elmhurst energy

SAP Report Submission for Building Regulations Compliance

Client: Foreman Homes

Project: Plot 72

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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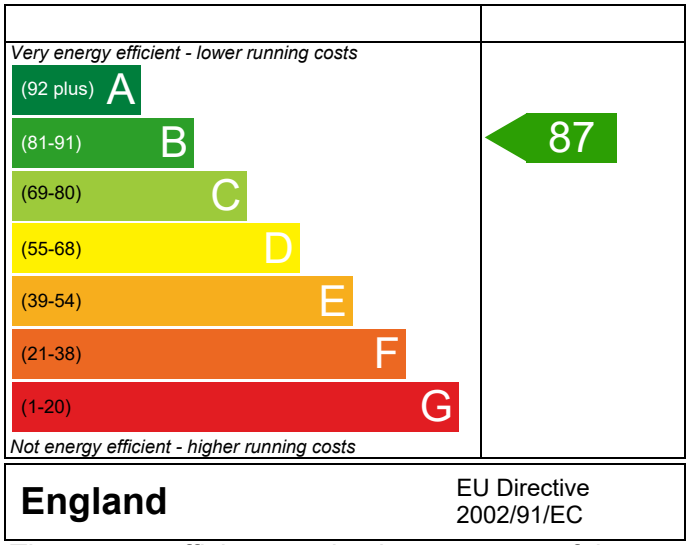
Plot 72

Dwelling type:	House, Semi-Detached
Date of assessment:	28/03/2023
Produced by:	Abacus Energy (UK) Ltd
Total floor area:	71.04 m²
DRRN:	1227-0672-8011

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.

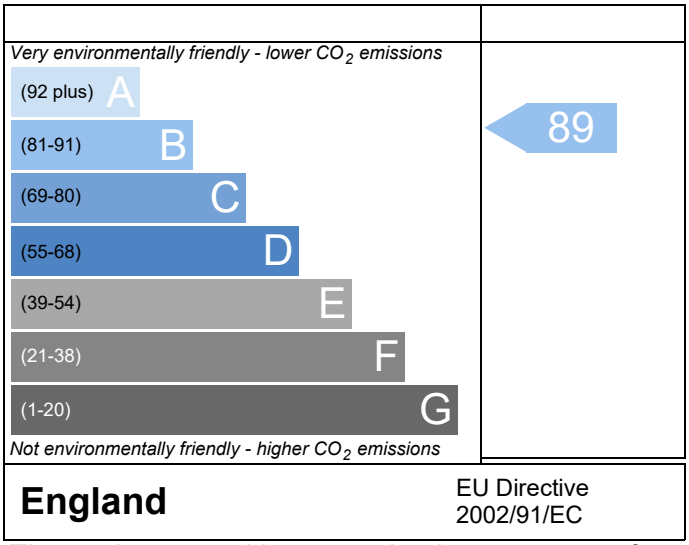
Energy Efficiency Rating



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 72	**Issued on Date**	28/03/2023
Assessment Reference	Rev A	**Prop Type Ref**	Beeley V5 (HA-SO)
Property	Plot 72		

SAP Rating	87 B	**DER**	15.87	**TER**	19.63
Environmental	89 B	**% DER<TER**	19.14		
CO_2 Emissions (t/year)	0.81	**DFEE**	54.34	**TFEE**	54.77
General Requirements Compliance	Pass	**% DFEE<TFEE**	0.79		

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)	19.63	$kgCO_2/m^2$	
Dwelling Carbon Dioxide Emission Rate (DER)	15.87	$kgCO_2/m^2$	Pass
	-3.76 (-19.2%)	$kgCO_2/m^2$	

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	54.77	$kWh/m^2/yr$	
Dwelling Fabric Energy Efficiency (DFEE)	54.34	$kWh/m^2/yr$	
	-0.5 (-0.9%)	$kWh/m^2/yr$	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	1.18 (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 East Windows facing South West	6.60 m², No overhang 3.49 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	0.85	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	£77	B 88	B 91	Recommended
Photovoltaic			0	0	Already installed
Wind turbine			0	0	Not applicable
Totals	**£4,000 - £6,000**	**£77**	**B 88**	**B 91**	

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THERMAL BRIDGING
Calculation Type: New Build (As Designed)

Design SAP
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General Requirements Compliance	Pass	**% DFEE<TFEE**	0.79		

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	0.110	0.46	0.05	Birtley Supatherm
External wall	E2 Other lintels (including other steel lintels)	Independently assessed	0.910	5.46	4.97	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	0.067	1.59	0.11	Birtley Supatherm
External wall	E3 Sill	Independently assessed	0.021	5.92	0.12	Knauf P5
External wall	E4 Jamb	Independently assessed	0.016	24.32	0.39	Knauf P6
External wall	E5 Ground floor (normal)	Table K1 - Default	0.320	24.59	7.87	
External wall	E6 Intermediate floor within a dwelling	Independently assessed	0.000	16.80	0.00	CD0029
External wall	E10 Eaves (insulation at ceiling level)	Table K1 - Approved	0.060	9.10	0.55	
External wall	E12 Gable (insulation at ceiling level)	Independently assessed	0.044	7.79	0.34	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	9.40	0.56	
Party wall	P1 Party wall - Ground floor	Table K1 - Default	0.160	7.79	1.25	
Party wall	P2 Party wall - Intermediate floor within a dwelling	Table K1 - Default	0.000	7.79	0.00	
Party wall	P4 Party wall - Roof (insulation at ceiling level)	Table K1 - Default	0.240	7.79	1.87	

Total: 18.56 **W/mK:**

Y-Value: 0.119 **W/m²K:**

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

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Environmental	89 B	**% DER<TER**	19.14		
CO_2 Emissions (t/year)	0.81	**DFEE**	54.34	**TFEE**	54.77
General Requirements Compliance	Pass	**% DFEE<TFEE**	0.79		

Assessor Details	Mr. Tobias Whiting, Abacus Energy (UK) Ltd, Tel: 07798936079, toby@abacusenergyuk.com	**Assessor ID**	E477-0001
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REGULATIONS COMPLIANCE REPORT - Approved Document L1A, 2013 Edition, England

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

Semi-Detached House, total floor area 71 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) 19.63 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 15.87 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)54.8 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)54.3 kWh/m²/yrOK

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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	1.18 (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

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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

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5 Cylinder insulation
Hot water storage: No cylinder

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

Hot water controls: No cylinder

Boiler interlock: Yes OK

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

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8 Mechanical ventilation
Not applicable

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9 Summertime temperature
Overheating risk (Southern England): Slight OK
Based on:
Overshading: Average
Windows facing North East: 6.60 m², No overhang
Windows facing South West: 3.49 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: None

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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 0.85 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	35.5200	(1b)	x 2.3900	(2b) =	84.8928	(1b) - (3b)
First floor	35.5200	(1c)	x 2.6100	(2c) =	92.7072	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.0400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		177.6000	(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) =	0.1689	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4189	(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) =	0.3561	(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	0.4540	0.4451	0.4362	0.3917	0.3828	0.3383	0.3383	0.3294	0.3561	0.3828	0.4006	0.4184	(22b)
Effective ac	0.6031	0.5991	0.5951	0.5767	0.5733	0.5572	0.5572	0.5542	0.5634	0.5733	0.5802	0.5875	(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)			10.0900	1.1450	11.5534			(27)
Ground Floor			35.5200	0.1200	4.2624	90.0000	3196.8000	(28a)
Brick and Block	83.9700	12.2400	71.7300	0.2400	17.2152	42.2200	3028.4406	(29a)
Stepped Party Wall	1.5000		1.5000	0.2600	0.3900	60.0000	90.0000	(29a)
External Roof 1	35.5200		35.5200	0.1000	3.5520	9.1000	323.2320	(30)
Total net area of external elements Aum(A, m2)			156.5100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	39.3380			(33)
Party Wall 1			34.3400	0.0000	0.0000	110.0000	3777.4000	(32)
GF Timber Stud			63.1100			9.0000	567.9900	(32c)
FF Timber Stud			66.2000			9.0000	595.8000	(32c)
Internal Floor 1			35.5200			18.0000	639.3600	(32d)
Internal Ceiling 1			35.5200			18.0000	639.3600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12858.3826 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		181.0020 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		18.5626 (36)
Total fabric heat loss	(33) + (36) =	57.9006 (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	35.3441	35.1096	34.8797	33.7998	33.5978	32.6573	32.6573	32.4831	33.0196	33.5978	34.0065	34.4338	(38)
Heat transfer coeff	93.2447	93.0102	92.7803	91.7004	91.4984	90.5579	90.5579	90.3837	90.9201	91.4984	91.9071	92.3344	(39)
Average = Sum(39)m / 12 =												91.6994	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3126	1.3093	1.3060	1.2908	1.2880	1.2747	1.2747	1.2723	1.2798	1.2880	1.2937	1.2998	(40)
HLP (average)												1.2908	(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		2.2711 (42)
Average daily hot water use (litres/day)		88.1388 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	96.9527	93.4271	89.9016	86.3760	82.8505	79.3249	79.3249	82.8505	86.3760	89.9016	93.4271	96.9527	(44)
Energy conte	143.7780	125.7491	129.7619	113.1295	108.5505	93.6708	86.7998	99.6040	100.7936	117.4652	128.2225	139.2413	(45)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Energy content (annual)												Total = Sum(45)m =	1386.7662 (45)
Distribution loss (46)m = 0.15 x (45)m													
	21.5667	18.8624	19.4643	16.9694	16.2826	14.0506	13.0200	14.9406	15.1190	17.6198	19.2334	20.8862	(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	25.2901	22.8200	25.2287	24.3739	25.1566	24.3107	25.0997	25.1366	24.3452	25.1989	24.4335	25.2783	(61)
Total heat required for water heating calculated for each month													
	169.0681	148.5691	154.9906	137.5035	133.7071	117.9815	111.8995	124.7406	125.1388	142.6641	152.6560	164.5196	(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													
	169.0681	148.5691	154.9906	137.5035	133.7071	117.9815	111.8995	124.7406	125.1388	142.6641	152.6560	164.5196	(64)
								Total per year (kWh/year) = Sum(64)m =				1683.4385	(64)
Heat gains from water heating, kWh/month													
	54.1287	47.5166	49.4530	43.7091	42.3822	37.2232	35.1358	39.4025	39.6002	45.3569	48.7424	52.6173	(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	113.5553	113.5553	113.5553	113.5553	113.5553	113.5553	113.5553	113.5553	113.5553	113.5553	113.5553	113.5553	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.0413	16.9123	13.7540	10.4127	7.7836	6.5712	7.1005	9.2294	12.3877	15.7291	18.3582	19.5705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	199.7121	201.7845	196.5621	185.4444	171.4102	158.2200	149.4082	147.3358	152.5582	163.6759	177.7101	190.9002	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.3555	34.3555	34.3555	34.3555	34.3555	34.3555	34.3555	34.3555	34.3555	34.3555	34.3555	34.3555	(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)													
	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	(71)
Water heating gains (Table 5)													
	72.7537	70.7092	66.4691	60.7070	56.9653	51.6989	47.2256	52.9603	55.0002	60.9636	67.6977	70.7222	(72)
Total internal gains													
	351.5736	349.4726	336.8518	316.6306	296.2257	276.5568	263.8009	269.5922	280.0127	300.4352	323.8326	341.2595	(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	
Northeast	6.6000	11.2829	0.6300	0.7000	0.7700	22.7582	(75)
Southwest	3.4900	36.7938	0.6300	0.7000	0.7700	39.2439	(79)

Solar gains	62.0021	113.1719	174.9257	250.3970	311.1846	322.4466	305.2498	257.8336	200.7358	130.4929	75.6409	52.1701 (83)
Total gains	413.5757	462.6445	511.7776	567.0276	607.4103	599.0034	569.0506	527.4258	480.7485	430.9281	399.4735	393.4296 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	38.3054	38.4020	38.4971	38.9505	39.0365	39.4419	39.4419	39.5179	39.2847	39.0365	38.8629	38.6830	
alpha	3.5537	3.5601	3.5665	3.5967	3.6024	3.6295	3.6295	3.6345	3.6190	3.6024	3.5909	3.5789	
util living area													
	0.9934	0.9894	0.9800	0.9542	0.8922	0.7709	0.6289	0.6831	0.8739	0.9676	0.9894	0.9945	(86)
MIT	19.1323	19.3048	19.6233	20.0692	20.4938	20.8064	20.9334	20.9087	20.6599	20.1242	19.5564	19.1047	(87)
Th 2	19.8310	19.8336	19.8361	19.8480	19.8503	19.8607	19.8607	19.8626	19.8567	19.8503	19.8457	19.8410	(88)
util rest of house													
	0.9917	0.9866	0.9744	0.9399	0.8550	0.6868	0.4947	0.5536	0.8155	0.9548	0.9861	0.9931	(89)
MIT 2	18.1398	18.3131	18.6309	19.0769	19.4794	19.7539	19.8380	19.8281	19.6411	19.1377	18.5736	18.1197	(90)
Living area fraction										fLA = Living area / (4) =		0.2500	(91)
MIT	18.3879	18.5610	18.8790	19.3250	19.7330	20.0170	20.1118	20.0983	19.8958	19.3843	18.8193	18.3659	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3879	18.5610	18.8790	19.3250	19.7330	20.0170	20.1118	20.0983	19.8958	19.3843	18.8193	18.3659	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9887	0.9824	0.9682	0.9316	0.8505	0.6999	0.5269	0.5835	0.8179	0.9479	0.9819	0.9905	(94)
Useful gains	408.8881	454.4990	495.4909	528.2638	516.5968	419.2526	299.8145	307.7276	393.2176	408.4933	392.2623	389.6798	(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													
	1313.6212	1270.6157	1148.5254	955.9740	735.0046	490.5550	318.0247	334.2655	526.9537	803.7535	1077.0875	1308.0007	(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													
	673.1214	548.4305	485.8576	307.9513	162.4954	0.0000	0.0000	0.0000	0.0000	294.0736	493.0742	683.2307	(98)
Space heating												3648.2348	(98)
Space heating per m2											(98) / (4) =	51.3547	(99)

8c. Space cooling requirement

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.7000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4022.3096	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	673.1214	548.4305	485.8576	307.9513	162.4954	0.0000	0.0000	0.0000	0.0000	294.0736	493.0742	683.2307	(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)													
	742.1405	604.6642	535.6755	339.5273	179.1570	0.0000	0.0000	0.0000	0.0000	324.2267	543.6320	753.2864	(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													
	169.0681	148.5691	154.9906	137.5035	133.7071	117.9815	111.8995	124.7406	125.1388	142.6641	152.6560	164.5196	(64)
Efficiency of water heater												87.2000	(216)
(217)m	89.9750	89.9306	89.8280	89.5900	89.0859	87.2000	87.2000	87.2000	87.2000	89.5262	89.8474	89.9990	(217)
Fuel for water heating, kWh/month													
	187.9056	165.2042	172.5415	153.4808	150.0878	135.2999	128.3251	143.0511	143.5078	159.3546	169.9058	182.8016	(219)
Water heating fuel used												1891.4659	(219)
Annual totals kWh/year													
Space heating fuel - main system												4022.3096	(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)												336.2752	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.85 * 1029 * 1.00) =										-699.8470		-699.8470	(233)
Total delivered energy for all uses												5625.2036	(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	4022.3096	0.2160	868.8189	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1891.4659	0.2160	408.5566	(264)
Space and water heating			1277.3755	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	336.2752	0.5190	174.5268	(268)
Energy saving/generation technologies				
PV Unit	-699.8470	0.5190	-363.2206	(269)
Total CO2, kg/year			1127.6067	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			15.8700	(273)

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

DER		15.8700	ZC1
Total Floor Area	TFA	71.0400	
Assumed number of occupants	N	2.2711	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		16.6589	ZC2
CO2 emissions from cooking, equation (L16)		2.4424	ZC3
Total CO2 emissions		34.9713	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		34.9713	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	35.5200	(1b)	x 2.3900	(2b) =	84.8928	(1b) - (3b)
First floor	35.5200	(1c)	x 2.6100	(2c) =	92.7072	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.0400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		177.6000	(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) =	0.1689	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.4189	(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) =		0.3561	(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	0.4540	0.4451	0.4362	0.3917	0.3828	0.3383	0.3383	0.3294	0.3561	0.3828	0.4006	0.4184	(22b)
Effective ac	0.6031	0.5991	0.5951	0.5767	0.5733	0.5572	0.5572	0.5542	0.5634	0.5733	0.5802	0.5875	(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)			10.0900	1.3258	13.3769			(27)
Ground Floor			35.5200	0.1300	4.6176			(28a)
Brick and Block	83.9700	12.2400	71.7300	0.1800	12.9114			(29a)
Stepped Party Wall	1.5000		1.5000	0.1800	0.2700			(29a)
External Roof 1	35.5200		35.5200	0.1300	4.6176			(30)
Total net area of external elements Aum(A, m2)			156.5100					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		37.9435			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.9623	(36)
Total fabric heat loss					(33) + (36) =		47.9058	(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	35.3441	35.1096	34.8797	33.7998	33.5978	32.6573	32.6573	32.4831	33.0196	33.5978	34.0065	34.4338	(38)
Heat transfer coeff	83.2499	83.0154	82.7855	81.7056	81.5036	80.5631	80.5631	80.3889	80.9254	81.5036	81.9123	82.3396	(39)
Average = Sum(39)m / 12 =												81.7047	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1719	1.1686	1.1653	1.1501	1.1473	1.1341	1.1341	1.1316	1.1392	1.1473	1.1530	1.1591	(40)
HLP (average)												1.1501	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.2711	(42)
Average daily hot water use (litres/day)	88.1388	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	96.9527	93.4271	89.9016	86.3760	82.8505	79.3249	79.3249	82.8505	86.3760	89.9016	93.4271	96.9527	(44)
Energy conte	143.7780	125.7491	129.7619	113.1295	108.5505	93.6708	86.7998	99.6040	100.7936	117.4652	128.2225	139.2413	(45)
Energy content (annual)										Total = Sum(45)m =		1386.7662	(45)
Distribution loss (46)m = 0.15 x (45)m	21.5667	18.8624	19.4643	16.9694	16.2826	14.0506	13.0200	14.9406	15.1190	17.6198	19.2334	20.8862	(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	49.4060	43.0021	45.8128	42.5964	42.2197	39.1191	40.4231	42.2197	42.5964	45.8128	46.0736	49.4060 (61)
Total heat required for water heating calculated for each month												
	193.1840	168.7512	175.5747	155.7259	150.7702	132.7899	127.2229	141.8237	143.3900	163.2781	174.2961	188.6473 (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												
	193.1840	168.7512	175.5747	155.7259	150.7702	132.7899	127.2229	141.8237	143.3900	163.2781	174.2961	188.6473 (64)
								Total per year (kWh/year) = Sum(64)m =				1915.4540 (64)
Heat gains from water heating, kWh/month												
	60.1577	52.5621	54.5990	48.2647	46.6480	40.9253	38.9667	43.6733	44.1630	50.5104	54.1524	58.6492 (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	113.5553	113.5553	113.5553	113.5553	113.5553	113.5553	113.5553	113.5553	113.5553	113.5553	113.5553	113.5553	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.0413	16.9123	13.7540	10.4127	7.7836	6.5712	7.1005	9.2294	12.3877	15.7291	18.3582	19.5705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	199.7121	201.7845	196.5621	185.4444	171.4102	158.2200	149.4082	147.3358	152.5582	163.6759	177.7101	190.9002	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.3555	34.3555	34.3555	34.3555	34.3555	34.3555	34.3555	34.3555	34.3555	34.3555	34.3555	34.3555	(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)													
	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	(71)
Water heating gains (Table 5)													
	80.8571	78.2174	73.3858	67.0343	62.6989	56.8407	52.3746	58.7006	61.3375	67.8903	75.2116	78.8296	(72)
Total internal gains													
	359.6771	356.9808	343.7685	322.9579	301.9592	281.6986	268.9499	275.3325	286.3500	307.3619	331.3465	349.3670	(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	
Northeast	6.6000	11.2829	0.6300	0.7000	0.7700	22.7582	(75)
Southwest	3.4900	36.7938	0.6300	0.7000	0.7700	39.2439	(79)

Solar gains	62.0021	113.1719	174.9257	250.3970	311.1846	322.4466	305.2498	257.8336	200.7358	130.4929	75.6409	52.1701	(83)
Total gains	421.6792	470.1527	518.6943	573.3548	613.1439	604.1452	574.1996	533.1661	487.0857	437.8548	406.9874	401.5371	(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	59.2593	59.4268	59.5918	60.3794	60.5290	61.2357	61.2357	61.3683	60.9615	60.5290	60.2270	59.9145	
alpha	4.9506	4.9618	4.9728	5.0253	5.0353	5.0824	5.0824	5.0912	5.0641	5.0353	5.0151	4.9943	
util living area	0.9981	0.9964	0.9912	0.9718	0.9090	0.7631	0.5958	0.6566	0.8865	0.9823	0.9963	0.9985	(86)
MIT	19.7235	19.8562	20.0953	20.4296	20.7346	20.9276	20.9836	20.9739	20.8323	20.4477	20.0314	19.7034	(87)
Th 2	19.9426	19.9452	19.9478	19.9601	19.9624	19.9731	19.9731	19.9751	19.9690	19.9624	19.9577	19.9529	(88)
util rest of house	0.9975	0.9951	0.9879	0.9603	0.8708	0.6735	0.4676	0.5281	0.8244	0.9731	0.9948	0.9980	(89)
MIT 2	18.2422	18.4378	18.7876	19.2764	19.6922	19.9227	19.9668	19.9638	19.8266	19.3095	18.7031	18.2202	(90)
Living area fraction									fLA = Living area / (4) =			0.2500	(91)
MIT	18.6126	18.7924	19.1145	19.5647	19.9528	20.1739	20.2210	20.2163	20.0780	19.5941	19.0351	18.5910	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6126	18.7924	19.1145	19.5647	19.9528	20.1739	20.2210	20.2163	20.0780	19.5941	19.0351	18.5910	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9962	0.9931	0.9843	0.9546	0.8704	0.6927	0.4999	0.5602	0.8322	0.9685	0.9928	0.9970	(94)
Useful gains	420.0838	466.8922	510.5257	547.3338	533.6867	418.5039	287.0525	298.6960	405.3684	424.0761	404.0411	400.3418	(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	1191.5194	1153.2840	1044.3002	871.3682	672.6340	449.0530	291.7225	306.7878	483.7726	733.0500	977.6343	1184.9483	(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	573.9481	461.2553	397.1282	233.3048	103.3768	0.0000	0.0000	0.0000	0.0000	229.8765	412.9871	583.7473	(98)
Space heating												2995.6241	(98)
Space heating per m2											(98) / (4) =	42.1681	(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												3207.3064	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	573.9481	461.2553	397.1282	233.3048	103.3768	0.0000	0.0000	0.0000	0.0000	229.8765	412.9871	583.7473	(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)													
	614.5054	493.8493	425.1908	249.7910	110.6818	0.0000	0.0000	0.0000	0.0000	246.1205	442.1704	624.9971	(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													
	193.1840	168.7512	175.5747	155.7259	150.7702	132.7899	127.2229	141.8237	143.3900	163.2781	174.2961	188.6473	(64)
Efficiency of water heater												80.3000	(216)
(217)m	87.6246	87.4536	87.0436	86.0667	84.1230	80.3000	80.3000	80.3000	80.3000	85.9123	87.1469	87.7057	(217)
Fuel for water heating, kWh/month													
	220.4679	192.9608	201.7089	180.9363	179.2258	165.3673	158.4345	176.6173	178.5679	190.0521	200.0027	215.0913	(219)
Water heating fuel used												2259.4327	(219)
Annual totals kWh/year													
Space heating fuel - main system												3207.3064	(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)												336.2752	(232)
Total delivered energy for all uses												5878.0142	(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	3207.3064	0.2160	692.7782	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2259.4327	0.2160	488.0375	(264)
Space and water heating			1180.8156	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	336.2752	0.5190	174.5268	(268)
Total CO2, kg/m2/year			1394.2675	(272)
Emissions per m2 for space and water heating			16.6218	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.4567	(272b)
Emissions per m2 for pumps and fans			0.5479	(272c)
Target Carbon Dioxide Emission Rate (TER) = (16.6218 * 1.00) + 2.4567 + 0.5479, rounded to 2 d.p.			19.6300	(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	35.5200	(1b)	x 2.3900	(2b) =	84.8928	(1b) - (3b)
First floor	35.5200	(1c)	x 2.6100	(2c) =	92.7072	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.0400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		177.6000	(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) =	0.1689	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4189	(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) =	0.3561	(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	0.4540	0.4451	0.4362	0.3917	0.3828	0.3383	0.3383	0.3294	0.3561	0.3828	0.4006	0.4184	(22b)
Effective ac	0.6031	0.5991	0.5951	0.5767	0.5733	0.5572	0.5572	0.5542	0.5634	0.5733	0.5802	0.5875	(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)			10.0900	1.1450	11.5534			(27)
Ground Floor			35.5200	0.1200	4.2624	90.0000	3196.8000	(28a)
Brick and Block	83.9700	12.2400	71.7300	0.2400	17.2152	42.2200	3028.4406	(29a)
Stepped Party Wall	1.5000		1.5000	0.2600	0.3900	60.0000	90.0000	(29a)
External Roof 1	35.5200		35.5200	0.1000	3.5520	9.1000	323.2320	(30)
Total net area of external elements Aum(A, m2)			156.5100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	39.3380			(33)
Party Wall 1			34.3400	0.0000	0.0000	110.0000	3777.4000	(32)
GF Timber Stud			63.1100			9.0000	567.9900	(32c)
FF Timber Stud			66.2000			9.0000	595.8000	(32c)
Internal Floor 1			35.5200			18.0000	639.3600	(32d)
Internal Ceiling 1			35.5200			9.0000	319.6800	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12538.7026 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		176.5020 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		18.5626 (36)
Total fabric heat loss	(33) + (36) =	57.9006 (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	35.3441	35.1096	34.8797	33.7998	33.5978	32.6573	32.6573	32.4831	33.0196	33.5978	34.0065	34.4338	(38)
Heat transfer coeff	93.2447	93.0102	92.7803	91.7004	91.4984	90.5579	90.5579	90.3837	90.9201	91.4984	91.9071	92.3344	(39)
Average = Sum(39)m / 12 =												91.6994	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3126	1.3093	1.3060	1.2908	1.2880	1.2747	1.2747	1.2723	1.2798	1.2880	1.2937	1.2998	(40)
HLP (average)												1.2908	(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		2.2711 (42)
Average daily hot water use (litres/day)		88.1388 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	96.9527	93.4271	89.9016	86.3760	82.8505	79.3249	79.3249	82.8505	86.3760	89.9016	93.4271	96.9527	(44)
Energy conte	143.7780	125.7491	129.7619	113.1295	108.5505	93.6708	86.7998	99.6040	100.7936	117.4652	128.2225	139.2413	(45)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy content (annual)											Total = Sum(45)m =	1386.7662	(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													
	30.5528	26.7217	27.5744	24.0400	23.0670	19.9050	18.4450	21.1659	21.4186	24.9614	27.2473	29.5888	(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	113.5553	113.5553	113.5553	113.5553	113.5553	113.5553	113.5553	113.5553	113.5553	113.5553	113.5553	113.5553	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.0413	16.9123	13.7540	10.4127	7.7836	6.5712	7.1005	9.2294	12.3877	15.7291	18.3582	19.5705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	199.7121	201.7845	196.5621	185.4444	171.4102	158.2200	149.4082	147.3358	152.5582	163.6759	177.7101	190.9002	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.3555	34.3555	34.3555	34.3555	34.3555	34.3555	34.3555	34.3555	34.3555	34.3555	34.3555	34.3555	(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)													
	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	(71)
Water heating gains (Table 5)													
	41.0656	39.7644	37.0624	33.3889	31.0040	27.6459	24.7916	28.4487	29.7481	33.5502	37.8434	39.7699	(72)
Total internal gains													
	316.8856	315.5278	304.4451	286.3126	267.2644	249.5038	238.3669	242.0806	251.7606	270.0218	290.9783	307.3072	(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	
Northeast	6.6000	11.2829	0.6300	0.7000	0.7700	22.7582	(75)
Southwest	3.4900	36.7938	0.6300	0.7000	0.7700	39.2439	(79)

Solar gains	62.0021	113.1719	174.9257	250.3970	311.1846	322.4466	305.2498	257.8336	200.7358	130.4929	75.6409	52.1701	(83)
Total gains	378.8877	428.6997	479.3708	536.7095	578.4490	571.9504	543.6166	499.9142	452.4964	400.5147	366.6192	359.4773	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	37.3530	37.4472	37.5400	37.9821	38.0660	38.4613	38.4613	38.5354	38.3080	38.0660	37.8967	37.7213	
alpha	3.4902	3.4965	3.5027	3.5321	3.5377	3.5641	3.5641	3.5690	3.5539	3.5377	3.5264	3.5148	
util living area													
	0.9945	0.9910	0.9825	0.9588	0.9011	0.7860	0.6476	0.7043	0.8873	0.9723	0.9912	0.9955	(86)
MIT	19.0426	19.2199	19.5479	20.0084	20.4502	20.7825	20.9224	20.8934	20.6226	20.0625	19.4776	19.0152	(87)
Th 2	19.8310	19.8336	19.8361	19.8480	19.8503	19.8607	19.8607	19.8626	19.8567	19.8503	19.8457	19.8410	(88)
util rest of house													
	0.9931	0.9886	0.9776	0.9459	0.8665	0.7047	0.5131	0.5762	0.8334	0.9614	0.9885	0.9943	(89)
MIT 2	18.0534	18.2318	18.5594	19.0209	19.4425	19.7380	19.8334	19.8209	19.6122	19.0809	18.4983	18.0335	(90)
Living area fraction									fLA = Living area / (4) =			0.2500	(91)
MIT	18.3007	18.4788	18.8066	19.2678	19.6944	19.9992	20.1056	20.0890	19.8648	19.3263	18.7431	18.2789	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3007	18.4788	18.8066	19.2678	19.6944	19.9992	20.1056	20.0890	19.8648	19.3263	18.7431	18.2789	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9905	0.9848	0.9717	0.9375	0.8608	0.7161	0.5449	0.6049	0.8338	0.9546	0.9848	0.9921	(94)
Useful gains	375.2889	422.1719	465.7937	503.1798	497.9528	409.5500	296.2177	302.3832	377.3122	382.3349	361.0609	356.6312	(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													
	1305.4931	1262.9694	1141.8048	950.7305	731.4773	488.9359	317.4607	333.4262	524.1380	798.4416	1070.0872	1299.9703	(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													
	692.0719	565.0159	502.9523	322.2365	173.7422	0.0000	0.0000	0.0000	0.0000	309.5834	510.4990	701.8443	(98)
Space heating												3777.9454	(98)
Space heating per m2											(98) / (4) =	53.1805	(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	851.2441	670.1283	686.9162	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7310	0.8073	0.7708	0.0000	0.0000	0.0000	0.0000	(101)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	622.2431	541.0196	529.4505	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	753.4289	718.6454	669.1104	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	94.4537	132.1536	103.9070	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												330.5143	(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	23.6134	33.0384	25.9767	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												82.6286	(107)
Space cooling per m2												1.1631	(108)
Energy for space heating												53.1805	(99)
Energy for space cooling												1.1631	(108)
Total												54.3437	(109)
Dwelling Fabric Energy Efficiency (DFEE)												54.3	(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	35.5200	(1b)	x 2.3900	(2b) =	84.8928	(1b) - (3b)
First floor	35.5200	(1c)	x 2.6100	(2c) =	92.7072	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.0400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		177.6000	(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) =	0.1689	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4189	(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) =	0.3561	(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	0.4540	0.4451	0.4362	0.3917	0.3828	0.3383	0.3383	0.3294	0.3561	0.3828	0.4006	0.4184	(22b)
Effective ac	0.6031	0.5991	0.5951	0.5767	0.5733	0.5572	0.5572	0.5542	0.5634	0.5733	0.5802	0.5875	(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)			10.0900	1.3258	13.3769			(27)
Ground Floor			35.5200	0.1300	4.6176			(28a)
Brick and Block	83.9700	12.2400	71.7300	0.1800	12.9114			(29a)
Stepped Party Wall	1.5000		1.5000	0.1800	0.2700			(29a)
External Roof 1	35.5200		35.5200	0.1300	4.6176			(30)
Total net area of external elements Aum(A, m2)			156.5100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	37.9435			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							9.9623	(36)
Total fabric heat loss					(33) + (36) =		47.9058	(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	35.3441	35.1096	34.8797	33.7998	33.5978	32.6573	32.6573	32.4831	33.0196	33.5978	34.0065	34.4338	(38)
Heat transfer coeff	83.2499	83.0154	82.7855	81.7056	81.5036	80.5631	80.5631	80.3889	80.9254	81.5036	81.9123	82.3396	(39)
Average = Sum(39)m / 12 =												81.7047	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1719	1.1686	1.1653	1.1501	1.1473	1.1341	1.1341	1.1316	1.1392	1.1473	1.1530	1.1591	(40)
HLP (average)												1.1501	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	2.2711	(42)
Average daily hot water use (litres/day)	88.1388	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	96.9527	93.4271	89.9016	86.3760	82.8505	79.3249	79.3249	82.8505	86.3760	89.9016	93.4271	96.9527	(44)
Energy conte	143.7780	125.7491	129.7619	113.1295	108.5505	93.6708	86.7998	99.6040	100.7936	117.4652	128.2225	139.2413	(45)
Energy content (annual)										Total = Sum(45)m =		1386.7662	(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	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													
	30.5528	26.7217	27.5744	24.0400	23.0670	19.9050	18.4450	21.1659	21.4186	24.9614	27.2473	29.5888	(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	113.5553	113.5553	113.5553	113.5553	113.5553	113.5553	113.5553	113.5553	113.5553	113.5553	113.5553	113.5553	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	19.0413	16.9123	13.7540	10.4127	7.7836	6.5712	7.1005	9.2294	12.3877	15.7291	18.3582	19.5705	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	199.7121	201.7845	196.5621	185.4444	171.4102	158.2200	149.4082	147.3358	152.5582	163.6759	177.7101	190.9002	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	34.3555	34.3555	34.3555	34.3555	34.3555	34.3555	34.3555	34.3555	34.3555	34.3555	34.3555	34.3555	(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)													
	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	(71)
Water heating gains (Table 5)													
	41.0656	39.7644	37.0624	33.3889	31.0040	27.6459	24.7916	28.4487	29.7481	33.5502	37.8434	39.7699	(72)
Total internal gains													
	316.8856	315.5278	304.4451	286.3126	267.2644	249.5038	238.3669	242.0806	251.7606	270.0218	290.9783	307.3072	(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	
Northeast	6.6000	11.2829	0.6300	0.7000	0.7700	22.7582	(75)
Southwest	3.4900	36.7938	0.6300	0.7000	0.7700	39.2439	(79)

Solar gains	62.0021	113.1719	174.9257	250.3970	311.1846	322.4466	305.2498	257.8336	200.7358	130.4929	75.6409	52.1701	(83)
Total gains	378.8877	428.6997	479.3708	536.7095	578.4490	571.9504	543.6166	499.9142	452.4964	400.5147	366.6192	359.4773	(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	59.2593	59.4268	59.5918	60.3794	60.5290	61.2357	61.2357	61.3683	60.9615	60.5290	60.2270	59.9145	
alpha	4.9506	4.9618	4.9728	5.0253	5.0353	5.0824	5.0824	5.0912	5.0641	5.0353	5.0151	4.9943	
util living area													
	0.9988	0.9976	0.9937	0.9782	0.9245	0.7894	0.6242	0.6904	0.9093	0.9878	0.9977	0.9991	(86)
MIT	19.6677	19.8025	20.0455	20.3871	20.7048	20.9150	20.9799	20.9673	20.8054	20.4021	19.9789	19.6483	(87)
Th 2	19.9426	19.9452	19.9478	19.9601	19.9624	19.9731	19.9731	19.9751	19.9690	19.9624	19.9577	19.9529	(88)
util rest of house													
	0.9984	0.9967	0.9913	0.9690	0.8908	0.7021	0.4924	0.5598	0.8546	0.9811	0.9967	0.9988	(89)
MIT 2	18.7259	18.8626	19.1066	19.4530	19.7532	19.9316	19.9677	19.9651	19.8521	19.4729	19.0490	18.7148	(90)
Living area fraction									fLA = Living area / (4) =			0.2500	(91)
MIT	18.9614	19.0976	19.3413	19.6865	19.9911	20.1775	20.2208	20.2156	20.0904	19.7052	19.2815	18.9482	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9614	19.0976	19.3413	19.6865	19.9911	20.1775	20.2208	20.2156	20.0904	19.7052	19.2815	18.9482	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9979	0.9958	0.9894	0.9659	0.8919	0.7214	0.5258	0.5928	0.8625	0.9789	0.9958	0.9984	(94)
Useful gains	378.0891	426.8903	474.3126	518.4302	515.9048	412.6122	285.8551	296.3461	390.2660	392.0500	365.0858	358.8977	(95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	(96)
Heat loss rate W													
	1220.5574	1178.6171	1063.0770	881.3209	675.7544	449.3389	291.7005	306.7349	484.7771	742.1042	997.8114	1214.3607	(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													
	626.7965	505.1604	438.0407	261.2813	118.9282	0.0000	0.0000	0.0000	0.0000	260.4403	455.5624	636.4645	(98)
Space heating												3302.6742	(98)
Space heating per m2											(98) / (4) =	46.4903	(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	757.2930	596.1669	610.9558	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8334	0.9029	0.8714	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	631.1628	538.2785	532.3604	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	753.4289	718.6454	669.1104	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	88.0316	134.1930	101.7420	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												323.9666	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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Cooled fraction                                                                  fC = cooled area / (4) =      1.0000 (105)
Intermittency factor (Table 10b)
                0.0000     0.0000     0.0000     0.0000     0.0000     0.2500     0.2500     0.2500     0.0000     0.0000     0.0000     0.0000 (106)
Space cooling kWh
                0.0000     0.0000     0.0000     0.0000     0.0000    22.0079    33.5482    25.4355     0.0000     0.0000     0.0000     0.0000 (107)
Space cooling                                                                                                                          80.9917 (107)
Space cooling per m2                                                                                                                    1.1401 (108)
Energy for space heating                                                                                                               46.4903 (99)
Energy for space cooling                                                                                                                1.1401 (108)
Total                                                                                                                                  47.6304 (109)
Target Fabric Energy Efficiency (TFEE)                                                                                                    54.8 (109)


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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	35.5200	(1b)	x 2.3900	(2b) =	84.8928	(1b) - (3b)
First floor	35.5200	(1c)	x 2.6100	(2c) =	92.7072	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.0400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		177.6000	(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) =	0.1689	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4189	(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) =	0.3561	(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	0.4540	0.4184	0.4095	0.3828	0.3828	0.3561	0.3561	0.3472	0.3561	0.4006	0.3917	0.4184	(22b)
Effective ac	0.6031	0.5875	0.5838	0.5733	0.5733	0.5634	0.5634	0.5603	0.5634	0.5802	0.5767	0.5875	(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)			10.0900	1.1450	11.5534			(27)
Ground Floor			35.5200	0.1200	4.2624	90.0000	3196.8000	(28a)
Brick and Block	83.9700	12.2400	71.7300	0.2400	17.2152	42.2200	3028.4406	(29a)
Stepped Party Wall	1.5000		1.5000	0.2600	0.3900	60.0000	90.0000	(29a)
External Roof 1	35.5200		35.5200	0.1000	3.5520	9.1000	323.2320	(30)
Total net area of external elements Aum(A, m2)			156.5100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	39.3380			(33)
Party Wall 1			34.3400	0.0000	0.0000	110.0000	3777.4000	(32)
GF Timber Stud			63.1100			9.0000	567.9900	(32c)
FF Timber Stud			66.2000			9.0000	595.8000	(32c)
Internal Floor 1			35.5200			18.0000	639.3600	(32d)
Internal Ceiling 1			35.5200			18.0000	639.3600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12858.3826 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		181.0020 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		18.5626 (36)
Total fabric heat loss	(33) + (36) =	57.9006 (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	35.3441	34.4338	34.2178	33.5978	33.5978	33.0196	33.0196	32.8361	33.0196	34.0065	33.7998	34.4338	(38)
Heat transfer coeff	93.2447	92.3344	92.1184	91.4984	91.4984	90.9201	90.9201	90.7367	90.9201	91.9071	91.7004	92.3344	(39)
Average = Sum(39)m / 12 =												91.6778	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3126	1.2998	1.2967	1.2880	1.2880	1.2798	1.2798	1.2773	1.2798	1.2937	1.2908	1.2998	(40)
HLP (average)												1.2905	(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		2.2711 (42)
Average daily hot water use (litres/day)		88.1388 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	96.9527	93.4271	89.9016	86.3760	82.8505	79.3249	79.3249	82.8505	86.3760	89.9016	93.4271	96.9527	(44)
Energy conte	143.7780	125.7491	129.7619	113.1295	108.5505	93.6708	86.7998	99.6040	100.7936	117.4652	128.2225	139.2413	(45)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1386.7662 (45)

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

	21.5667	18.8624	19.4643	16.9694	16.2826	14.0506	13.0200	14.9406	15.1190	17.6198	19.2334	20.8862 (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	25.2901	22.8200	25.2287	24.3739	25.1566	24.3107	25.0997	25.1366	24.3452	25.1989	24.4335	25.2783 (61)

Total heat required for water heating calculated for each month

	169.0681	148.5691	154.9906	137.5035	133.7071	117.9815	111.8995	124.7406	125.1388	142.6641	152.6560	164.5196 (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

	169.0681	148.5691	154.9906	137.5035	133.7071	117.9815	111.8995	124.7406	125.1388	142.6641	152.6560	164.5196 (64)

Total per year (kWh/year) = Sum(64)m = 1683.4385 (64)

RHI water heating demand 1683 (64)

Heat gains from water heating, kWh/month

	54.1287	47.5166	49.4530	43.7091	42.3822	37.2232	35.1358	39.4025	39.6002	45.3569	48.7424	52.6173 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	(66)

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

	47.6032	42.2808	34.3850	26.0317	19.4590	16.4281	17.7511	23.0736	30.9693	39.3227	45.8954	48.9263 (67)

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

	298.0777	301.1708	293.3763	276.7826	255.8361	236.1493	222.9973	219.9042	227.6988	244.2924	265.2390	284.9257 (68)

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

	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977 (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)

	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443 (71)

Water heating gains (Table 5)

	72.7537	70.7092	66.4691	60.7070	56.9653	51.6989	47.2256	52.9603	55.0002	60.9636	67.6977	70.7222 (72)

Total internal gains

	517.7545	513.4807	493.5503	462.8412	431.5803	403.5962	387.2939	395.2580	412.9882	443.8986	478.1519	503.8941 (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	
Northeast	6.6000	15.0428	0.6300	0.7000	0.7700	30.3421	(75)
Southwest	3.4900	46.3896	0.6300	0.7000	0.7700	49.4786	(79)

Solar gains	79.8207	125.1263	193.7003	283.8247	337.4753	378.4267	349.6976	301.4636	236.2723	152.9940	96.6207	64.0501 (83)
Total gains	597.5752	638.6070	687.2506	746.6659	769.0555	782.0229	736.9916	696.7217	649.2605	596.8926	574.7726	567.9442 (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	38.3054	38.6830	38.7737	39.0365	39.0365	39.2847	39.2847	39.3642	39.2847	38.8629	38.9505	38.6830	
alpha	3.5537	3.5789	3.5849	3.6024	3.6024	3.6190	3.6190	3.6243	3.6190	3.5909	3.5967	3.5789	
util living area													
	0.9746	0.9672	0.9451	0.8915	0.7825	0.5953	0.4415	0.4635	0.7108	0.8945	0.9575	0.9776	(86)
MIT	19.5789	19.7009	19.9985	20.3816	20.7267	20.9284	20.9820	20.9790	20.8621	20.4901	20.0093	19.5687	(87)
Th 2	19.8310	19.8410	19.8434	19.8503	19.8503	19.8567	19.8567	19.8587	19.8567	19.8457	19.8480	19.8410	(88)
util rest of house													
	0.9681	0.9589	0.9307	0.8620	0.7216	0.4939	0.3121	0.3291	0.6153	0.8573	0.9447	0.9718	(89)
MIT 2	18.5813	18.7082	18.9999	19.3682	19.6726	19.8255	19.8526	19.8539	19.7876	19.4731	19.0183	18.5792	(90)
Living area fraction									fLA = Living area / (4) =			0.2500	(91)
MIT	18.8307	18.9564	19.2496	19.6216	19.9361	20.1012	20.1350	20.1352	20.0562	19.7273	19.2660	18.8266	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8307	18.9564	19.2496	19.6216	19.9361	20.1012	20.1350	20.1352	20.0562	19.7273	19.2660	18.8266	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9609	0.9509	0.9215	0.8551	0.7267	0.5169	0.3446	0.3629	0.6337	0.8527	0.9364	0.9651	(94)
Useful gains	574.2374	607.2493	633.3331	638.4889	558.8486	404.2374	253.9831	252.8265	411.4366	508.9455	538.2408	548.1504	(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													
	1252.3389	1224.0176	1100.7755	916.9563	671.2434	427.4360	257.7546	257.2563	459.7101	728.5771	996.4195	1230.5042	(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													
	504.5075	414.4683	347.7772	200.4965	83.6217	0.0000	0.0000	0.0000	0.0000	163.4059	329.8887	507.6712	(98)
Space heating												2551.8370	(98)
RHI space heating demand												2552	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.5200	(1b)	x 2.3900	(2b) =	84.8928	(1b) - (3b)
First floor	35.5200	(1c)	x 2.6100	(2c) =	92.7072	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.0400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		177.6000	(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) =	0.1689	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4189	(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) =	0.3561	(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	0.4540	0.4451	0.4362	0.3917	0.3828	0.3383	0.3383	0.3294	0.3561	0.3828	0.4006	0.4184	(22b)
Effective ac	0.6031	0.5991	0.5951	0.5767	0.5733	0.5572	0.5572	0.5542	0.5634	0.5733	0.5802	0.5875	(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)			10.0900	1.1450	11.5534			(27)
Ground Floor			35.5200	0.1200	4.2624	90.0000	3196.8000	(28a)
Brick and Block	83.9700	12.2400	71.7300	0.2400	17.2152	42.2200	3028.4406	(29a)
Stepped Party Wall	1.5000		1.5000	0.2600	0.3900	60.0000	90.0000	(29a)
External Roof 1	35.5200		35.5200	0.1000	3.5520	9.1000	323.2320	(30)
Total net area of external elements Aum(A, m2)			156.5100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	39.3380			(33)
Party Wall 1			34.3400	0.0000	0.0000	110.0000	3777.4000	(32)
GF Timber Stud			63.1100			9.0000	567.9900	(32c)
FF Timber Stud			66.2000			9.0000	595.8000	(32c)
Internal Floor 1			35.5200			18.0000	639.3600	(32d)
Internal Ceiling 1			35.5200			18.0000	639.3600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12858.3826 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		181.0020 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		18.5626 (36)
Total fabric heat loss	(33) + (36) =	57.9006 (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	35.3441	35.1096	34.8797	33.7998	33.5978	32.6573	32.6573	32.4831	33.0196	33.5978	34.0065	34.4338	(38)
Heat transfer coeff	93.2447	93.0102	92.7803	91.7004	91.4984	90.5579	90.5579	90.3837	90.9201	91.4984	91.9071	92.3344	(39)
Average = Sum(39)m / 12 =												91.6994	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3126	1.3093	1.3060	1.2908	1.2880	1.2747	1.2747	1.2723	1.2798	1.2880	1.2937	1.2998	(40)
HLP (average)												1.2908	(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		2.2711 (42)
Average daily hot water use (litres/day)		88.1388 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	96.9527	93.4271	89.9016	86.3760	82.8505	79.3249	79.3249	82.8505	86.3760	89.9016	93.4271	96.9527	(44)
Energy conte	143.7780	125.7491	129.7619	113.1295	108.5505	93.6708	86.7998	99.6040	100.7936	117.4652	128.2225	139.2413	(45)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1386.7662 (45)
Distribution loss (46)m = 0.15 x (45)m

	21.5667	18.8624	19.4643	16.9694	16.2826	14.0506	13.0200	14.9406	15.1190	17.6198	19.2334	20.8862 (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	25.2901	22.8200	25.2287	24.3739	25.1566	24.3107	25.0997	25.1366	24.3452	25.1989	24.4335	25.2783 (61)

Total heat required for water heating calculated for each month

	169.0681	148.5691	154.9906	137.5035	133.7071	117.9815	111.8995	124.7406	125.1388	142.6641	152.6560	164.5196 (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

	169.0681	148.5691	154.9906	137.5035	133.7071	117.9815	111.8995	124.7406	125.1388	142.6641	152.6560	164.5196 (64)

Total per year (kWh/year) = Sum(64)m = 1683.4385 (64)
Heat gains from water heating, kWh/month

	54.1287	47.5166	49.4530	43.7091	42.3822	37.2232	35.1358	39.4025	39.6002	45.3569	48.7424	52.6173 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	(66)

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

	47.6032	42.2808	34.3850	26.0317	19.4590	16.4281	17.7511	23.0736	30.9693	39.3227	45.8954	48.9263 (67)

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

	298.0777	301.1708	293.3763	276.7826	255.8361	236.1493	222.9973	219.9042	227.6988	244.2924	265.2390	284.9257 (68)

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

	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977 (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)

	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443 (71)

Water heating gains (Table 5)

	72.7537	70.7092	66.4691	60.7070	56.9653	51.6989	47.2256	52.9603	55.0002	60.9636	67.6977	70.7222 (72)

Total internal gains

	517.7545	513.4807	493.5503	462.8412	431.5803	403.5962	387.2939	395.2580	412.9882	443.8986	478.1519	503.8941 (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	
Northeast	6.6000	11.2829	0.6300	0.7000	0.7700	22.7582	(75)
Southwest	3.4900	36.7938	0.6300	0.7000	0.7700	39.2439	(79)

Solar gains	62.0021	113.1719	174.9257	250.3970	311.1846	322.4466	305.2498	257.8336	200.7358	130.4929	75.6409	52.1701 (83)
Total gains	579.7566	626.6526	668.4760	713.2382	742.7649	726.0429	692.5437	653.0917	613.7240	574.3915	553.7928	556.0642 (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	38.3054	38.4020	38.4971	38.9505	39.0365	39.4419	39.4419	39.5179	39.2847	39.0365	38.8629	38.6830	
alpha	3.5537	3.5601	3.5665	3.5967	3.6024	3.6295	3.6295	3.6345	3.6190	3.6024	3.5909	3.5789	
util living area	0.9810	0.9733	0.9567	0.9161	0.8325	0.6885	0.5397	0.5855	0.7920	0.9287	0.9712	0.9835	(86)
MIT	19.3896	19.5529	19.8484	20.2531	20.6190	20.8691	20.9595	20.9451	20.7681	20.3150	19.7898	19.3590	(87)
Th 2	19.8310	19.8336	19.8361	19.8480	19.8503	19.8607	19.8607	19.8626	19.8567	19.8503	19.8457	19.8410	(88)
util rest of house	0.9765	0.9668	0.9456	0.8931	0.7843	0.5992	0.4151	0.4614	0.7173	0.9044	0.9630	0.9795	(89)
MIT 2	18.3939	18.5568	18.8486	19.2473	19.5829	19.7927	19.8478	19.8435	19.7202	19.3147	18.8017	18.3713	(90)
Living area fraction									fLA = Living area / (4) =			0.2500	(91)
MIT	18.6428	18.8058	19.0985	19.4987	19.8419	20.0618	20.1257	20.1189	19.9822	19.5648	19.0487	18.6182	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6428	18.8058	19.0985	19.4987	19.8419	20.0618	20.1257	20.1189	19.9822	19.5648	19.0487	18.6182	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9703	0.9594	0.9367	0.8848	0.7839	0.6163	0.4456	0.4913	0.7267	0.8970	0.9557	0.9739	(94)
Useful gains	562.5310	601.2356	626.1763	631.0475	582.2411	447.4910	308.6289	320.8317	445.9812	515.2124	529.2406	541.5630	(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	1337.3918	1293.3824	1168.8964	971.9097	744.9725	494.6066	319.2820	336.1268	534.8073	820.2630	1098.1727	1331.2956	(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	576.4965	465.1226	403.7837	245.4208	121.0722	0.0000	0.0000	0.0000	0.0000	226.9576	409.6311	587.5610	(98)
Space heating												3036.0456	(98)
Space heating per m2										(98) / (4) =		42.7371	(99)

8c. Space cooling requirement

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.7000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3347.3490	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	576.4965	465.1226	403.7837	245.4208	121.0722	0.0000	0.0000	0.0000	0.0000	226.9576	409.6311	587.5610	(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)													
	635.6080	512.8144	445.1860	270.5852	133.4864	0.0000	0.0000	0.0000	0.0000	250.2289	451.6330	647.8071	(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													
	169.0681	148.5691	154.9906	137.5035	133.7071	117.9815	111.8995	124.7406	125.1388	142.6641	152.6560	164.5196	(64)
Efficiency of water heater												87.2000	(216)
(217)m	89.8819	89.8272	89.7013	89.4113	88.8289	87.2000	87.2000	87.2000	87.2000	89.3163	89.7223	89.9106	(217)
Fuel for water heating, kWh/month													
	188.1003	165.3944	172.7852	153.7875	150.5220	135.2999	128.3251	143.0511	143.5078	159.7291	170.1428	182.9814	(219)
Water heating fuel used												1893.6266	(219)
Annual totals kWh/year													
Space heating fuel - main system												3347.3490	(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)												336.2752	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.85 * 1029 * 1.00) =										-699.8470		-699.8470	(233)
Total delivered energy for all uses												4952.4038	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3347.3490	3.4800	116.4877	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1893.6266	3.4800	65.8982	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	336.2752	13.1900	44.3547	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-699.8470	13.1900	-92.3098	(252)
Total energy cost			264.3233	(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] =	0.9567	(257)
SAP value		86.6540	
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	3347.3490	0.2160	723.0274	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1893.6266	0.2160	409.0233	(264)
Space and water heating			1132.0507	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	336.2752	0.5190	174.5268	(268)
Energy saving/generation technologies				
PV Unit	-699.8470	0.5190	-363.2206	(269)
Total kg/year			982.2820	(272)
CO2 emissions per m2			13.8300	(273)
EI value			88.6569	
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 / 0.8878 = 3.920, stars = 4
Water heating environmental impact	0.216 / 0.8878 = 0.2433, 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	35.5200	(1b)	x 2.3900	(2b) =	84.8928	(1b) - (3b)
First floor	35.5200	(1c)	x 2.6100	(2c) =	92.7072	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.0400					(4)
Dwelling volume				(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =	177.6000	(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) =	0.1689	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4189	(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) =	0.3561	(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	0.4540	0.4184	0.4095	0.3828	0.3828	0.3561	0.3561	0.3472	0.3561	0.4006	0.3917	0.4184	(22b)
Effective ac	0.6031	0.5875	0.5838	0.5733	0.5733	0.5634	0.5634	0.5603	0.5634	0.5802	0.5767	0.5875	(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)			10.0900	1.1450	11.5534			(27)
Ground Floor			35.5200	0.1200	4.2624	90.0000	3196.8000	(28a)
Brick and Block	83.9700	12.2400	71.7300	0.2400	17.2152	42.2200	3028.4406	(29a)
Stepped Party Wall	1.5000		1.5000	0.2600	0.3900	60.0000	90.0000	(29a)
External Roof 1	35.5200		35.5200	0.1000	3.5520	9.1000	323.2320	(30)
Total net area of external elements Aum(A, m2)			156.5100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	39.3380			(33)
Party Wall 1			34.3400	0.0000	0.0000	110.0000	3777.4000	(32)
GF Timber Stud			63.1100			9.0000	567.9900	(32c)
FF Timber Stud			66.2000			9.0000	595.8000	(32c)
Internal Floor 1			35.5200			18.0000	639.3600	(32d)
Internal Ceiling 1			35.5200			18.0000	639.3600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12858.3826 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		181.0020 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		18.5626 (36)
Total fabric heat loss	(33) + (36) =	57.9006 (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	35.3441	34.4338	34.2178	33.5978	33.5978	33.0196	33.0196	32.8361	33.0196	34.0065	33.7998	34.4338	(38)
Heat transfer coeff	93.2447	92.3344	92.1184	91.4984	91.4984	90.9201	90.9201	90.7367	90.9201	91.9071	91.7004	92.3344	(39)
Average = Sum(39)m / 12 =												91.6778	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3126	1.2998	1.2967	1.2880	1.2880	1.2798	1.2798	1.2773	1.2798	1.2937	1.2908	1.2998	(40)
HLP (average)												1.2905	(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		2.2711 (42)
Average daily hot water use (litres/day)		88.1388 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	96.9527	93.4271	89.9016	86.3760	82.8505	79.3249	79.3249	82.8505	86.3760	89.9016	93.4271	96.9527	(44)
Energy conte	143.7780	125.7491	129.7619	113.1295	108.5505	93.6708	86.7998	99.6040	100.7936	117.4652	128.2225	139.2413	(45)

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

Energy content (annual) Total = Sum(45)m = 1386.7662 (45)
Distribution loss (46)m = 0.15 x (45)m

	21.5667	18.8624	19.4643	16.9694	16.2826	14.0506	13.0200	14.9406	15.1190	17.6198	19.2334	20.8862 (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	25.2901	22.8200	25.2287	24.3739	25.1566	24.3107	25.0997	25.1366	24.3452	25.1989	24.4335	25.2783 (61)

Total heat required for water heating calculated for each month

	169.0681	148.5691	154.9906	137.5035	133.7071	117.9815	111.8995	124.7406	125.1388	142.6641	152.6560	164.5196 (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

	169.0681	148.5691	154.9906	137.5035	133.7071	117.9815	111.8995	124.7406	125.1388	142.6641	152.6560	164.5196 (64)

Total per year (kWh/year) = Sum(64)m = 1683.4385 (64)
Heat gains from water heating, kWh/month

	54.1287	47.5166	49.4530	43.7091	42.3822	37.2232	35.1358	39.4025	39.6002	45.3569	48.7424	52.6173 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	(66)

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

	47.6032	42.2808	34.3850	26.0317	19.4590	16.4281	17.7511	23.0736	30.9693	39.3227	45.8954	48.9263 (67)

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

	298.0777	301.1708	293.3763	276.7826	255.8361	236.1493	222.9973	219.9042	227.6988	244.2924	265.2390	284.9257 (68)

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

	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977 (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)

	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443 (71)

Water heating gains (Table 5)

	72.7537	70.7092	66.4691	60.7070	56.9653	51.6989	47.2256	52.9603	55.0002	60.9636	67.6977	70.7222 (72)

Total internal gains

	517.7545	513.4807	493.5503	462.8412	431.5803	403.5962	387.2939	395.2580	412.9882	443.8986	478.1519	503.8941 (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	
Northeast	6.6000	15.0428	0.6300	0.7000	0.7700	30.3421	(75)
Southwest	3.4900	46.3896	0.6300	0.7000	0.7700	49.4786	(79)

Solar gains	79.8207	125.1263	193.7003	283.8247	337.4753	378.4267	349.6976	301.4636	236.2723	152.9940	96.6207	64.0501 (83)
Total gains	597.5752	638.6070	687.2506	746.6659	769.0555	782.0229	736.9916	696.7217	649.2605	596.8926	574.7726	567.9442 (84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C) 21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	38.3054	38.6830	38.7737	39.0365	39.0365	39.2847	39.2847	39.3642	39.2847	38.8629	38.9505	38.6830	
alpha	3.5537	3.5789	3.5849	3.6024	3.6024	3.6190	3.6190	3.6243	3.6190	3.5909	3.5967	3.5789	
util living area													
	0.9746	0.9672	0.9451	0.8915	0.7825	0.5953	0.4415	0.4635	0.7108	0.8945	0.9575	0.9776	(86)
MIT	19.5789	19.7009	19.9985	20.3816	20.7267	20.9284	20.9820	20.9790	20.8621	20.4901	20.0093	19.5687	(87)
Th 2	19.8310	19.8410	19.8434	19.8503	19.8503	19.8567	19.8567	19.8587	19.8567	19.8457	19.8480	19.8410	(88)
util rest of house													
	0.9681	0.9589	0.9307	0.8620	0.7216	0.4939	0.3121	0.3291	0.6153	0.8573	0.9447	0.9718	(89)
MIT 2	18.5813	18.7082	18.9999	19.3682	19.6726	19.8255	19.8526	19.8539	19.7876	19.4731	19.0183	18.5792	(90)
Living area fraction									fLA = Living area / (4) =			0.2500	(91)
MIT	18.8307	18.9564	19.2496	19.6216	19.9361	20.1012	20.1350	20.1352	20.0562	19.7273	19.2660	18.8266	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.8307	18.9564	19.2496	19.6216	19.9361	20.1012	20.1350	20.1352	20.0562	19.7273	19.2660	18.8266	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9609	0.9509	0.9215	0.8551	0.7267	0.5169	0.3446	0.3629	0.6337	0.8527	0.9364	0.9651	(94)
Useful gains	574.2374	607.2493	633.3331	638.4889	558.8486	404.2374	253.9831	252.8265	411.4366	508.9455	538.2408	548.1504	(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													
	1252.3389	1224.0176	1100.7755	916.9563	671.2434	427.4360	257.7546	257.2563	459.7101	728.5771	996.4195	1230.5042	(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													
	504.5075	414.4683	347.7772	200.4965	83.6217	0.0000	0.0000	0.0000	0.0000	163.4059	329.8887	507.6712	(98)
Space heating												2551.8370	(98)
Space heating per m2										(98) / (4) =		35.9211	(99)

8c. Space cooling requirement

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

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.7000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	2813.4918	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	504.5075	414.4683	347.7772	200.4965	83.6217	0.0000	0.0000	0.0000	0.0000	163.4059	329.8887	507.6712	(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)													
	556.2376	456.9662	383.4368	221.0546	92.1959	0.0000	0.0000	0.0000	0.0000	180.1609	363.7141	559.7257	(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													
	169.0681	148.5691	154.9906	137.5035	133.7071	117.9815	111.8995	124.7406	125.1388	142.6641	152.6560	164.5196	(64)
Efficiency of water heater												87.2000	(216)
(217)m	89.7953	89.7495	89.5914	89.2428	88.5142	87.2000	87.2000	87.2000	87.2000	89.0343	89.5628	89.8177	(217)
Fuel for water heating, kWh/month													
	188.2816	165.5376	172.9971	154.0780	151.0571	135.2999	128.3251	143.0511	143.5078	160.2351	170.4459	183.1706	(219)
Water heating fuel used												1895.9869	(219)
Annual totals kWh/year													
Space heating fuel - main system												2813.4918	(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)												336.2752	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.85 * 1182 * 1.00) =										-803.5605		-803.5605	(233)
Total delivered energy for all uses												4317.1934	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2813.4918	9.7400	274.0341	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1895.9869	9.7400	184.6691	(247)
Pumps and fans for heating	75.0000	36.8500	27.6375	(249)
Energy for lighting	336.2752	36.8500	123.9174	(250)
Additional standing charges			104.0000	(251)
Energy saving/generation technologies				
PV Unit	-803.5605	36.8500	-296.1120	(252)
Total energy cost			418.1461	(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	2813.4918	0.2160	607.7142	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1895.9869	0.2160	409.5332	(264)
Space and water heating			1017.2474	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	336.2752	0.5190	174.5268	(268)
Energy saving/generation technologies				
PV Unit	-803.5605	0.5190	-417.0479	(269)
Total kg/year			813.6513	(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	2813.4918	1.2200	3432.4600	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1895.9869	1.2200	2313.1040	(264)
Space and water heating			5745.5640	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	336.2752	3.0700	1032.3649	(268)
Energy saving/generation technologies				
PV Unit	-803.5605	3.0700	-2466.9306	(269)
Primary energy kWh/year			4541.2482	(272)
Primary energy kWh/m2/year			63.9252	(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	+ 1.3	-£ 77	-185 kg (22.7%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£77	2.60 kg/m²	B 88	B 91
Total Savings	£77	2.60 kg/m²		

Potential energy efficiency rating: B 88
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	£152	£170	-£18
Mains gas	£563	£468	£95
Space heating	£406	£406	£0
Water heating	£185	£108	£77
Lighting	£124	£124	£0
Generated (PV)	-£296	-£296	£0
Total cost of fuels	£419	£342	£77
Total cost of uses	£419	£342	£77
Delivered energy	61 kWh/m²	48 kWh/m²	13 kWh/m²
Carbon dioxide emissions	0.8 tonnes	0.6 tonnes	0.2 tonnes
CO2 emissions per m²	11 kg/m²	9 kg/m²	3 kg/m²
Primary energy	64 kWh/m²	49 kWh/m²	15 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	35.5200	(1b)	x 2.3900	(2b) =	84.8928	(1b) - (3b)
First floor	35.5200	(1c)	x 2.6100	(2c) =	92.7072	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.0400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		177.6000	(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) =	0.1689	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4189	(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) =	0.3561	(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	0.4540	0.4451	0.4362	0.3917	0.3828	0.3383	0.3383	0.3294	0.3561	0.3828	0.4006	0.4184	(22b)
Effective ac	0.6031	0.5991	0.5951	0.5767	0.5733	0.5572	0.5572	0.5542	0.5634	0.5733	0.5802	0.5875	(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)			10.0900	1.1450	11.5534			(27)
Ground Floor			35.5200	0.1200	4.2624	90.0000	3196.8000	(28a)
Brick and Block	83.9700	12.2400	71.7300	0.2400	17.2152	42.2200	3028.4406	(29a)
Stepped Party Wall	1.5000		1.5000	0.2600	0.3900	60.0000	90.0000	(29a)
External Roof 1	35.5200		35.5200	0.1000	3.5520	9.1000	323.2320	(30)
Total net area of external elements Aum(A, m2)			156.5100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	39.3380			(33)
Party Wall 1			34.3400	0.0000	0.0000	110.0000	3777.4000	(32)
GF Timber Stud			63.1100			9.0000	567.9900	(32c)
FF Timber Stud			66.2000			9.0000	595.8000	(32c)
Internal Floor 1			35.5200			18.0000	639.3600	(32d)
Internal Ceiling 1			35.5200			18.0000	639.3600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12858.3826 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		181.0020 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		18.5626 (36)
Total fabric heat loss	(33) + (36) =	57.9006 (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	35.3441	35.1096	34.8797	33.7998	33.5978	32.6573	32.6573	32.4831	33.0196	33.5978	34.0065	34.4338	(38)
Heat transfer coeff	93.2447	93.0102	92.7803	91.7004	91.4984	90.5579	90.5579	90.3837	90.9201	91.4984	91.9071	92.3344	(39)
Average = Sum(39)m / 12 =												91.6994	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3126	1.3093	1.3060	1.2908	1.2880	1.2747	1.2747	1.2723	1.2798	1.2880	1.2937	1.2998	(40)
HLP (average)												1.2908	(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		2.2711 (42)
Average daily hot water use (litres/day)		88.1388 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	96.9527	93.4271	89.9016	86.3760	82.8505	79.3249	79.3249	82.8505	86.3760	89.9016	93.4271	96.9527	(44)
Energy conte	143.7780	125.7491	129.7619	113.1295	108.5505	93.6708	86.7998	99.6040	100.7936	117.4652	128.2225	139.2413	(45)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Energy content (annual) Total = Sum(45)m = 1386.7662 (45)
Distribution loss (46)m = 0.15 x (45)m

	21.5667	18.8624	19.4643	16.9694	16.2826	14.0506	13.0200	14.9406	15.1190	17.6198	19.2334	20.8862 (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	25.2901	22.8200	25.2287	24.3739	25.1566	24.3107	25.0997	25.1366	24.3452	25.1989	24.4335	25.2783 (61)

Total heat required for water heating calculated for each month

	169.0681	148.5691	154.9906	137.5035	133.7071	117.9815	111.8995	124.7406	125.1388	142.6641	152.6560	164.5196 (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	1.3078 (H8)
Utilisation factor	0.5345 (H9)
Collector performance factor	0.8793 (H10)
Dedicated solar storage volume	75.0000 (H11)
Effective solar volume	75.0000 (H13)
Daily hot water demand	88.1388 (H14)
Volume ratio Veff/V	0.8509 (H15)
Solar storage volume factor	0.9677 (H16)
Solar input	-824.8455 (H17)

Solar input	-23.9189	-39.9137	-67.9776	-91.1034	-112.5506	-110.6552	-109.1928	-95.4023	-74.7192	-51.0244	-28.3712	-20.0160 (63)

Solar input (sum of months) = Sum(63)m = -824.8455 (63)
Output from w/h

	145.1493	108.6554	87.0130	46.4000	21.1564	7.3263	2.7066	29.3383	50.4196	91.6397	124.2848	144.5036 (64)

Total per year (kWh/year) = Sum(64)m = 858.5929 (64)
Heat gains from water heating, kWh/month

	54.1287	47.5166	49.4530	43.7091	42.3822	37.2232	35.1358	39.4025	39.6002	45.3569	48.7424	52.6173 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	136.2664	(66)

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

	47.6032	42.2808	34.3850	26.0317	19.4590	16.4281	17.7511	23.0736	30.9693	39.3227	45.8954	48.9263 (67)

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

	298.0777	301.1708	293.3763	276.7826	255.8361	236.1493	222.9973	219.9042	227.6988	244.2924	265.2390	284.9257 (68)

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

	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977	50.8977 (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)

	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443	-90.8443 (71)

Water heating gains (Table 5)

	72.7537	70.7092	66.4691	60.7070	56.9653	51.6989	47.2256	52.9603	55.0002	60.9636	67.6977	70.7222 (72)

Total internal gains

	517.7545	513.4807	493.5503	462.8412	431.5803	403.5962	387.2939	395.2580	412.9882	443.8986	478.1519	503.8941 (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	
Northeast	6.6000	11.2829	0.6300	0.7000	0.7700	22.7582	(75)
Southwest	3.4900	36.7938	0.6300	0.7000	0.7700	39.2439	(79)

Solar gains	62.0021	113.1719	174.9257	250.3970	311.1846	322.4466	305.2498	257.8336	200.7358	130.4929	75.6409	52.1701	(83)
Total gains	579.7566	626.6526	668.4760	713.2382	742.7649	726.0429	692.5437	653.0917	613.7240	574.3915	553.7928	556.0642	(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	38.3054	38.4020	38.4971	38.9505	39.0365	39.4419	39.4419	39.5179	39.2847	39.0365	38.8629	38.6830	
alpha	3.5537	3.5601	3.5665	3.5967	3.6024	3.6295	3.6295	3.6345	3.6190	3.6024	3.5909	3.5789	
util living area	0.9810	0.9733	0.9567	0.9161	0.8325	0.6885	0.5397	0.5855	0.7920	0.9287	0.9712	0.9835	(86)
MIT	19.3896	19.5529	19.8484	20.2531	20.6190	20.8691	20.9595	20.9451	20.7681	20.3150	19.7898	19.3590	(87)
Th 2	19.8310	19.8336	19.8361	19.8480	19.8503	19.8607	19.8607	19.8626	19.8567	19.8503	19.8457	19.8410	(88)
util rest of house	0.9765	0.9668	0.9456	0.8931	0.7843	0.5992	0.4151	0.4614	0.7173	0.9044	0.9630	0.9795	(89)
MIT 2	18.3939	18.5568	18.8486	19.2473	19.5829	19.7927	19.8478	19.8435	19.7202	19.3147	18.8017	18.3713	(90)
Living area fraction									fLA = Living area / (4) =			0.2500	(91)
MIT	18.6428	18.8058	19.0985	19.4987	19.8419	20.0618	20.1257	20.1189	19.9822	19.5648	19.0487	18.6182	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6428	18.8058	19.0985	19.4987	19.8419	20.0618	20.1257	20.1189	19.9822	19.5648	19.0487	18.6182	(93)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9703	0.9594	0.9367	0.8848	0.7839	0.6163	0.4456	0.4913	0.7267	0.8970	0.9557	0.9739	(94)
Useful gains	562.5310	601.2356	626.1763	631.0475	582.2411	447.4910	308.6289	320.8317	445.9812	515.2124	529.2406	541.5630	(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													
	1337.3918	1293.3824	1168.8964	971.9097	744.9725	494.6066	319.2820	336.1268	534.8073	820.2630	1098.1727	1331.2956	(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													
	576.4965	465.1226	403.7837	245.4208	121.0722	0.0000	0.0000	0.0000	0.0000	226.9576	409.6311	587.5610	(98)
Space heating												3036.0456	(98)
Space heating per m2											(98) / (4) =	42.7371	(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	3347.3490	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	576.4965	465.1226	403.7837	245.4208	121.0722	0.0000	0.0000	0.0000	0.0000	226.9576	409.6311	587.5610	(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)													
	635.6080	512.8144	445.1860	270.5852	133.4864	0.0000	0.0000	0.0000	0.0000	250.2289	451.6330	647.8071	(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													
	145.1493	108.6554	87.0130	46.4000	21.1564	7.3263	2.7066	29.3383	50.4196	91.6397	124.2848	144.5036	(64)
Efficiency of water heater												87.2000	(216)
(217)m	89.9736	90.0158	90.0591	90.1248	90.1617	87.2000	87.2000	87.2000	87.2000	89.6648	89.8604	89.9870	(217)
Fuel for water heating, kWh/month													
	161.3242	120.7070	96.6176	51.4842	23.4650	8.4018	3.1039	33.6448	57.8206	102.2025	138.3087	160.5826	(219)
Water heating fuel used												957.6629	(219)
Annual totals kWh/year													
Space heating fuel - main system												3347.3490	(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)												336.2752	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.85 * 1029 * 1.00) =										-699.8470		-699.8470	(233)
Total delivered energy for all uses												4066.4402	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3347.3490	3.4800	116.4877	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	957.6629	3.4800	33.3267	(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	336.2752	13.1900	44.3547	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-699.8470	13.1900	-92.3098	(252)
Total energy cost			238.3468	(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] =	0.8627	(257)
SAP value	87.9656	
SAP rating (Section 12)	88	(258)
SAP band	B	

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

	Energy	Emission factor	Emissions	

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	kWh/year	kg CO2/kWh	kg CO2/year	
Space heating - main system 1	3347.3490	0.2160	723.0274	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	957.6629	0.2160	206.8552	(264)
Space and water heating			929.8826	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	336.2752	0.5190	174.5268	(268)
Energy saving/generation technologies				
PV Unit	-699.8470	0.5190	-363.2206	(269)
Total kg/year			806.0638	(272)
CO2 emissions per m2			11.3500	(273)
EI value			90.6918	
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	35.5200	(1b)	x 2.3900	(2b) =	84.8928	(1b) - (3b)
First floor	35.5200	(1c)	x 2.6100	(2c) =	92.7072	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	71.0400					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		177.6000	(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) =	0.1689	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4189	(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) =	0.3561	(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	0.4540	0.4184	0.4095	0.3828	0.3828	0.3561	0.3561	0.3472	0.3561	0.4006	0.3917	0.4184	(22b)
Effective ac	0.6031	0.5875	0.5838	0.5733	0.5733	0.5634	0.5634	0.5603	0.5634	0.5802	0.5767	0.5875	(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)			10.0900	1.1450	11.5534			(27)
Ground Floor			35.5200	0.1200	4.2624	90.0000	3196.8000	(28a)
Brick and Block	83.9700	12.2400	71.7300	0.2400	17.2152	42.2200	3028.4406	(29a)
Stepped Party Wall	1.5000		1.5000	0.2600	0.3900	60.0000	90.0000	(29a)
External Roof 1	35.5200		35.5200	0.1000	3.5520	9.1000	323.2320	(30)
Total net area of external elements Aum(A, m2)			156.5100					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	39.3380			(33)
Party Wall 1			34.3400	0.0000	0.0000	110.0000	3777.4000	(32)
GF Timber Stud			63.1100			9.0000	567.9900	(32c)
FF Timber Stud			66.2000			9.0000	595.8000	(32c)
Internal Floor 1			35.5200			18.0000	639.3600	(32d)
Internal Ceiling 1			35.5200			18.0000	639.3600	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	12858.3826 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		181.0020 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		18.5626 (36)
Total fabric heat loss	(33) + (36) =	57.9006 (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	35.3441	34.4338	34.2178	33.5978	33.5978	33.0196	33.0196	32.8361	33.0196	34.0065	33.7998	34.4338	(38)
Heat transfer coeff	93.2447	92.3344	92.1184	91.4984	91.4984	90.9201	90.9201	90.7367	90.9201	91.9071	91.7004	92.3344	(39)
Average = Sum(39)m / 12 =												91.6778	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3126	1.2998	1.2967	1.2880	1.2880	1.2798	1.2798	1.2773	1.2798	1.2937	1.2908	1.2998	(40)
HLP (average)												1.2905	(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		2.2711 (42)
Average daily hot water use (litres/day)		88.1388 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	96.9527	93.4271	89.9016	86.3760	82.8505	79.3249	79.3249	82.8505	86.3760	89.9016	93.4271	96.9527	(44)
Energy conte	143.7780	125.7491	129.7619	113.1295	108.5505	93.6708	86.7998	99.6040	100.7936	117.4652	128.2225	139.2413	(45)

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

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Energy content (annual)                                                                        Total = Sum(45)m =    1386.7662 (45)
Distribution loss  (46)m = 0.15 x (45)m
                21.5667    18.8624    19.4643    16.9694    16.2826    14.0506    13.0200    14.9406    15.1190    17.6198    19.2334    20.8862 (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      25.2901    22.8200    25.2287    24.3739    25.1566    24.3107    25.0997    25.1366    24.3452    25.1989    24.4335    25.2783 (61)
Total heat required for water heating calculated for each month
               169.0681   148.5691   154.9906   137.5035   133.7071   117.9815   111.8995   124.7406   125.1388   142.6641   152.6560   164.5196 (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                                                                                                             1.4955 (H8)
Utilisation factor                                                                                                              0.4876 (H9)
Collector performance factor                                                                                                    0.8793 (H10)
Dedicated solar storage volume                                                                                                 75.0000 (H11)
Effective solar volume                                                                                                         75.0000 (H13)
Daily hot water demand                                                                                                         88.1388 (H14)
Volume ratio Veff/V                                                                                                             0.8509 (H15)
Solar storage volume factor                                                                                                     0.9677 (H16)
Solar input                                                                                                                  -860.4878 (H17)
Solar input    -28.2384   -40.3112   -68.3206   -93.2277  -110.0290  -117.0917  -112.7687  -100.6045   -79.6226   -54.5174   -33.1999   -22.5562 (63)
                                                                                  Solar input (sum of months) = Sum(63)m =   -860.4878 (63)
Output from w/h
               140.8297   108.2579    86.6700    44.2758    23.6781     0.8899     0.0000    24.1361    45.5162    88.1467   119.4561   141.9634 (64)
                                                                                    Total per year (kWh/year) = Sum(64)m =    823.8199 (64)
Heat gains from water heating, kWh/month
                54.1287    47.5166    49.4530    43.7091    42.3822    37.2232    35.1358    39.4025    39.6002    45.3569    48.7424    52.6173 (65)


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5. Internal gains (see Table 5 and 5a)
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Metabolic gains (Table 5), Watts
                   Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m          136.2664   136.2664   136.2664   136.2664   136.2664   136.2664   136.2664   136.2664   136.2664   136.2664   136.2664   136.2664 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                47.6032    42.2808    34.3850    26.0317    19.4590    16.4281    17.7511    23.0736    30.9693    39.3227    45.8954    48.9263 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               298.0777   301.1708   293.3763   276.7826   255.8361   236.1493   222.9973   219.9042   227.6988   244.2924   265.2390   284.9257 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                50.8977    50.8977    50.8977    50.8977    50.8977    50.8977    50.8977    50.8977    50.8977    50.8977    50.8977    50.8977 (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)
               -90.8443   -90.8443   -90.8443   -90.8443   -90.8443   -90.8443   -90.8443   -90.8443   -90.8443   -90.8443   -90.8443   -90.8443 (71)
Water heating gains (Table 5)
                72.7537    70.7092    66.4691    60.7070    56.9653    51.6989    47.2256    52.9603    55.0002    60.9636    67.6977    70.7222 (72)
Total internal gains
               517.7545   513.4807   493.5503   462.8412   431.5803   403.5962   387.2939   395.2580   412.9882   443.8986   478.1519   503.8941 (73)


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6. Solar gains
----------------------------------------------------------------------------------------------------
[Jan]                                        Area         Solar flux                g                FF              Access                Gains
                                               m2           Table 6a    Specific data     Specific data              factor                    W
                                                                W/m2      or Table 6b       or Table 6c            Table 6d
----------------------------------------------------------------------------------------------------
Northeast                                  6.6000            15.0428           0.6300            0.7000              0.7700              30.3421 (75)
Southwest                                  3.4900            46.3896           0.6300            0.7000              0.7700              49.4786 (79)
----------------------------------------------------------------------------------------------------

Solar gains     79.8207   125.1263   193.7003   283.8247   337.4753   378.4267   349.6976   301.4636   236.2723   152.9940    96.6207    64.0501 (83)
Total gains    597.5752   638.6070   687.2506   746.6659   769.0555   782.0229   736.9916   696.7217   649.2605   596.8926   574.7726   567.9442 (84)


----------------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
----------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                    21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                   Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau             38.3054    38.6830    38.7737    39.0365    39.0365    39.2847    39.2847    39.3642    39.2847    38.8629    38.9505    38.6830
alpha            3.5537     3.5789     3.5849     3.6024     3.6024     3.6190     3.6190     3.6243     3.6190     3.5909     3.5967     3.5789
util living area
                 0.9746     0.9672     0.9451     0.8915     0.7825     0.5953     0.4415     0.4635     0.7108     0.8945     0.9575     0.9776 (86)

MIT             19.5789    19.7009    19.9985    20.3816    20.7267    20.9284    20.9820    20.9790    20.8621    20.4901    20.0093    19.5687 (87)
Th 2            19.8310    19.8410    19.8434    19.8503    19.8503    19.8567    19.8567    19.8587    19.8567    19.8457    19.8480    19.8410 (88)
util rest of house
                 0.9681     0.9589     0.9307     0.8620     0.7216     0.4939     0.3121     0.3291     0.6153     0.8573     0.9447     0.9718 (89)
MIT 2           18.5813    18.7082    18.9999    19.3682    19.6726    19.8255    19.8526    19.8539    19.7876    19.4731    19.0183    18.5792 (90)
Living area fraction                                                                             fLA = Living area / (4) =      0.2500 (91)
MIT             18.8307    18.9564    19.2496    19.6216    19.9361    20.1012    20.1350    20.1352    20.0562    19.7273    19.2660    18.8266 (92)
Temperature adjustment                                                                                                          0.0000
adjusted MIT    18.8307    18.9564    19.2496    19.6216    19.9361    20.1012    20.1350    20.1352    20.0562    19.7273    19.2660    18.8266 (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	0.9609	0.9509	0.9215	0.8551	0.7267	0.5169	0.3446	0.3629	0.6337	0.8527	0.9364	0.9651	(94)
Useful gains	574.2374	607.2493	633.3331	638.4889	558.8486	404.2374	253.9831	252.8265	411.4366	508.9455	538.2408	548.1504	(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	1252.3389	1224.0176	1100.7755	916.9563	671.2434	427.4360	257.7546	257.2563	459.7101	728.5771	996.4195	1230.5042	(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	504.5075	414.4683	347.7772	200.4965	83.6217	0.0000	0.0000	0.0000	0.0000	163.4059	329.8887	507.6712	(98)
Space heating												2551.8370	(98)
Space heating per m2											(98) / (4) =	35.9211	(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	2813.4918	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	504.5075	414.4683	347.7772	200.4965	83.6217	0.0000	0.0000	0.0000	0.0000	163.4059	329.8887	507.6712	(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)													
	556.2376	456.9662	383.4368	221.0546	92.1959	0.0000	0.0000	0.0000	0.0000	180.1609	363.7141	559.7257	(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													
	140.8297	108.2579	86.6700	44.2758	23.6781	0.8899	0.0000	24.1361	45.5162	88.1467	119.4561	141.9634	(64)
Efficiency of water heater												87.2000	(216)
(217)m	89.9124	89.9523	89.9795	90.0462	89.9037	87.2000	87.2000	87.2000	87.2000	89.4420	89.7424	89.9114	(217)
Fuel for water heating, kWh/month													
	156.6298	120.3504	96.3220	49.1701	26.3371	1.0205	0.0000	27.6790	52.1974	98.5518	133.1100	157.8926	(219)
Water heating fuel used												919.2608	(219)
Annual totals kWh/year													
Space heating fuel - main system												2813.4918	(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)												336.2752	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 0.85 * 1182 * 1.00) =										-803.5605		-803.5605	(233)
Total delivered energy for all uses												3390.4673	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2813.4918	9.7400	274.0341	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	919.2608	9.7400	89.5360	(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	336.2752	36.8500	123.9174	(250)
Additional standing charges			104.0000	(251)
Energy saving/generation technologies				
PV Unit	-803.5605	36.8500	-296.1120	(252)
Total energy cost			341.4380	(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	2813.4918	0.2160	607.7142	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	919.2608	0.2160	198.5603	(264)
Space and water heating			806.2746	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	336.2752	0.5190	174.5268	(268)
Energy saving/generation technologies				
PV Unit	-803.5605	0.5190	-417.0479	(269)
Total kg/year			628.6285	(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	2813.4918	1.2200	3432.4600	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	919.2608	1.2200	1121.4982	(264)
Space and water heating			4553.9581	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	336.2752	3.0700	1032.3649	(268)
Energy saving/generation technologies				
PV Unit	-803.5605	3.0700	-2466.9306	(269)
Primary energy kWh/year			3503.1423	(272)
Primary energy kWh/m2/year			49.3123	(273)

U-VALUE CALCULATOR REPORT

Design SAP
elmhurst energy

Property Reference	SAP 0879 Plot 72	**Issued on Date**	28/03/2023
Assessment Reference	Rev A	**Prop Type Ref**	Beeley V5 (HA-SO)
Project	Plot 72		
Calculation Type	New Build (As Designed)		

SAP Rating	87 B	**DER**	15.87	**TER**	19.63
Environmental	89 B	**% DER<TER**	19.14		
CO_2 Emissions (t/year)	0.81	**DFEE**	54.34	**TFEE**	54.77
General Requirements Compliance	Pass	**% DFEE<TFEE**	0.79		

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 72	**Issued on Date**	28/03/2023
Assessment Reference	Rev A	**Prop Type Ref**	Beeley V5 (HA-SO)
Project	Plot 72		
Calculation Type	New Build (As Designed)		

SAP Rating	87 B	**DER**	15.87	**TER**	19.63
Environmental	89 B	**% DER<TER**	19.14		
CO_2 Emissions (t/year)	0.81	**DFEE**	54.34	**TFEE**	54.77
General Requirements Compliance	Pass	**% DFEE<TFEE**	0.79		

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 72	**Issued on Date**	28/03/2023
Assessment Reference	Rev A	**Prop Type Ref**	Beeley V5 (HA-SO)
Project	Plot 72		
Calculation Type	New Build (As Designed)		

SAP Rating	87 B	**DER**	15.87	**TER**	19.63
Environmental	89 B	**% DER<TER**	19.14		
CO_2 Emissions (t/year)	0.81	**DFEE**	54.34	**TFEE**	54.77
General Requirements Compliance	Pass	**% DFEE<TFEE**	0.79		

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 000009

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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Project	Plot 72		
Calculation Type	New Build (As Designed)		

SAP Rating	87 B	**DER**	15.87	**TER**	19.63
Environmental	89 B	**% DER<TER**	19.14		
CO_2 Emissions (t/year)	0.81	**DFEE**	54.34	**TFEE**	54.77
General Requirements Compliance	Pass	**% DFEE<TFEE**	0.79		

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 000008

Floor Type: Suspended Floor
Area = 42.22 m², Perimeter = 18.37 m, Wall thickness = 300.00 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 72	**Issued on Date**	28/03/2023
Assessment Reference	Rev A	**Prop Type Ref**	Beeley V5 (HA-SO)
Property	Plot 72		

SAP Rating	87 B	**DER**	15.87	**TER**	19.63
Environmental	89 B	**% DER<TER**	19.14		
CO_2 Emissions (t/year)	0.81	**DFEE**	54.34	**TFEE**	54.77
General Requirements Compliance	Pass	**% DFEE<TFEE**	0.79		

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	South West
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	2022
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:	24.59 m	35.52 m²	2.39 m
1st Storey:	16.80 m	35.52 m²	2.61 m

7.0 Living Area	17.76	m²
8.0 Thermal Mass Parameter	Precise calculation	
Thermal Mass	181	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	83.97	71.73
Stepped Party Wall	Cavity Wall	Cavity wall : plasterboard on dabs, AAC block, filled cavity, any outside structure	0.26	60.00	1.50	1.50

9.1 Party Walls

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Area (m²)
Party Wall 1	Filled Cavity with Edge Sealing	Single plasterboard on dabs both sides, lightweight aggregate blocks, cavity or cavity fill	0.00	110.00	34.34

9.2 Internal Walls

Description	Construction	Kappa (kJ/m²K)	Area (m²)
GF Timber Stud	Plasterboard on timber frame	9.00	63.11
FF Timber Stud	Plasterboard on timber frame	9.00	66.20

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	35.52	35.52

10.2 Internal Ceilings

Description	Construction	Kappa (kJ/m²K)	Area (m²)
Internal Ceiling 1	Plasterboard ceiling, carpeted chipboard floor	9.00	35.52

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	35.52

11.2 Internal Floors

Description	Construction	Kappa (kJ/m²K)	Area (m²)
Internal Floor 1	Plasterboard ceiling, carpeted chipboard floor	18.00	35.52

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	South West							2.15	
Front Elevation	Window	[1] Brick and Block	South West	None	0.00					3.49	
Rear Elevation	Window	[1] Brick and Block	North East	None	0.00					6.60	

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)	0.46	0.110	No	Birtley Supatherm
Independently assessed	E2 Other lintels (including other steel lintels)	5.46	0.910	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)	1.59	0.067	No	Birtley Supatherm
Independently assessed	E3 Sill	5.92	0.021	No	Knauf P5
Independently assessed	E4 Jamb	24.32	0.016	No	Knauf P6
Table K1 - Default	E5 Ground floor (normal)	24.59	0.320	No	
Independently assessed	E6 Intermediate floor within a dwelling	16.80	0.000	No	CD0029
Table K1 - Approved	E10 Eaves (insulation at ceiling level)	9.10	0.060	No	
Independently assessed	E12 Gable (insulation at ceiling level)	7.79	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	9.40	0.060	No	
Table K1 - Default	P1 Party wall - Ground floor	7.79	0.160	No	
Table K1 - Default	P2 Party wall - Intermediate floor within a dwelling	7.79	0.000	No	
Table K1 - Default	P4 Party wall - Roof (insulation at ceiling level)	7.79	0.240	No	

Y-value	0.119	W/m²K
18.0 Pressure Testing	Yes	
Designed AP_{50}	5.00	m³/(h.m²) @ 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	16	
Total number of L.E.L. fittings	16	
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
0.85	South 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	£77	B 88	