659	91.6873	92.1278	(39)
Average = Sum(39)m / 12 =												91.4732	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1011	1.0983	1.0955	1.0823	1.0798	1.0683	1.0683	1.0662	1.0728	1.0798	1.0848	1.0900	(40)
HLP (average)												1.0823	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.5431 (42)
Average daily hot water use (litres/day)		94.5975 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	104.0573	100.2734	96.4895	92.7056	88.9217	85.1378	85.1378	88.9217	92.7056	96.4895	100.2734	104.0573	(44)
Energy conte	154.3139	134.9639	139.2707	121.4196	116.5050	100.5349	93.1604	106.9029	108.1797	126.0730	137.6185	149.4448	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1488.3871	(45)
Distribution loss (46)m = 0.15 x (45)m													
	23.1471	20.2446	20.8906	18.2129	17.4757	15.0802	13.9741	16.0354	16.2269	18.9109	20.6428	22.4167	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	25.3185	22.8670	25.2766	24.4140	25.1935	24.3412	25.1279	25.1704	24.3809	25.2422	24.4815	25.3057	(61)
Total heat required for water heating calculated for each month													
	179.6324	157.8309	164.5473	145.8336	141.6984	124.8761	118.2883	132.0733	132.5605	151.3152	162.1000	174.7505	(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												1.2185	(H8)
Utilisation factor												0.5599	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												94.5975	(H14)
Volume ratio Veff/V												0.7928	(H15)
Solar storage volume factor												0.9536	(H16)
Solar input												-851.3624	(H17)
Solar input	-24.6878	-41.1969	-70.1630	-94.0322	-116.1689	-114.2125	-112.7031	-98.4693	-77.1212	-52.6647	-29.2833	-20.6595	(63)
											Solar input (sum of months) = Sum(63)m =	-851.3624	(63)
Output from w/h													
	154.9446	116.6340	94.3843	51.8014	25.5296	10.6636	5.5852	33.6040	55.4393	98.6505	132.8167	154.0910	(64)
											Total per year (kWh/year) = Sum(64)m =	934.1442	(64)
Heat gains from water heating, kWh/month													
	57.6390	50.5922	52.6267	46.4755	45.0363	39.5132	37.2578	41.8378	42.0650	48.2298	51.8785	56.0168	(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	152.5832	152.5832	152.5832	152.5832	152.5832	152.5832	152.5832	152.5832	152.5832	152.5832	152.5832	152.5832	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	52.5996	46.7185	37.9941	28.7639	21.5014	18.1524	19.6143	25.4954	34.2198	43.4500	50.7125	54.0615	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	341.2353	344.7762	335.8531	316.8569	292.8776	270.3405	255.2843	251.7433	260.6664	279.6626	303.6419	326.1791	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.8014	52.8014	52.8014	52.8014	52.8014	52.8014	52.8014	52.8014	52.8014	52.8014	52.8014	52.8014	(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)													
	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	(71)
Water heating gains (Table 5)													
	77.4718	75.2861	70.7347	64.5493	60.5326	54.8794	50.0777	56.2336	58.4236	64.8250	72.0535	75.2914	(72)
Total internal gains													
	577.9691	573.4432	551.2444	516.8326	481.5741	450.0347	431.6387	440.1348	459.9722	494.6000	533.0704	562.1944	(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	3.0700	10.6334	0.6300	0.7000	0.7700	9.9766	(74)
East	4.1500	19.6403	0.6300	0.7000	0.7700	24.9096	(76)
West	7.0800	19.6403	0.6300	0.7000	0.7700	42.4964	(80)

Solar gains	77.3826	150.9263	249.5529	368.7469	458.2387	472.3732	448.3367	380.5175	291.5130	179.1589	96.3548	63.7484	(83)
Total gains	655.3517	724.3696	800.7973	885.5795	939.8128	922.4078	879.9754	820.6523	751.4853	673.7590	629.4252	625.9429	(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	37.1844	37.2813	37.3767	37.8316	37.9179	38.3251	38.3251	38.4014	38.1672	37.9179	37.7437	37.5632	
alpha	3.4790	3.4854	3.4918	3.5221	3.5279	3.5550	3.5550	3.5601	3.5445	3.5279	3.5162	3.5042	
util living area													
	0.9707	0.9570	0.9263	0.8565	0.7379	0.5761	0.4364	0.4821	0.7037	0.8901	0.9558	0.9746	(86)
MIT	19.4698	19.6635	19.9972	20.4164	20.7396	20.9218	20.9777	20.9682	20.8374	20.4141	19.8735	19.4323	(87)
Th 2	19.9999	20.0023	20.0046	20.0153	20.0174	20.0268	20.0268	20.0285	20.0231	20.0174	20.0133	20.0090	(88)
util rest of house													
	0.9651	0.9490	0.9123	0.8293	0.6897	0.5034	0.3460	0.3893	0.6355	0.8629	0.9461	0.9698	(89)
MIT 2	18.6188	18.8105	19.1368	19.5422	19.8315	19.9836	20.0185	20.0158	19.9232	19.5512	19.0280	18.5889	(90)
Living area fraction									fLA = Living area / (4) =			0.1745	(91)
MIT	18.7673	18.9594	19.2870	19.6948	19.9900	20.1473	20.1859	20.1820	20.0827	19.7018	19.1756	18.7361	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7673	18.9594	19.2870	19.6948	19.9900	20.1473	20.1859	20.1820	20.0827	19.7018	19.1756	18.7361	(93)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9563	0.9384	0.9001	0.8192	0.6883	0.5129	0.3612	0.4045	0.6400	0.8526	0.9358	0.9617	(94)
Useful gains	626.7401	679.7734	720.8177	725.4573	646.8460	473.0584	317.8765	331.9365	480.9460	574.4775	588.9884	601.9635	(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	1346.4187	1305.0519	1183.9125	987.4450	756.5902	500.9026	323.7922	340.8243	542.4520	830.6809	1107.1756	1339.1755	(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	535.4409	420.1872	344.5425	188.6311	81.6497	0.0000	0.0000	0.0000	0.0000	190.6153	373.0948	548.4857	(98)

Space heating		2682.6472 (98)
Space heating per m2	(98) / (4) =	31.7398 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	90.7000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	2957.7147 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	535.4409	420.1872	344.5425	188.6311	81.6497	0.0000	0.0000	0.0000	0.0000	190.6153	373.0948	548.4857	(98)
Space heating efficiency (main heating system 1)	90.7000	90.7000	90.7000	90.7000	90.7000	0.0000	0.0000	0.0000	0.0000	90.7000	90.7000	90.7000	(210)
Space heating fuel (main heating system)	590.3427	463.2714	379.8705	207.9726	90.0217	0.0000	0.0000	0.0000	0.0000	210.1602	411.3504	604.7252	(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	154.9446	116.6340	94.3843	51.8014	25.5296	10.6636	5.5852	33.6040	55.4393	98.6505	132.8167	154.0910	(64)
Efficiency of water heater												87.2000	(216)
(217)m	89.8903	89.9159	89.9239	89.9224	89.8411	87.2000	87.2000	87.2000	87.2000	89.4752	89.7542	89.9085	(217)
Fuel for water heating, kWh/month	172.3709	129.7146	104.9602	57.6068	28.4164	12.2289	6.4050	38.5367	63.5772	110.2545	147.9782	171.3865	(219)

Water heating fuel used	1043.4358 (219)
Annual totals kWh/year	
Space heating fuel - main system	2957.7147 (211)
Space heating fuel - secondary	0.0000 (215)
Electricity for pumps and fans:	
central heating pump	30.0000 (230c)
main heating flue fan	45.0000 (230e)
pump for solar water heating	50.0000 (230g)
Total electricity for the above, kWh/year	125.0000 (231)
Electricity for lighting (calculated in Appendix L)	371.5703 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV Unit 0 (0.80 * 0.75 * 908 * 1.00) = -544.7125	-544.7125 (233)
Total delivered energy for all uses	3953.0083 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2957.7147	3.4800	102.9285	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1043.4358	3.4800	36.3116	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	371.5703	13.1900	49.0101	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-544.7125	13.1900	-71.8476	(252)
Total energy cost			252.8901	(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] =	0.8201 (257)
SAP value		88.5602
SAP rating (Section 12)		89 (258)
SAP band		B

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

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2957.7147	0.2160	638.8664	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1043.4358	0.2160	225.3821	(264)
Space and water heating			864.2485	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	371.5703	0.5190	192.8450	(268)
Energy saving/generation technologies				
PV Unit	-544.7125	0.5190	-282.7058	(269)
Total kg/year			839.2627	(272)
CO2 emissions per m2			9.9300	(273)
EI value			91.3171	
EI rating			91	(274)
EI band			B	

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	42.2600	(1b)	x 2.3900	(2b) =	101.0014	(1b) - (3b)
First floor	42.2600	(1c)	x 2.4200	(2c) =	102.2692	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	84.5200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		203.2706	(5)

2. Ventilation rate

	main heating		secondary heating		other		total		m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =		0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =		0.0000	(6b)
Number of intermittent fans							3 * 10 =		30.0000	(7a)
Number of passive vents							0 * 10 =		0.0000	(7b)
Number of flueless gas fires							0 * 40 =		0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	30.0000 / (5) =	0.1476	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3976	(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) =	0.3379	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	4.7000	4.6000	4.3000	4.3000	4.0000	4.0000	3.9000	4.0000	4.5000	4.4000	4.7000	(22)
Wind factor	1.2750	1.1750	1.1500	1.0750	1.0750	1.0000	1.0000	0.9750	1.0000	1.1250	1.1000	1.1750	(22a)
Adj infilt rate	0.4309	0.3971	0.3886	0.3633	0.3633	0.3379	0.3379	0.3295	0.3379	0.3802	0.3717	0.3971	(22b)
Effective ac	0.5928	0.5788	0.5755	0.5660	0.5660	0.5571	0.5571	0.5543	0.5571	0.5723	0.5691	0.5788	(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	
Front Door			2.1500	1.1000	2.3650			(26)
Windows & Fully Glazed Do (Uw = 1.20)			14.3000	1.1450	16.3740			(27)
Ground Floor			42.2600	0.1200	5.0712	90.0000	3803.4000	(28a)
Brick and Block	88.3100	16.4500	71.8600	0.2400	17.2464	42.2200	3033.9292	(29a)
Step Party Wall	2.6200		2.6200	0.2600	0.6812	110.0000	288.2000	(29a)
External Roof 1	42.2600		42.2600	0.1000	4.2260	9.1000	384.5660	(30)
Total net area of external elements Aum(A, m2)			175.4500					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	45.9638			(33)
Party Wall 1			40.9700	0.0000	0.0000	45.0000	1843.6500	(32)
GF Timber Stud			76.4600			9.0000	688.1400	(32c)
FF Timber Stud			83.4400			9.0000	750.9600	(32c)
Internal Floor 1			46.2600			18.0000	832.6800	(32d)
Internal Ceiling 1			46.2600			18.0000	832.6800	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12458.2052 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		147.3995 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		7.3358 (36)
Total fabric heat loss	(33) + (36) =	53.2996 (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	39.7667	38.8282	38.6055	37.9663	37.9663	37.3702	37.3702	37.1811	37.3702	38.3877	38.1746	38.8282	(38)
Heat transfer coeff	93.0663	92.1278	91.9051	91.2659	91.2659	90.6698	90.6698	90.4807	90.6698	91.6873	91.4742	92.1278	(39)
Average = Sum(39)m / 12 =												91.4509	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1011	1.0900	1.0874	1.0798	1.0798	1.0728	1.0728	1.0705	1.0728	1.0848	1.0823	1.0900	(40)
HLP (average)												1.0820	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		2.5431 (42)
Average daily hot water use (litres/day)		94.5975 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	104.0573	100.2734	96.4895	92.7056	88.9217	85.1378	85.1378	88.9217	92.7056	96.4895	100.2734	104.0573	(44)
Energy conte	154.3139	134.9639	139.2707	121.4196	116.5050	100.5349	93.1604	106.9029	108.1797	126.0730	137.6185	149.4448	(45)

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

Energy content (annual)												Total = Sum(45)m =	1488.3871 (45)
Distribution loss (46)m = 0.15 x (45)m													
	23.1471	20.2446	20.8906	18.2129	17.4757	15.0802	13.9741	16.0354	16.2269	18.9109	20.6428	22.4167	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	25.3185	22.8670	25.2766	24.4140	25.1935	24.3412	25.1279	25.1704	24.3809	25.2422	24.4815	25.3057	(61)
Total heat required for water heating calculated for each month													
	179.6324	157.8309	164.5473	145.8336	141.6984	124.8761	118.2883	132.0733	132.5605	151.3152	162.1000	174.7505	(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												1234.4649	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												2073.9010	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.3934	(H8)
Utilisation factor												0.5121	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												94.5975	(H14)
Volume ratio Veff/V												0.7928	(H15)
Solar storage volume factor												0.9536	(H16)
Solar input												-890.5173	(H17)
Solar input	-29.2239	-41.7180	-70.7049	-96.4811	-113.8688	-121.1780	-116.7042	-104.1155	-82.4013	-56.4200	-34.3585	-23.3433	(63)
										Solar input (sum of months) = Sum(63)m =		-890.5173	(63)
Output from w/h													
	150.4085	116.1129	93.8424	49.3524	27.8296	3.6982	1.5841	27.9579	50.1592	94.8952	127.7415	151.4072	(64)
										Total per year (kWh/year) = Sum(64)m =		894.9892	(64)
Heat gains from water heating, kWh/month													
	57.6390	50.5922	52.6267	46.4755	45.0363	39.5132	37.2578	41.8378	42.0650	48.2298	51.8785	56.0168	(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	152.5832	152.5832	152.5832	152.5832	152.5832	152.5832	152.5832	152.5832	152.5832	152.5832	152.5832	152.5832	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	52.5996	46.7185	37.9941	28.7639	21.5014	18.1524	19.6143	25.4954	34.2198	43.4500	50.7125	54.0615	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	341.2353	344.7762	335.8531	316.8569	292.8776	270.3405	255.2843	251.7433	260.6664	279.6626	303.6419	326.1791	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	52.8014	52.8014	52.8014	52.8014	52.8014	52.8014	52.8014	52.8014	52.8014	52.8014	52.8014	52.8014	(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)													
	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	-101.7221	(71)
Water heating gains (Table 5)													
	77.4718	75.2861	70.7347	64.5493	60.5326	54.8794	50.0777	56.2336	58.4236	64.8250	72.0535	75.2914	(72)
Total internal gains													
	577.9691	573.4432	551.2444	516.8326	481.5741	450.0347	431.6387	440.1348	459.9722	494.6000	533.0704	562.1944	(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	3.0700	13.8645	0.6300	0.7000	0.7700	13.0082	(74)
East	4.1500	25.9136	0.6300	0.7000	0.7700	32.8661	(76)
West	7.0800	25.9136	0.6300	0.7000	0.7700	56.0704	(80)

Solar gains	101.9447	170.0584	279.3072	418.7476	495.5433	552.1048	511.7574	444.6851	345.4970	213.4611	125.8251	80.1557	(83)
Total gains	679.9138	743.5016	830.5516	935.5802	977.1174	1002.1395	943.3961	884.8198	805.4693	708.0611	658.8954	642.3501	(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	37.1844	37.5632	37.6542	37.9179	37.9179	38.1672	38.1672	38.2470	38.1672	37.7437	37.8316	37.5632	
alpha	3.4790	3.5042	3.5103	3.5279	3.5279	3.5445	3.5445	3.5498	3.5445	3.5162	3.5221	3.5042	
util living area													
	0.9607	0.9468	0.9067	0.8185	0.6769	0.4831	0.3497	0.3708	0.6098	0.8412	0.9351	0.9656	(86)
MIT	19.6689	19.8203	20.1534	20.5396	20.8235	20.9604	20.9906	20.9888	20.9113	20.5849	20.1012	19.6496	(87)
Th 2	19.9999	20.0090	20.0112	20.0174	20.0174	20.0231	20.0231	20.0250	20.0231	20.0133	20.0153	20.0090	(88)
util rest of house													
	0.9530	0.9366	0.8889	0.7854	0.6208	0.4070	0.2600	0.2765	0.5302	0.8019	0.9202	0.9586	(89)
MIT 2	18.8151	18.9693	19.2918	19.6553	19.8995	20.0041	20.0205	20.0218	19.9755	19.7031	19.2511	18.8038	(90)
Living area fraction										fLA = Living area / (4) =		0.1745	(91)
MIT	18.9641	19.1178	19.4422	19.8096	20.0607	20.1710	20.1898	20.1905	20.1388	19.8570	19.3994	18.9514	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9641	19.1178	19.4422	19.8096	20.0607	20.1710	20.1898	20.1905	20.1388	19.8570	19.3994	18.9514	(93)

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

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9428	0.9253	0.8768	0.7776	0.6235	0.4189	0.2756	0.2928	0.5403	0.7948	0.9089	0.9492	(94)
Useful gains	641.0372	687.9842	728.2313	727.4699	609.2112	419.7897	259.9923	259.0923	435.1573	562.7523	598.8417	609.7233	(95)
Ext temp.	5.4000	5.7000	7.3000	9.6000	12.6000	15.4000	17.3000	17.3000	15.0000	11.8000	8.4000	5.5000	(96)
Heat loss rate W	1262.3611	1236.1517	1115.9263	931.7880	680.9094	432.5867	262.0166	261.5362	465.9351	738.7252	1006.1628	1239.2450	(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	462.2650	368.3686	288.4451	147.1090	53.3435	0.0000	0.0000	0.0000	0.0000	130.9238	293.2712	468.3641	(98)

Space heating		2212.0903 (98)
Space heating per m2	(98) / (4) =	26.1724 (99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000 (201)
Fraction of space heat from main system(s)	1.0000 (202)
Efficiency of main space heating system 1 (in %)	90.7000 (206)
Efficiency of secondary/supplementary heating system, %	0.0000 (208)
Space heating requirement	2438.9089 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	462.2650	368.3686	288.4451	147.1090	53.3435	0.0000	0.0000	0.0000	0.0000	130.9238	293.2712	468.3641	(98)
Space heating efficiency (main heating system 1)	90.7000	90.7000	90.7000	90.7000	90.7000	0.0000	0.0000	0.0000	0.0000	90.7000	90.7000	90.7000	(210)
Space heating fuel (main heating system)	509.6637	406.1395	318.0210	162.1929	58.8132	0.0000	0.0000	0.0000	0.0000	144.3482	323.3420	516.3882	(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	150.4085	116.1129	93.8424	49.3524	27.8296	3.6982	1.5841	27.9579	50.1592	94.8952	127.7415	151.4072	(64)
Efficiency of water heater												87.2000	(216)
(217)m	89.8150	89.8358	89.8151	89.7946	89.4688	87.2000	87.2000	87.2000	87.2000	89.1955	89.6087	89.8193	(217)
Fuel for water heating, kWh/month	167.4648	129.2502	104.4841	54.9615	31.1054	4.2410	1.8167	32.0618	57.5221	106.3901	142.5547	168.5687	(219)

Water heating fuel used	1000.4209 (219)
Annual totals kWh/year	
Space heating fuel - main system	2438.9089 (211)
Space heating fuel - secondary	0.0000 (215)
Electricity for pumps and fans:	
central heating pump	30.0000 (230c)
main heating flue fan	45.0000 (230e)
pump for solar water heating	50.0000 (230g)
Total electricity for the above, kWh/year	125.0000 (231)
Electricity for lighting (calculated in Appendix L)	371.5703 (232)
Energy saving/generation technologies (Appendices M ,N and Q)	
PV Unit 0 (0.80 * 0.75 * 1054 * 1.00) = -632.6656	-632.6656 (233)
Total delivered energy for all uses	3303.2345 (238)

10a. Fuel costs - using BEDF prices (513)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2438.9089	9.7400	237.5497	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1000.4209	9.7400	97.4410	(247)
Pumps and fans for heating	75.0000	36.8500	27.6375	(249)
Pump for solar water heating	50.0000	36.8500	18.4250	(249)
Energy for lighting	371.5703	36.8500	136.9237	(250)
Additional standing charges			104.0000	(251)
Energy saving/generation technologies				
PV Unit	-632.6656	36.8500	-233.1373	(252)
Total energy cost			388.8396	(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	2438.9089	0.2160	526.8043	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1000.4209	0.2160	216.0909	(264)
Space and water heating			742.8952	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	371.5703	0.5190	192.8450	(268)
Energy saving/generation technologies				
PV Unit	-632.6656	0.5190	-328.3535	(269)

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

Total kg/year			672.2618 (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	2438.9089	1.2200	2975.4688	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1000.4209	1.2200	1220.5135	(264)
Space and water heating			4195.9823	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	371.5703	3.0700	1140.7208	(268)
Energy saving/generation technologies				
PV Unit	-632.6656	3.0700	-1942.2834	(269)
Primary energy kWh/year			3778.1697	(272)
Primary energy kWh/m2/year			44.7015	(273)

U-VALUE CALCULATOR REPORT

Design SAP
elmhurst energy

Property Reference	SAP 0879 Plot 115	**Issued on Date**	28/03/2023
Assessment Reference	Rev A	**Prop Type Ref**	3B AFF (HA/SO)
Project	Plot 115		
Calculation Type	New Build (As Designed)		

SAP Rating	87 B	**DER**	13.83	**TER**	17.86
Environmental	89 B	**% DER<TER**	22.56		
CO_2 Emissions (t/year)	0.87	**DFEE**	42.45	**TFEE**	50.75
General Requirements Compliance	Pass	**% DFEE<TFEE**	16.35		

Assessor Details	Mr. Tobias Whiting, Abacus Energy (UK) Ltd, Tel: 07798936079, toby@abacusenergyuk.com	**Assessor ID**	E477-0001
Client	Foreman Homes, FORE		

Building Elements

Roof 000002 - Mineral Wool between and above

Roof Type: Pitched Roof, insulated flat ceiling

Layer	Description	Thickness (mm)	Conductivity (W/m²K)	Resistance (m²K/W)	Fraction (%)	Density (kg/m³)	Heat Cap. (J/kgK)
Ext surface				0.0400			
Layer 1	**Earthwool Loft Roll 40**						
	Main construction	150	0.0400	3.7500	100.00		
	Corrections - Air Gap: Level 1, Fasteners: None or plastic						
Layer 2	**Earthwool Loft Roll 40**						
	Main construction	200	0.0400	5.0000	100.00		
	Corrections - Air Gap: Level 1, Fasteners: None or plastic						
Layer 3	**Earthwool Loft Roll 40**						
	Main construction	100	0.0400	2.5000	87.50		
	Main construction	100	0.1300	0.7692	12.50		
	Corrections - Air Gap: Level 1, Fasteners: None or plastic						
Layer 4	**Plasterboard, standard**						
	Main construction	12.5	0.2100	0.0595	100.00	700	1000
Int surface				0.1000			

Total resistance: **Upper limit =** 11.200 m² K/W **Lower limit =** 10.901 m² K/W **Average =** 11.050 m² K/W

Total correction = 0.0065 m² K/W **U-value (unrounded) =** 0.1 W/m² K

Unheated space: None

Total thickness: 463 mm **U-value: 0.10 W/m² K** **Kappa: 9.10 kJ/m² K**

U-VALUE CALCULATOR REPORT

Design SAP
elmhurst energy

Property Reference	SAP 0879 Plot 115	**Issued on Date**	28/03/2023
Assessment Reference	Rev A	**Prop Type Ref**	3B AFF (HA/SO)
Project	Plot 115		
Calculation Type	New Build (As Designed)		

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Environmental	89 B	**% DER<TER**	22.56		
CO_2 Emissions (t/year)	0.87	**DFEE**	42.45	**TFEE**	50.75
General Requirements Compliance	Pass	**% DFEE<TFEE**	16.35		

Assessor Details	Mr. Tobias Whiting, Abacus Energy (UK) Ltd, Tel: 07798936079, toby@abacusenergyuk.com	**Assessor ID**	E477-0001
Client	Foreman Homes, FORE		

Building Elements

Wall 000001

Wall Type: Standard Wall

Layer	Description	Thickness (mm)	Conductivity (W/m²K)	Resistance (m²K/W)	Fraction (%)	Density (kg/m³)	Heat Cap. (J/kgK)
Ext surface				0.0400			
Layer 1	**Brick, outer leaf**						
	Main construction	102	0.7700	0.1325	82.81		
	Main construction	102	0.9407	0.1084	17.19		
Layer 2	**Supafil 34**						
	Main construction	100	0.0340	2.9412	100.00		
	Corrections - Air Gap: Level 0, Fasteners: None or plastic						
Layer 3	**Supabloc**						
	Main construction	100	0.1100	0.9091	94.04	460	1000
	Main construction	100	0.8803	0.1136	5.96	460	1000
	Corrections - Air Gap: Level 1, Fasteners: None or plastic						
Layer 4	**airspace/plaster dabs**						
	Main construction	15	0.0882	0.1700	80.00		
	Main construction	15	0.0882	0.1700	20.00		
	Corrections - Cavity Unventilated, Emissivity: Normal						
Layer 5	**Plasterboard, standard**						
	Main construction	12.5	0.2100	0.0595	100.00	700	1000
Int surface				0.1300			

Total resistance: **Upper limit =** 4.321 m² K/W **Lower limit =** 4.110 m² K/W **Average =** 4.215 m² K/W

Total correction = 0.0002 m² K/W **U-value (unrounded) =** 0.24 W/m² K

Unheated space: None

Total thickness: 330 mm **U-value: 0.24 W/m² K** **Kappa: 42.22 kJ/m² K**

U-VALUE CALCULATOR REPORT

Design SAP
elmhurst energy

Property Reference	SAP 0879 Plot 115	**Issued on Date**	28/03/2023
Assessment Reference	Rev A	**Prop Type Ref**	3B AFF (HA/SO)
Project	Plot 115		
Calculation Type	New Build (As Designed)		

SAP Rating	87 B	**DER**	13.83	**TER**	17.86
Environmental	89 B	**% DER<TER**	22.56		
CO_2 Emissions (t/year)	0.87	**DFEE**	42.45	**TFEE**	50.75
General Requirements Compliance	Pass	**% DFEE<TFEE**	16.35		

Assessor Details	Mr. Tobias Whiting, Abacus Energy (UK) Ltd, Tel: 07798936079, toby@abacusenergyuk.com	**Assessor ID**	E477-0001
Client	Foreman Homes, FORE		

Building Elements

Wall Party Step

Wall Type: Standard Wall

Layer	Description	Thickness (mm)	Conductivity (W/m²K)	Resistance (m²K/W)	Fraction (%)
Ext surface				0.0400	
Layer 1	**Supabloc *7**				
	Main construction	100	0.1900	0.5263	94.04
	Main construction	100	0.8803	0.1136	5.96
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Layer 2	**Supafil Party Wall**				
	Main construction	100	0.0400	2.5000	100.00
	Corrections - Air Gap: Level 0, Fasteners: None or plastic				
Layer 3	**Supabloc *7**				
	Main construction	100	0.1900	0.5263	94.04
	Main construction	100	0.8803	0.1136	5.96
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Layer 4	**airspace/plaster dabs**				
	Main construction	15	0.0882	0.1700	80.00
	Main construction	15	0.0882	0.1700	20.00
	Corrections - Cavity Unventilated, Emissivity: Normal				
Layer 5	**Plasterboard, standard**				
	Main construction	12.5	0.2100	0.0595	100.00
Int surface				0.1300	

Total resistance: **Upper limit =** 3.898 m² K/W **Lower limit =** 3.765 m² K/W **Average =** 3.831 m² K/W

Total correction = 0.0003 m² K/W **U-value (unrounded) =** 0.26 W/m² K

Unheated space: None

Total thickness: 328 mm **U-value: 0.26 W/m² K** **Kappa: n/a**

U-VALUE CALCULATOR REPORT

Design SAP
elmhurst energy

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Assessment Reference	Rev A	**Prop Type Ref**	3B AFF (HA/SO)
Project	Plot 115		
Calculation Type	New Build (As Designed)		

SAP Rating	87 B	**DER**	13.83	**TER**	17.86
Environmental	89 B	**% DER<TER**	22.56		
CO_2 Emissions (t/year)	0.87	**DFEE**	42.45	**TFEE**	50.75
General Requirements Compliance	Pass	**% DFEE<TFEE**	16.35		

Assessor Details	Mr. Tobias Whiting, Abacus Energy (UK) Ltd, Tel: 07798936079, toby@abacusenergyuk.com	**Assessor ID**	E477-0001
Client	Foreman Homes, FORE		

Building Elements

Floor 000003

Floor Type: Suspended Floor
Area = 46.25 m², Perimeter = 19.32 m, Wall thickness = 275.00 mm, Soil: Unknown
Depth of underfloor space below ground:0.200 m Floor wind shielding: Average (suburban)
Floor height above ground:h = 0.200 m
U-value of walls above ground:Uw = 1.500 m
Ventilation openings per perimeter length:e = 0.0015 %
Mean wind speed:v = 5.000 m/s
Resistance on solum:Rg = 0.000 m²K/W

Layer	Description	Thickness (mm)	Conductivity (W/m²K)	Resistance (m²K/W)	Fraction (%)	Density (kg/m³)	Heat Cap. (J/kgK)
Ext surface				0.1700			
Layer 1	**EPS 200 Lower portion**						
	Main construction	55	0.0340	1.6176	80.65		
	Main construction	55	2.0000	0.0275	19.35		
	Corrections - Air Gap: Level 1, Fasteners: None or plastic						
Layer 2	**EPS Upper portion**						
	Main construction	100	0.0340	2.9412	87.10		
	Main construction	100	2.0000	0.0500	12.90		
	Corrections - Air Gap: Level 1, Fasteners: None or plastic						
Layer 3	**Grey EPS 100 Topsheet**						
	Main construction	155	0.0300	5.1667	100.00	15	1450
	Corrections - Air Gap: Level 1, Fasteners: None or plastic						
Layer 4	**Screed**						
	Main construction	75	1.1500	0.0652	100.00	1200	1000
Int surface				0.1700			

Total resistance: **Upper limit =** 9.271 m² K/W **Lower limit =** 6.052 m² K/W **Average =** 7.661 m² K/W

Total correction = 0.0046 m² K/W **U-value (unrounded) =** 0.12 W/m² K

Unheated space: None

Total thickness: 385 mm **U-value: 0.12 W/m² K** **Kappa: 90.00 kJ/m² K**

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

Design SAP
elmhurst energy

Property Reference	SAP 0879 Plot 115	**Issued on Date**	28/03/2023
Assessment Reference	Rev A	**Prop Type Ref**	3B AFF (HA/SO)
Property	Plot 115		

SAP Rating	87 B	**DER**	13.83	**TER**	17.86
Environmental	89 B	**% DER<TER**	22.56		
CO_2 Emissions (t/year)	0.87	**DFEE**	42.45	**TFEE**	50.75
General Requirements Compliance	Pass	**% DFEE<TFEE**	16.35		

Assessor Details	Mr. Tobias Whiting, Abacus Energy (UK) Ltd, Tel: 07798936079, toby@abacusenergyuk.com	**Assessor ID**	E477-0001
Client	Foreman Homes, FORE		

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

Orientation	East
Property Tenure	Unknown
Transaction Type	New dwelling
Terrain Type	Suburban
1.0 Property Type	House, Semi-Detached
2.0 Number of Storeys	2
3.0 Date Built	2020
4.0 Sheltered Sides	2
5.0 Sunlight/Shade	Average or unknown

6.0 Measurements

	Heat Loss Perimeter	Internal Floor Area	Average Storey Height
Ground Floor:	18.36 m	42.26 m²	2.39 m
1st Storey:	18.36 m	42.26 m²	2.42 m

7.0 Living Area	14.75	m²
8.0 Thermal Mass Parameter	Precise calculation	
Thermal Mass	147.4	kJ/m²K

9.0 External Walls

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Gross Area (m²)	Nett Area (m²)
Brick and Block	Cavity Wall	Other	0.24	42.22	88.31	71.86
Step Party Wall	Cavity Wall	Cavity wall; plasterboard on dabs or battens, lightweight aggregate block, filled cavity, any outside structure	0.26	110.00	2.62	2.62

9.1 Party Walls

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Area (m²)
Party Wall 1	Filled Cavity with Edge Sealing	Plasterboard on dabs mounted on cement render on both sides, AAC blocks, cavity	0.00	45.00	40.97

9.2 Internal Walls

Description	Construction	Kappa (kJ/m²K)	Area (m²)
GF Timber Stud	Plasterboard on timber frame	9.00	76.46
FF Timber Stud	Plasterboard on timber frame	9.00	83.44

10.0 External Roofs

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

Design SAP
elmhurst energy

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Gross Area (m²)	Nett Area (m²)
External Roof 1	External Plane Roof	Other	0.10	9.10	42.26	42.26

10.2 Internal Ceilings

Description	Construction	Kappa (kJ/m²K)	Area (m²)
Internal Ceiling 1	Plasterboard ceiling, carpeted chipboard floor	9.00	46.26

11.0 Heat Loss Floors

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Area (m²)
Ground Floor	Ground Floor - Solid	Other	0.12	90.00	42.26

11.2 Internal Floors

Description	Construction	Kappa (kJ/m²K)	Area (m²)
Internal Floor 1	Plasterboard ceiling, carpeted chipboard floor	18.00	46.26

12.0 Opening Types

Description	Data Source	Type	Glazing	Glazing Gap	Argon Filled	G-value	Frame Type	Frame Factor	U Value (W/m²K)
Front Door	Manufacturer	Solid Door							1.10
Windows & Fully Glazed Do	Manufacturer	Window	Double Low-E Soft 0.1			0.63		0.70	1.20

13.0 Openings

Name	Opening Type	Location	Orientation	Curtain Type	Overhang Ratio	Wide Overhang	Width (m)	Height (m)	Count	Area (m²)	Curtain Closed
Front Door	Solid Door	[1] Brick and Block	East							2.15	
Front Elevation	Window	[1] Brick and Block	East	None	0.00					4.15	
Rear Elevation	Window	[1] Brick and Block	West	None	0.00					7.08	
Side Elevation	Window	[1] Brick and Block	North	None	0.00					3.07	

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

17.1 List of Bridges

Source Type	Bridge Type	Length	Psi	Imported	Reference:
Independently assessed	E2 Other lintels (including other steel lintels)	2.74	0.077	No	Birtley Supatherm
Independently assessed	E2 Other lintels (including other steel lintels)	0.91	0.070	No	Birtley Supatherm
Independently assessed	E2 Other lintels (including other steel lintels)	1.02	0.071	No	Birtley Supatherm
Independently assessed	E2 Other lintels (including other steel lintels)	4.99	0.064	No	Birtley Supatherm
Independently assessed	E2 Other lintels (including other steel lintels)	1.36	0.070	No	Birtley Supatherm
Independently assessed	E2 Other lintels (including other steel lintels)	1.81	0.064	No	Birtley Supatherm
Independently assessed	E3 Sill	10.90	0.021	No	Knauf P5
Independently assessed	E4 Jamb	24.15	0.016	No	Knauf P6
Table K1 - Approved	E5 Ground floor (normal)	18.36	0.160	No	
Independently assessed	E6 Intermediate floor within a dwelling	18.36	0.000	No	CD0029
Table K1 - Approved	E10 Eaves (insulation at ceiling level)	9.77	0.060	No	
Independently assessed	E12 Gable (insulation at ceiling level)	17.44	0.044	No	Knauf P21
Independently assessed	E16 Corner (normal)	10.60	0.039	No	Knauf P23
Table K1 - Approved	E18 Party wall between dwellings	8.80	0.060	No	
Table K1 - Default	P6 Party wall - Ground floor (inverted)	8.72	0.070	No	
Table K1 - Default	P2 Party wall - Intermediate floor within a dwelling	8.72	0.000	No	

Y-value	0.042	W/m²K

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

Design SAP
elmhurst energy

18.0 Pressure Testing	Yes	
Designed AP_{50}	5.00	$m^3/(h.m^2)$ @ 50 Pa
Property Tested ?		
As Built AP_{50}		$m^3/(h.m^2)$ @ 50 Pa

19.0 Mechanical Ventilation

Summer Overheating

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

Mechanical Ventilation

Mechanical Ventilation System Present	No

20.0 Fans, Open Fireplaces, Flues

	MHS	SHS	Other	Total
Number of Chimneys	0		0	0
Number of open flues	0		0	0
Number of intermittent fans				3
Number of passive vents				0
Number of flueless gas fires				0

21.0 Fixed Cooling System	No	

22.0 Lighting

Internal

Total number of light fittings	17	
Total number of L.E.L. fittings	17	
Percentage of L.E.L. fittings	100.00	%

External

External lights fitted	Yes	
Light and motion sensor	Yes	

23.0 Electricity Tariff	Standard	

24.0 Main Heating 1	Database	
Description	Gas Combi	
Percentage of Heat	100	%
Database Ref. No.	17513	
Fuel Type	Mains gas	
Main Heating	BGW	
SAP Code	104	
In Winter	90.7	
In Summer	87.2	
Controls	CBE Programmer, room thermostat and TRVs	
PCDF Controls	0	
Delayed Start Stat	No	
Sap Code	2106	
Flue Type	Balanced	
Fan Assisted Flue	Yes	
Is MHS Pumped	Pump in heated space	
Heat Emitter	Radiators	

Flow Temperature	Normal (> 45°C)
Combi boiler type	Standard Combi
Combi keep hot type	Gas/Oil, time clock
25.0 Main Heating 2	None
Community Heating	None
28.0 Water Heating	HWP From main heating 1
Water Heating	Main Heating 1
Flue Gas Heat Recovery System	No
Waste Water Heat Recovery Instantaneous System 1	No
Waste Water Heat Recovery Instantaneous System 2	No
Waste Water Heat Recovery Storage System	No
Solar Panel	No
Water use <= 125 litres/person/day	Yes
SAP Code	901
29.0 Hot Water Cylinder	None
32.0 Photovoltaic Unit	One Dwelling

PV Cells kWp	Orientation	Elevation	Overshading	Connected to Dwelling
0.75	West	30°	None Or Little	Yes

Recommendations

Lower cost measures

None

Further measures to achieve even higher standards

	Typical Cost	Typical savings per year	Ratings after improvement	
			SAP rating	Environmental Impact
Solar water heating	£4,000 - £6,000	£80	B 89	