Energy Assessment

For the proposed development at:

17 Frognal, London, NW3 6AR

Energy Calculations Ltd
SAP ◆ CODE ◆ SBEM ◆ DESIGN
Marine Avenue
Skegness
Lincolnshire
PE25 3ER
Tel: 01754 761035
Email: info@energycalculations.co.uk
www.energycalculations.co.uk

Contents:

1. Background

The development to proposed 1 new detached dwelling at 17 Frognall London NW3 6AR.

The SAP calculations have been completed on SAP 2012 have been completed to achieve compliance with L1A and 19 % reduction in Co2 over building regulations , incorporating renewable energy

The U - values and the services applied are required to be confirmed that they are suitable of the proposed new dwellings.

2. PLANNING REQUIREDMENTS

Local

Camden Local Plan 2017, policies CC1 and CC2 of the Core strategy and Rural issues being a minimum reduction of 19 % in carbon emission rate below the normal Building Regulations requirements, and include renewable energy.

A reasoned statement of how the layout, orientation, design and materials used in the construction of the development can affect the consumption and use of energy.

2.1 National Policy

3.1.1 KYOTO PROTOCOL

The Kyoto Protocol is an international agreement linked to the United Nations Framework Convention on Climate Change. The major feature of the Kyoto Protocol is that it sets binding targets for 37 industrialized countries and the European community for reducing greenhouse gas (GHG) emissions .These amount to an average of five per cent against 1990 levels over the five-year period 2008-2012. The major distinction between the Protocol and the Convention is that while the Convention encouraged industrialised countries to stabilize GHG emissions, the Protocol commits them to do so.

3.1.2 BUILDING REGULATIONS – PART L 2013

This section of the building regulations deals with the conservation of energy in new domestic and commercial buildings; specifically the energy used for space heating/cooling, water heating, cooking, lighting and appliances. The methodology for the assessment of such has been adopted from the Building Research Establishment's Domestic Energy Model energy assessment method for the domestic portion of the building and Simplified Building Energy Model (SBEM) for the commercial units.

This method requires the calculation of a target emissions rate (TER), which assumes standard or typical building components and the calculation of the buildings actual emissions (DER for SAP). It is a requirement that the building's actual emissions will be lower than the target emission rate.

3.Building Regulations Compliance

Services Applied to the calculations are as follows

Please note the details below have been applied for the dwelling to comply with L1A building regulations, certain assumptions have been made and require to be confirmed. Please not these suggestion need to be clarified that they are suitable for the build, as they have only been applied for Part L building regulations, and for the purpose of efficiency only. Please could you confirm the details or forward any amendments required.

· Accredited construction details applied to table K1 *(can be down loaded from the planning portal to be uploaded and signed off during the construction*
of the build, completed forms are required for the as built SAP calculations, the ACDs that have been applied can be found within the calculations)
· 100 % Low energy lighting
· Air pressure test to achieve 5.00 or less
· Intermittent extract fans
· Time and temperature zone controls,
· Emitters- Under floor
· ***Air to water heat pump – Panasonic WH- MDCO5H3E5***
· Water cylinder minimum Heat loss
· 1.00 Kw peak photovoltaic panels facing South

With reference to the boiler this has been chosen for the efficiency only and needs to be clarified that its suitable for use, if an alternative is used please inform us and we will check the efficiencies as an alternative boiler could make the calculations fail L1A building regulations.

The U - Values below have been applied to the dwelling to achieve compliance with L1A

L1A compliance

Element	U – Value W/m2K	Element	U – Value W/m2K
Main Wall	**0.20**	**Floor**	**0.14**
Roof	**0.14**	**Windows**	**1.40**
Doors	**1.40**		

4. Calculations - Domestic - reduction in Co2 and renewables:

1.35 Kw peak photovoltaic panels facing South East

Table1

Plot	SAP rating	Environmental	TFEE kWh/m^2/yr	DFEE kWh/m^2/yr	% Reduction	TER kgCO$_2$/yr/m^2	DER kgCO$_2$/yr/m^2	% Reduction
1	86 B	87B	74.22	72.95	1.72	32.05	15.31	**52.23**

5: Design Considerations

Within the design the following consideration have been made that can affect the energy use of the development .

The orientation of the building is North / South , with openings on all elevations, this giving the advantage of solar gains, therefore reducing the heating requirement, and with the use of photovoltaic panels makes it more effective with the proposed flat roof .

Cycle Store this has been incorporated within the design, to encourage to the use of cycle usage, and reduce the Co2 associated with public or private transport.

Appendix 1

Energy Calculations Ltd

SAP ◆ CODE ◆ SBEM ◆ DESIGN

01754-761035

SAP Report Submission for Building Regulations Compliance

Client:

Project: 17, Frognal
LONDON, NW3 6AR

Contact: Matthew Carter
Energy Calculations Limited
mcarter@energycalculations.co.uk

Report Issue Date: 14/11/2019

EXCELLENCE IN ENERGY ASSESSMENT

PREDICTED ENERGY ASSESSMENT

Energy Calculations Ltd
SAP ◆ CODE ◆ SBEM ◆ DESIGN

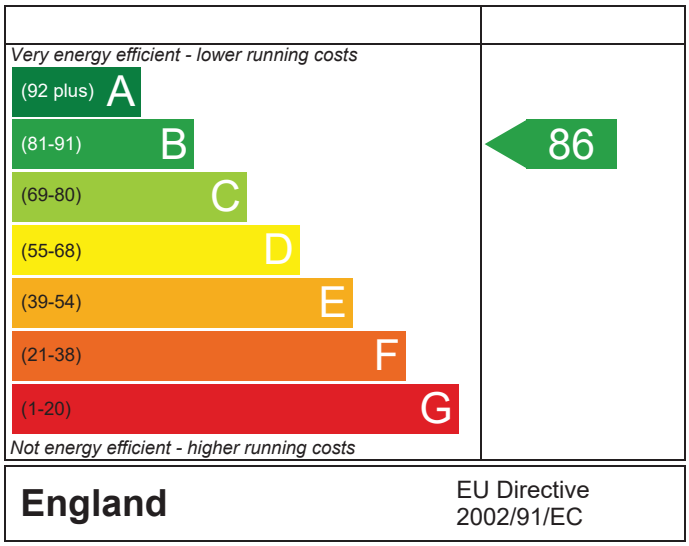
17, Frognal ,
LONDON,
NW3 6AR

Dwelling type:	Bungalow, Detached
Date of assessment:	14/11/2019
Produced by:	Energy Calculations Limited
Total floor area:	93.02 m²
DRRN:	9593-4983-9916

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.

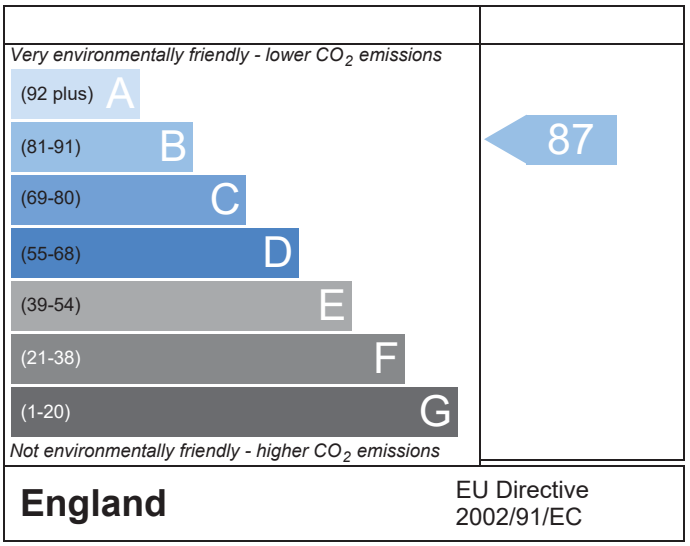
Energy Efficiency Rating



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.

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

Energy Calculations Ltd
SAP ◆ CODE ◆ SBEM ◆ DESIGN

Property Reference	014651c	Issued on Date	14/11/2019
Assessment Reference	001	Prop Type Ref	
Property	17, Frognal , LONDON, NW3 6AR		

SAP Rating	86 B	DER	15.31	TER	32.05
Environmental	87 B	% DER<TER	52.23		
CO_2 Emissions (t/year)	1.14	DFEE	72.95	TFEE	74.22
General Requirements Compliance	Pass	% DFEE<TFEE	1.72		

Assessor Details	Mr. Matthew Carter, Energy Calculations Limited, Tel: 01754 761035, mcarter@energycalculations.co.uk	Assessor ID	7869-0001
Client			

SUMARY FOR INPUT DATA FOR New Build (As Designed)

Criterion 1 – Achieving the TER and TFEE rate

1a TER and DER

Fuel for main heating	Electricity		
Fuel factor	1.55 (electricity)		
Target Carbon Dioxide Emission Rate (TER)	32.05	$kgCO_2/m^2$	
Dwelling Carbon Dioxide Emission Rate (DER)	15.31	$kgCO_2/m^2$	Pass
	-16.74 (-52.2%)	$kgCO_2/m^2$	

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	74.22	$kWh/m^2/yr$	
Dwelling Fabric Energy Efficiency (DFEE)	72.95	$kWh/m^2/yr$	
	-1.3 (-1.8%)	$kWh/m^2/yr$	Pass

Criterion 2 – Limits on design flexibility

Limiting Fabric Standards

2 Fabric U-values

Element	Average	Highest	
External wall	0.20 (max. 0.30)	0.20 (max. 0.70)	Pass
Floor	0.14 (max. 0.25)	0.14 (max. 0.70)	Pass
Roof	0.14 (max. 0.20)	0.14 (max. 0.35)	Pass
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	Pass

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

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

Limiting System Efficiencies

4 Heating efficiency

Main heating system	Heat pump with radiators or underfloor - Electric Panasonic WH-MDC05H3E5	

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.

Secondary heating system	None		
5 Cylinder insulation			
Hot water storage	Measured cylinder loss: 1.86 kWh/day Permitted by DBSCG 2.30		Pass
Primary pipework insulated	Yes		Pass
6 Controls			
Space heating controls	Time and temperature zone control		Pass
Hot water controls	Cylinderstat		Pass
	Independent timer for DHW		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 (Thames Valley)	Slight		Pass
Based on:			
Overshading	Average		
Windows facing North	6.08 m², No overhang		
Windows facing East	7.75 m², No overhang		
Windows facing South	11.50 m², No overhang		
Windows facing West	17.25 m², No overhang		
Air change rate	6.00 ach		
Blinds/curtains	None		

Criterion 4 – Building performance consistent with DER and DFEE rate

Air permeability and pressure testing

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

10 Key features

Photovoltaic array	1.00	kW	

THERMAL BRIDGING
Calculation Type: New Build (As Designed)

Energy Calculations Ltd
SAP ◆ CODE ◆ SBEM ◆ DESIGN

Property Reference	014651c	**Issued on Date**	14/11/2019
Assessment Reference	001	**Prop Type Ref**	
Property	17, Frognal , LONDON, NW3 6AR		

SAP Rating	86 B	**DER**	15.31	**TER**	32.05
Environmental	87 B	**% DER<TER**	52.23		
CO_2 Emissions (t/year)	1.14	**DFEE**	72.95	**TFEE**	74.22
General Requirements Compliance	Pass	**% DFEE<TFEE**	1.72		

Assessor Details	Mr. Matthew Carter, Energy Calculations Limited, Tel: 01754 761035, mcarter@energycalculations.co.uk	**Assessor ID**	7869-0001
Client			

	Junction detail	Source Type	Psi (W/mK)	Length (m)	Result	Reference
External wall	E2 Other lintels (including other steel lintels)	Table K1 - Approved	0.300	23.00	6.90	
External wall	E3 Sill	Table K1 - Approved	0.040	9.40	0.38	
External wall	E4 Jamb	Table K1 - Approved	0.050	56.20	2.81	
External wall	E5 Ground floor (normal)	Table K1 - Approved	0.160	43.40	6.94	
External wall	E14 Flat roof	Table K1 - Default	0.080	43.40	3.47	
External wall	E16 Corner (normal)	Table K1 - Approved	0.090	17.40	1.57	
External wall	E17 Corner (inverted – internal area greater than external area)	Table K1 - Approved	-0.090	5.80	-0.52	

Total: 21.55 **W/mK:**

Y-Value: 0.069 **W/m²K:**

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

Energy Calculations Ltd
SAP ◆ CODE ◆ SBEM ◆ DESIGN

Property Reference	014651c	**Issued on Date**	14/11/2019
Assessment Reference	001	**Prop Type Ref**	
Property	17, Frognal , LONDON, NW3 6AR		

SAP Rating	86 B	**DER**	15.31	**TER**	32.05
Environmental	87 B	**% DER<TER**	52.23		
CO_2 Emissions (t/year)	1.14	**DFEE**	72.95	**TFEE**	74.22
General Requirements Compliance	Pass	**% DFEE<TFEE**	1.72		

Assessor Details	Mr. Matthew Carter, Energy Calculations Limited, Tel: 01754 761035, mcarter@energycalculations.co.uk	**Assessor ID**	7869-0001
Client			

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

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

DWELLING AS DESIGNED

Detached Bungalow, total floor area 93 m²

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

1a TER and DER
Fuel for main heating:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 32.05 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 15.31 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)74.2 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)72.9 kWh/m²/yrOK

---
2 Fabric U-values

Element	Average	Highest	
External wall	0.20 (max. 0.30)	0.20 (max. 0.70)	OK
Floor	0.14 (max. 0.25)	0.14 (max. 0.70)	OK
Roof	0.14 (max. 0.20)	0.14 (max. 0.35)	OK
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	OK

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

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

---
4 Heating efficiency
Main heating system: Heat pump with radiators or underfloor - Electric
Panasonic WH-MDC05H3E5

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: Measured cylinder loss: 1.86 kWh/day
Permitted by DBSCG 2.30: OK
Primary pipework insulated: Yes OK

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

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

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

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing North: 6.08 m², No overhang
Windows facing East: 7.75 m², No overhang
Windows facing South: 11.50 m², No overhang
Windows facing West: 17.25 m², No overhang
Air change rate: 6.00 ach
Blinds/curtains: None

---
10 Key features
Photovoltaic array 1.00 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	93.0200 (1b)	x	2.9000 (2b)	=	269.7580	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.0200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	269.7580	(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							2 * 10 =	20.0000	(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) =	20.0000 / (5) =	0.0741	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3241	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3241	(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	0.4133	0.4052	0.3971	0.3566	0.3485	0.3079	0.3079	0.2998	0.3241	0.3485	0.3647	0.3809	(22b)
Effective ac	0.5854	0.5821	0.5788	0.5636	0.5607	0.5474	0.5474	0.5449	0.5525	0.5607	0.5665	0.5725	(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	
Door			2.5000	1.4000	3.5000			(26)
Windows (Uw = 1.40)			42.5800	1.3258	56.4508			(27)
Floor			93.0200	0.1400	13.0228	110.0000	10232.2000	(28a)
Main Walls	125.8600	45.0800	80.7800	0.2000	16.1560	60.0000	4846.8000	(29a)
Flat Roof	93.0200		93.0200	0.1400	13.0228	9.0000	837.1800	(30)
Total net area of external elements Aum(A, m2)			311.9000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		102.1524			(33)
Internal Wall 1			121.2200			9.0000	1090.9800	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		17007.1600	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							182.8334	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							21.5460	(36)
Total fabric heat loss					(33) + (36) =		123.6984	(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	52.1124	51.8172	51.5278	50.1687	49.9144	48.7307	48.7307	48.5114	49.1866	49.9144	50.4288	50.9666	(38)
Heat transfer coeff	175.8107	175.5155	175.2262	173.8670	173.6128	172.4290	172.4290	172.2098	172.8850	173.6128	174.1272	174.6650	(39)
Average = Sum(39)m / 12 =												173.8658	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.8900	1.8869	1.8837	1.8691	1.8664	1.8537	1.8537	1.8513	1.8586	1.8664	1.8719	1.8777	(40)
HLP (average)												1.8691	(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	2.6648	(42)
Average daily hot water use (litres/day)	97.4900	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.2390	103.3394	99.4398	95.5402	91.6406	87.7410	87.7410	91.6406	95.5402	99.4398	103.3394	107.2390	(44)
Energy conte	159.0323	139.0907	143.5291	125.1322	120.0673	103.6090	96.0089	110.1716	111.4874	129.9279	141.8264	154.0143	(45)
Energy content (annual)										Total = Sum(45)m =		1533.8973	(45)
Distribution loss (46)m = 0.15 x (45)m	23.8548	20.8636	21.5294	18.7698	18.0101	15.5413	14.4013	16.5257	16.7231	19.4892	21.2740	23.1021	(46)

Water storage loss:		
Store volume	210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):	1.8600	(48)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.0044	(55)
Total storage loss													
	31.1364	28.1232	31.1364	30.1320	31.1364	30.1320	31.1364	31.1364	30.1320	31.1364	30.1320	31.1364	(56)
If cylinder contains dedicated solar storage													
	31.1364	28.1232	31.1364	30.1320	31.1364	30.1320	31.1364	31.1364	30.1320	31.1364	30.1320	31.1364	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	213.4311	188.2251	197.9279	177.7762	174.4661	156.2530	150.4077	164.5704	164.1314	184.3267	194.4704	208.4131	(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													
	213.4311	188.2251	197.9279	177.7762	174.4661	156.2530	150.4077	164.5704	164.1314	184.3267	194.4704	208.4131	(64)
									Total per year (kWh/year) = Sum(64)m =			2174.3993	(64)
Heat gains from water heating, kWh/month													
	96.3973	85.5552	91.2425	83.7216	83.4414	76.5652	75.4420	80.1511	79.1848	86.7201	89.2725	94.7288	(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	133.2421	133.2421	133.2421	133.2421	133.2421	133.2421	133.2421	133.2421	133.2421	133.2421	133.2421	133.2421	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	21.7996	19.3622	15.7464	11.9211	8.9111	7.5231	8.1290	10.5664	14.1822	18.0076	21.0175	22.4055	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	244.5253	247.0628	240.6686	227.0561	209.8728	193.7229	182.9338	180.3964	186.7906	200.4031	217.5864	233.7362	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.3242	36.3242	36.3242	36.3242	36.3242	36.3242	36.3242	36.3242	36.3242	36.3242	36.3242	36.3242	(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)													
	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	(71)
Water heating gains (Table 5)													
	129.5663	127.3142	122.6377	116.2801	112.1524	106.3405	101.4005	107.7300	109.9789	116.5592	123.9896	127.3237	(72)
Total internal gains													
	458.8638	456.7119	442.0254	418.2299	393.9090	370.5592	355.4360	361.6655	373.9243	397.9425	425.5661	446.4380	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	6.0800	10.6334	0.6300	0.7000	0.7700	19.7582	(74)
East	7.7500	19.6403	0.6300	0.7000	0.7700	46.5180	(76)
South	11.5000	46.7521	0.6300	0.7000	0.7700	164.3124	(78)
West	17.2500	19.6403	0.6300	0.7000	0.7700	103.5400	(80)

Solar gains	334.1286	600.4056	890.3764	1195.5342	1406.6164	1421.6730	1360.4750	1202.0985	997.4710	683.5144	406.2452	281.8529	(83)
Total gains	792.9925	1057.1175	1332.4018	1613.7640	1800.5254	1792.2322	1715.9110	1563.7639	1371.3953	1081.4569	831.8113	728.2909	(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	26.8710	26.9162	26.9606	27.1714	27.2112	27.3980	27.3980	27.4329	27.3257	27.2112	27.1308	27.0473	
alpha	2.7914	2.7944	2.7974	2.8114	2.8141	2.8265	2.8265	2.8289	2.8217	2.8141	2.8087	2.8032	
util living area													
	0.9810	0.9589	0.9145	0.8262	0.6964	0.5445	0.4165	0.4672	0.6849	0.8896	0.9668	0.9848	(86)
Tweekday	17.0035	17.4108	17.9785	18.5969	19.0168	19.2280	19.2812	19.2759	19.1374	18.5437	17.6509	16.9332	
Tweekend	19.7925	19.9756	20.2353	20.5277	20.7460	20.8703	20.9150	20.9056	20.8030	20.4885	20.0774	19.7585	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	11	0	0	0	0	0	0	0	0	0	0	0	
MIT	19.4644	19.4153	19.8198	20.2625	20.6079	20.8008	20.8688	20.8544	20.6924	20.2106	19.5593	19.0840	(87)
Th 2	19.4077	19.4098	19.4120	19.4220	19.4239	19.4327	19.4327	19.4343	19.4293	19.4239	19.4201	19.4161	(88)
util rest of house													
	0.9757	0.9480	0.8921	0.7820	0.6219	0.4348	0.2788	0.3240	0.5800	0.8498	0.9560	0.9806	(89)
Tweekday	17.0035	17.4108	17.9785	18.5969	19.0168	19.2280	19.2812	19.2759	19.1374	18.5437	17.6509	16.9332	
Tweekend	17.0035	17.4108	17.9785	18.5969	19.0168	19.2280	19.2812	19.2759	19.1374	18.5437	17.6509	16.9332	
MIT 2	17.0035	17.4108	17.9785	18.5969	19.0168	19.2280	19.2812	19.2759	19.1374	18.5437	17.6509	16.9332	(90)
Living area fraction									fLA = Living area / (4) =			0.4406	(91)
MIT	18.0876	18.2939	18.7897	19.3307	19.7178	19.9209	19.9806	19.9713	19.8225	19.2781	18.4917	17.8807	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0876	18.2939	18.7897	19.3307	19.7178	19.9209	19.9806	19.9713	19.8225	19.2781	18.4917	17.8807	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9698	0.9380	0.8813	0.7790	0.6371	0.4711	0.3289	0.3758	0.6092	0.8453	0.9475	0.9749	(94)
Useful gains	769.0622	991.6158	1174.2330	1257.1735	1147.1417	844.3637	564.4230	587.6153	835.4820	914.1797	788.1593	709.9790	(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													
	2424.0136	2350.8358	2153.4713	1813.5475	1391.9860	917.4768	582.9176	615.0142	989.3311	1506.6234	1983.6032	2389.5412	(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													
	1231.2838	913.3958	728.5533	400.5892	182.1642	0.0000	0.0000	0.0000	0.0000	440.7781	860.7195	1249.5943	(98)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Space heating			6007.0782 (98)
Space heating per m2		(98) / (4) =	64.5784 (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 %)												264.0440	(206)
Efficiency of secondary/supplementary heating system, %												100.0000	(208)
Space heating requirement												2275.0289	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1231.2838	913.3958	728.5533	400.5892	182.1642	0.0000	0.0000	0.0000	0.0000	440.7781	860.7195	1249.5943	(98)
Space heating efficiency (main heating system 1)													
	264.0440	264.0440	264.0440	264.0440	264.0440	0.0000	0.0000	0.0000	0.0000	264.0440	264.0440	264.0440	(210)
Space heating fuel (main heating system)													
	466.3176	345.9256	275.9211	151.7130	68.9901	0.0000	0.0000	0.0000	0.0000	166.9336	325.9757	473.2522	(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													
	213.4311	188.2251	197.9279	177.7762	174.4661	156.2530	150.4077	164.5704	164.1314	184.3267	194.4704	208.4131	(64)
Efficiency of water heater												280.3450	(216)
(217)m	280.3450	280.3450	280.3450	280.3450	280.3450	280.3450	280.3450	280.3450	280.3450	280.3450	280.3450	280.3450	(217)
Fuel for water heating, kWh/month													
	76.1316	67.1405	70.6016	63.4134	62.2326	55.7360	53.6509	58.7028	58.5462	65.7499	69.3683	74.3417	(219)
Water heating fuel used												775.6155	(219)
Annual totals kWh/year													
Space heating fuel - main system												2275.0289	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
Total electricity for the above, kWh/year												0.0000	(231)
Electricity for lighting (calculated in Appendix L)												384.9880	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.00 * 1080 * 0.80) =										-690.8958		-690.8958	(233)
Total delivered energy for all uses												2744.7366	(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	2275.0289	0.5190	1180.7400	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	775.6155	0.5190	402.5444	(264)
Space and water heating			1583.2844	(265)
Pumps and fans	0.0000	0.0000	0.0000	(267)
Energy for lighting	384.9880	0.5190	199.8088	(268)
Energy saving/generation technologies				
PV Unit	-690.8958	0.5190	-358.5749	(269)
Total CO2, kg/year			1424.5183	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			15.3100	(273)

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

DER		15.3100	ZC1
Total Floor Area	TFA	93.0200	
Assumed number of occupants	N	2.6648	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.5774	ZC2
CO2 emissions from cooking, equation (L16)		1.9668	ZC3
Total CO2 emissions		32.8542	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		32.8542	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	93.0200 (1b)	x	2.9000 (2b)	=	269.7580	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.0200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	269.7580	(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) =	0.1112	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3612	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3612	(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	0.4605	0.4515	0.4425	0.3973	0.3883	0.3432	0.3432	0.3341	0.3612	0.3883	0.4064	0.4244	(22b)
Effective ac	0.6061	0.6019	0.5979	0.5789	0.5754	0.5589	0.5589	0.5558	0.5652	0.5754	0.5826	0.5901	(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			2.5000	1.0000	2.5000			(26)
TER Opening Type (Uw = 1.40)			20.7600	1.3258	27.5227			(27)
Floor			93.0200	0.1300	12.0926			(28a)
Main Walls	125.8600	23.2600	102.6000	0.1800	18.4680			(29a)
Flat Roof	93.0200		93.0200	0.1300	12.0926			(30)
Total net area of external elements Aum(A, m2)			311.9000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		72.6759			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	15.8900	(36)
Total fabric heat loss (33) + (36) =	88.5659	(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	53.9507	53.5841	53.2248	51.5370	51.2212	49.7512	49.7512	49.4790	50.3174	51.2212	51.8600	52.5279	(38)
Heat transfer coeff	142.5166	142.1500	141.7907	140.1029	139.7871	138.3172	138.3172	138.0449	138.8834	139.7871	140.4260	141.0938	(39)
Average = Sum(39)m / 12 =												140.1014	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.5321	1.5282	1.5243	1.5062	1.5028	1.4870	1.4870	1.4840	1.4930	1.5028	1.5096	1.5168	(40)
HLP (average)												1.5061	(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	2.6648	(42)
Average daily hot water use (litres/day)	97.4900	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.2390	103.3394	99.4398	95.5402	91.6406	87.7410	87.7410	91.6406	95.5402	99.4398	103.3394	107.2390	(44)
Energy conte	159.0323	139.0907	143.5291	125.1322	120.0673	103.6090	96.0089	110.1716	111.4874	129.9279	141.8264	154.0143	(45)
Energy content (annual)										Total = Sum(45)m =		1533.8973	(45)
Distribution loss (46)m = 0.15 x (45)m	23.8548	20.8636	21.5294	18.7698	18.0101	15.5413	14.4013	16.5257	16.7231	19.4892	21.2740	23.1021	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7016	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.9188	(55)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Total storage loss
28.4842 25.7277 28.4842 27.5653 28.4842 27.5653 28.4842 28.4842 27.5653 28.4842 27.5653 28.4842 (56)
If cylinder contains dedicated solar storage
28.4842 25.7277 28.4842 27.5653 28.4842 27.5653 28.4842 28.4842 27.5653 28.4842 27.5653 28.4842 (57)
Primary loss 23.2624 21.0112 23.2624 22.5120 23.2624 22.5120 23.2624 23.2624 22.5120 23.2624 22.5120 23.2624 (59)
Total heat required for water heating calculated for each month
210.7789 185.8295 195.2757 175.2095 171.8139 153.6863 147.7555 161.9182 161.5648 181.6745 191.9038 205.7609 (62)
Solar input 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 (63)
Solar input (sum of months) = Sum(63)m = 0.0000 (63)
Output from w/h
210.7789 185.8295 195.2757 175.2095 171.8139 153.6863 147.7555 161.9182 161.5648 181.6745 191.9038 205.7609 (64)
Total per year (kWh/year) = Sum(64)m = 2143.1716 (64)
Heat gains from water heating, kWh/month
94.2755 83.6387 89.1207 81.6683 81.3197 74.5119 73.3202 78.0293 77.1315 84.5983 87.2192 92.6070 (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	133.2421	133.2421	133.2421	133.2421	133.2421	133.2421	133.2421	133.2421	133.2421	133.2421	133.2421	133.2421	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	21.7992	19.3619	15.7461	11.9208	8.9110	7.5230	8.1289	10.5662	14.1819	18.0072	21.0171	22.4051	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	244.5253	247.0628	240.6686	227.0561	209.8728	193.7229	182.9338	180.3964	186.7906	200.4031	217.5864	233.7362	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.3242	36.3242	36.3242	36.3242	36.3242	36.3242	36.3242	36.3242	36.3242	36.3242	36.3242	36.3242	(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)													
	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	(71)
Water heating gains (Table 5)													
	126.7144	124.4624	119.7859	113.4282	109.3006	103.4887	98.5487	104.8782	107.1270	113.7074	121.1377	124.4718	(72)
Total internal gains													
	459.0116	456.8596	442.1732	418.3778	394.0570	370.7073	355.5840	361.8134	374.0722	398.0903	425.7138	446.5857	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.9600	10.6334	0.6300	0.7000	0.7700	9.6191	(74)
East	3.7800	19.6403	0.6300	0.7000	0.7700	22.6888	(76)
South	5.6100	46.7521	0.6300	0.7000	0.7700	80.1559	(78)
West	8.4100	19.6403	0.6300	0.7000	0.7700	50.4795	(80)

Solar gains 162.9433 292.7900 434.1764 582.9519 685.8522 693.1830 663.3483 586.1431 486.3894 333.3132 198.1107 137.4511 (83)
Total gains 621.9549 749.6497 876.3496 1001.3297 1079.9092 1063.8902 1018.9323 947.9565 860.4616 731.4035 623.8246 584.0368 (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	45.3261	45.4430	45.5582	46.1070	46.2111	46.7023	46.7023	46.7943	46.5118	46.2111	46.0009	45.7832	
alpha	4.0217	4.0295	4.0372	4.0738	4.0807	4.1135	4.1135	4.1196	4.1008	4.0807	4.0667	4.0522	
util living area													
	0.9967	0.9925	0.9814	0.9485	0.8699	0.7244	0.5662	0.6212	0.8447	0.9689	0.9934	0.9974	(86)
MIT	19.3385	19.5410	19.8696	20.2932	20.6579	20.8911	20.9699	20.9561	20.7800	20.2931	19.7376	19.3080	(87)
Th 2	19.6635	19.6664	19.6693	19.6829	19.6854	19.6973	19.6973	19.6995	19.6927	19.6854	19.6803	19.6749	(88)
util rest of house													
	0.9955	0.9898	0.9744	0.9279	0.8162	0.6158	0.4135	0.4680	0.7608	0.9525	0.9906	0.9965	(89)
MIT 2	17.4923	17.7890	18.2664	18.8753	19.3592	19.6278	19.6874	19.6830	19.5228	18.8888	18.0861	17.4551	(90)
Living area fraction									fLA = Living area / (4) =			0.4406	(91)
MIT	18.3057	18.5609	18.9727	19.5000	19.9313	20.1843	20.2524	20.2438	20.0767	19.5075	18.8137	18.2714	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3057	18.5609	18.9727	19.5000	19.9313	20.1843	20.2524	20.2438	20.0767	19.5075	18.8137	18.2714	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9937	0.9866	0.9695	0.9244	0.8278	0.6599	0.4815	0.5360	0.7892	0.9496	0.9879	0.9950	(94)
Useful gains	618.0085	739.6276	849.6029	925.5961	893.9391	702.0174	490.5678	508.0717	679.1015	694.5155	616.2602	581.1350	(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													
	1996.0414	1941.8914	1768.5161	1485.0840	1150.6335	772.4114	505.1857	530.6237	830.0582	1245.1480	1644.9077	1985.3859	(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													
	1025.2565	807.9213	683.6714	402.8313	190.9806	0.0000	0.0000	0.0000	0.0000	409.6706	740.6262	1044.7627	(98)
Space heating												5305.7206	(98)
Space heating per m2											(98) / (4) =	57.0385	(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 %)												93.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5674.5675	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1025.2565	807.9213	683.6714	402.8313	190.9806	0.0000	0.0000	0.0000	0.0000	409.6706	740.6262	1044.7627	(98)
Space heating efficiency (main heating system 1)													
	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000	(210)
Space heating fuel (main heating system)													
	1096.5310	864.0869	731.1994	430.8356	204.2573	0.0000	0.0000	0.0000	0.0000	438.1504	792.1136	1117.3933	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	210.7789	185.8295	195.2757	175.2095	171.8139	153.6863	147.7555	161.9182	161.5648	181.6745	191.9038	205.7609	(64)
Efficiency of water heater												79.8000	(216)
(217)m	88.4769	88.2863	87.8820	86.9655	85.0963	79.8000	79.8000	79.8000	79.8000	86.9194	88.0699	88.5465	(217)
Fuel for water heating, kWh/month													
	238.2303	210.4851	222.2021	201.4701	201.9052	192.5893	185.1573	202.9051	202.4621	209.0148	217.8995	232.3762	(219)
Water heating fuel used												2516.6971	(219)
Annual totals kWh/year													
Space heating fuel - main system												5674.5675	(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)												384.9806	(232)
Total delivered energy for all uses												8651.2452	(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	5674.5675	0.2160	1225.7066	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2516.6971	0.2160	543.6066	(264)
Space and water heating			1769.3132	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	384.9806	0.5190	199.8049	(268)
Total CO2, kg/m2/year			2008.0431	(272)
Emissions per m2 for space and water heating			19.0208	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			2.1480	(272b)
Emissions per m2 for pumps and fans			0.4185	(272c)
Target Carbon Dioxide Emission Rate (TER) = (19.0208 * 1.55) + 2.1480 + 0.4185, rounded to 2 d.p.			32.0500	(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	93.0200 (1b)	x	2.9000 (2b)	=	269.7580	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.0200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	269.7580	(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) =	0.1112	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3612	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3612	(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	0.4605	0.4515	0.4425	0.3973	0.3883	0.3432	0.3432	0.3341	0.3612	0.3883	0.4064	0.4244	(22b)
Effective ac	0.6061	0.6019	0.5979	0.5789	0.5754	0.5589	0.5589	0.5558	0.5652	0.5754	0.5826	0.5901	(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	
Door			2.5000	1.4000	3.5000			(26)
Windows (Uw = 1.40)			42.5800	1.3258	56.4508			(27)
Floor			93.0200	0.1400	13.0228	110.0000	10232.2000	(28a)
Main Walls	125.8600	45.0800	80.7800	0.2000	16.1560	60.0000	4846.8000	(29a)
Flat Roof	93.0200		93.0200	0.1400	13.0228	9.0000	837.1800	(30)
Total net area of external elements Aum(A, m2)			311.9000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	102.1524			(33)
Internal Wall 1			121.2200			9.0000	1090.9800	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		17007.1600	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							182.8334	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							21.5460	(36)
Total fabric heat loss					(33) + (36) =		123.6984	(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	53.9507	53.5841	53.2248	51.5370	51.2212	49.7512	49.7512	49.4790	50.3174	51.2212	51.8600	52.5279	(38)
Heat transfer coeff	177.6490	177.2824	176.9231	175.2353	174.9196	173.4496	173.4496	173.1774	174.0158	174.9196	175.5584	176.2262	(39)
Average = Sum(39)m / 12 =												175.2338	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.9098	1.9059	1.9020	1.8838	1.8805	1.8646	1.8646	1.8617	1.8707	1.8805	1.8873	1.8945	(40)
HLP (average)												1.8838	(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	2.6648	(42)
Average daily hot water use (litres/day)	97.4900	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.2390	103.3394	99.4398	95.5402	91.6406	87.7410	87.7410	91.6406	95.5402	99.4398	103.3394	107.2390	(44)
Energy conte	159.0323	139.0907	143.5291	125.1322	120.0673	103.6090	96.0089	110.1716	111.4874	129.9279	141.8264	154.0143	(45)
Energy content (annual)										Total = Sum(45)m =		1533.8973	(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 FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage

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

Heat gains from water heating, kWh/month

	33.7944	29.5568	30.4999	26.5906	25.5143	22.0169	20.4019	23.4115	23.6911	27.6097	30.1381	32.7280 (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	133.2421	133.2421	133.2421	133.2421	133.2421	133.2421	133.2421	133.2421	133.2421	133.2421	133.2421	133.2421	(66)

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

	21.7996	19.3622	15.7464	11.9211	8.9111	7.5231	8.1290	10.5664	14.1822	18.0076	21.0175	22.4055 (67)

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

	244.5253	247.0628	240.6686	227.0561	209.8728	193.7229	182.9338	180.3964	186.7906	200.4031	217.5864	233.7362 (68)

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

	36.3242	36.3242	36.3242	36.3242	36.3242	36.3242	36.3242	36.3242	36.3242	36.3242	36.3242	36.3242 (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)

	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937 (71)

Water heating gains (Table 5)

	45.4225	43.9833	40.9945	36.9314	34.2934	30.5790	27.4219	31.4670	32.9043	37.1098	41.8585	43.9893 (72)

Total internal gains

	374.7201	373.3809	360.3822	338.8812	316.0500	294.7977	281.4574	285.4025	296.8497	318.4931	343.4350	363.1037 (73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	6.0800	10.6334	0.6300	0.7000	0.7700	19.7582	(74)
East	7.7500	19.6403	0.6300	0.7000	0.7700	46.5180	(76)
South	11.5000	46.7521	0.6300	0.7000	0.7700	164.3124	(78)
West	17.2500	19.6403	0.6300	0.7000	0.7700	103.5400	(80)

Solar gains	334.1286	600.4056	890.3764	1195.5342	1406.6164	1421.6730	1360.4750	1202.0985	997.4710	683.5144	406.2452	281.8529	(83)
Total gains	708.8488	973.7865	1250.7586	1534.4153	1722.6664	1716.4707	1641.9324	1487.5010	1294.3207	1002.0075	749.6802	644.9565	(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	26.5929	26.6479	26.7021	26.9592	27.0079	27.2368	27.2368	27.2796	27.1482	27.0079	26.9096	26.8076	
alpha	2.7729	2.7765	2.7801	2.7973	2.8005	2.8158	2.8158	2.8186	2.8099	2.8005	2.7940	2.7872	
util living area	0.9856	0.9661	0.9255	0.8419	0.7154	0.5641	0.4344	0.4884	0.7093	0.9057	0.9741	0.9888	(86)
MIT	18.5270	18.9121	19.4627	20.0920	20.5676	20.8440	20.9451	20.9228	20.6894	20.0002	19.1273	18.4597	(87)
Th 2	19.3941	19.3968	19.3995	19.4119	19.4142	19.4251	19.4251	19.4271	19.4209	19.4142	19.4095	19.4046	(88)
util rest of house	0.9815	0.9569	0.9053	0.7998	0.6417	0.4522	0.2914	0.3401	0.6052	0.8700	0.9655	0.9856	(89)
MIT 2	17.2291	17.6093	18.1438	18.7381	19.1467	19.3584	19.4124	19.4070	19.2642	18.6794	17.8355	17.1695	(90)
Living area fraction									fLA = Living area / (4) =			0.4406	(91)
MIT	17.8009	18.1833	18.7249	19.3345	19.7726	20.0129	20.0876	20.0748	19.8920	19.2613	18.4046	17.7379	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.8009	18.1833	18.7249	19.3345	19.7726	20.0129	20.0876	20.0748	19.8920	19.2613	18.4046	17.7379	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9758	0.9476	0.8947	0.7974	0.6600	0.4966	0.3541	0.4046	0.6398	0.8657	0.9580	0.9808	(94)
Useful gains	691.6727	922.7769	1119.0908	1223.5852	1136.9364	852.4284	581.4435	601.7774	828.1336	867.4503	718.1670	632.5869	(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	2398.4190	2354.8899	2162.8619	1828.5016	1412.0638	938.8572	604.9282	636.3902	1007.9074	1515.0315	1984.6152	2385.7308	(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	1269.8192	962.3800	776.5657	435.5398	204.6948	0.0000	0.0000	0.0000	0.0000	481.8004	911.8427	1304.3391	(98)
Space heating												6346.9818	(98)
Space heating per m2											(98) / (4) =	68.2324	(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	1630.4261	1283.5269	1316.1479	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8240	0.8762	0.8465	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1343.4338	1124.5913	1114.0853	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2107.1721	2017.8964	1839.1324	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

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

```
                0.0000     0.0000     0.0000     0.0000     0.0000   549.8915   664.6189   539.4350     0.0000     0.0000     0.0000     0.0000 (104)
Space cooling                                                                                                                          1753.9455 (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   137.4729   166.1547   134.8588     0.0000     0.0000     0.0000     0.0000 (107)
Space cooling                                                                                                                           438.4864 (107)
Space cooling per m2                                                                                                                      4.7139 (108)
Energy for space heating                                                                                                                 68.2324 (99)
Energy for space cooling                                                                                                                  4.7139 (108)
Total                                                                                                                                    72.9463 (109)
Dwelling Fabric Energy Efficiency (DFEE)                                                                                                    72.9 (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	93.0200 (1b)	x	2.9000 (2b)	=	269.7580	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.0200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	269.7580	(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) =	0.1112	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3612	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3612	(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	0.4605	0.4515	0.4425	0.3973	0.3883	0.3432	0.3432	0.3341	0.3612	0.3883	0.4064	0.4244	(22b)
Effective ac	0.6061	0.6019	0.5979	0.5789	0.5754	0.5589	0.5589	0.5558	0.5652	0.5754	0.5826	0.5901	(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			2.5000	1.0000	2.5000			(26)
TER Opening Type (Uw = 1.40)			20.7600	1.3258	27.5227			(27)
Floor			93.0200	0.1300	12.0926			(28a)
Main Walls	125.8600	23.2600	102.6000	0.1800	18.4680			(29a)
Flat Roof	93.0200		93.0200	0.1300	12.0926			(30)
Total net area of external elements Aum(A, m2)			311.9000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	72.6759			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							15.8900	(36)
Total fabric heat loss					(33) + (36) =		88.5659	(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	53.9507	53.5841	53.2248	51.5370	51.2212	49.7512	49.7512	49.4790	50.3174	51.2212	51.8600	52.5279	(38)
Heat transfer coeff	142.5166	142.1500	141.7907	140.1029	139.7871	138.3172	138.3172	138.0449	138.8834	139.7871	140.4260	141.0938	(39)
Average = Sum(39)m / 12 =												140.1014	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.5321	1.5282	1.5243	1.5062	1.5028	1.4870	1.4870	1.4840	1.4930	1.5028	1.5096	1.5168	(40)
HLP (average)												1.5061	(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		2.6648 (42)
Average daily hot water use (litres/day)		97.4900 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.2390	103.3394	99.4398	95.5402	91.6406	87.7410	87.7410	91.6406	95.5402	99.4398	103.3394	107.2390	(44)
Energy conte	159.0323	139.0907	143.5291	125.1322	120.0673	103.6090	96.0089	110.1716	111.4874	129.9279	141.8264	154.0143	(45)
Energy content (annual)										Total = Sum(45)m =		1533.8973	(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)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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													
	33.7944	29.5568	30.4999	26.5906	25.5143	22.0169	20.4019	23.4115	23.6911	27.6097	30.1381	32.7280	(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	133.2421	133.2421	133.2421	133.2421	133.2421	133.2421	133.2421	133.2421	133.2421	133.2421	133.2421	133.2421	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	21.7992	19.3619	15.7461	11.9208	8.9110	7.5230	8.1289	10.5662	14.1819	18.0072	21.0171	22.4051	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	244.5253	247.0628	240.6686	227.0561	209.8728	193.7229	182.9338	180.3964	186.7906	200.4031	217.5864	233.7362	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	36.3242	36.3242	36.3242	36.3242	36.3242	36.3242	36.3242	36.3242	36.3242	36.3242	36.3242	36.3242	(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)													
	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	(71)
Water heating gains (Table 5)													
	45.4225	43.9833	40.9945	36.9314	34.2934	30.5790	27.4219	31.4670	32.9043	37.1098	41.8585	43.9893	(72)
Total internal gains													
	374.7197	373.3805	360.3819	338.8809	316.0498	294.7976	281.4572	285.4023	296.8495	318.4927	343.4346	363.1032	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.9600	10.6334	0.6300	0.7000	0.7700	9.6191	(74)
East	3.7800	19.6403	0.6300	0.7000	0.7700	22.6888	(76)
South	5.6100	46.7521	0.6300	0.7000	0.7700	80.1559	(78)
West	8.4100	19.6403	0.6300	0.7000	0.7700	50.4795	(80)

Solar gains	162.9433	292.7900	434.1764	582.9519	685.8522	693.1830	663.3483	586.1431	486.3894	333.3132	198.1107	137.4511	(83)
Total gains	537.6630	666.1705	794.5583	921.8329	1001.9020	987.9806	944.8055	871.5454	783.2388	651.8059	541.5453	500.5543	(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	45.3261	45.4430	45.5582	46.1070	46.2111	46.7023	46.7023	46.7943	46.5118	46.2111	46.0009	45.7832	
alpha	4.0217	4.0295	4.0372	4.0738	4.0807	4.1135	4.1135	4.1196	4.1008	4.0807	4.0667	4.0522	
util living area													
	0.9980	0.9951	0.9867	0.9600	0.8920	0.7580	0.6022	0.6617	0.8757	0.9787	0.9961	0.9986	(86)
MIT	19.2599	19.4644	19.7977	20.2318	20.6146	20.8703	20.9623	20.9445	20.7411	20.2260	19.6616	19.2297	(87)
Th 2	19.6635	19.6664	19.6693	19.6829	19.6854	19.6973	19.6973	19.6995	19.6927	19.6854	19.6803	19.6749	(88)
util rest of house													
	0.9973	0.9933	0.9815	0.9433	0.8440	0.6516	0.4437	0.5047	0.8006	0.9669	0.9943	0.9980	(89)
MIT 2	18.1029	18.3088	18.6415	19.0750	19.4287	19.6390	19.6885	19.6847	19.5505	19.0785	18.5166	18.0813	(90)
Living area fraction									fLA = Living area / (4) =			0.4406	(91)
MIT	18.6126	18.8179	19.1509	19.5846	19.9511	20.1814	20.2497	20.2397	20.0750	19.5840	19.0210	18.5872	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6126	18.8179	19.1509	19.5846	19.9511	20.1814	20.2497	20.2397	20.0750	19.5840	19.0210	18.5872	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9965	0.9917	0.9788	0.9417	0.8553	0.6950	0.5146	0.5748	0.8265	0.9657	0.9931	0.9974	(94)
Useful gains	535.8040	660.6471	777.7496	868.1003	856.9401	686.6458	486.2152	501.0018	647.3166	629.4306	537.8117	499.2572	(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													
	2039.7854	1978.4260	1793.7758	1496.9441	1153.4016	772.0051	504.8136	530.0518	829.8313	1255.8510	1674.0161	2029.9508	(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													
	1118.9622	885.5474	755.9235	452.7675	220.5674	0.0000	0.0000	0.0000	0.0000	466.0568	818.0672	1138.8360	(98)
Space heating												5856.7280	(98)
Space heating per m2											(98) / (4) =	62.9620	(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	1300.1812	1023.5469	1049.1415	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7902	0.8635	0.8298	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1027.3861	883.8376	870.5426	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1255.6898	1203.0725	1119.1841	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	164.3787	237.5108	184.9893	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												586.8787	(104)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

```
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   41.0947   59.3777   46.2473    0.0000    0.0000    0.0000    0.0000 (107)
Space cooling                                                                                                        146.7197 (107)
Space cooling per m2                                                                                                   1.5773 (108)
Energy for space heating                                                                                              62.9620 (99)
Energy for space cooling                                                                                               1.5773 (108)
Total                                                                                                                 64.5393 (109)
Target Fabric Energy Efficiency (TFEE)                                                                                  74.2 (109)


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

CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	93.0200 (1b)	x	2.9000 (2b)	=	269.7580	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.0200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	269.7580	(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							2 * 10 =	20.0000	(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) =	20.0000 / (5) =	0.0741	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3241	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3241	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.6000	4.5000	4.4000	4.1000	4.1000	3.7000	3.8000	3.7000	3.7000	4.0000	3.9000	4.3000	(22)
Wind factor	1.1500	1.1250	1.1000	1.0250	1.0250	0.9250	0.9500	0.9250	0.9250	1.0000	0.9750	1.0750	(22a)
Adj infilt rate	0.3728	0.3647	0.3566	0.3322	0.3322	0.2998	0.3079	0.2998	0.2998	0.3241	0.3160	0.3485	(22b)
Effective ac	0.5695	0.5665	0.5636	0.5552	0.5552	0.5449	0.5474	0.5449	0.5449	0.5525	0.5499	0.5607	(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	
Door			2.5000	1.4000	3.5000			(26)
Windows (Uw = 1.40)			42.5800	1.3258	56.4508			(27)
Floor			93.0200	0.1400	13.0228	110.0000	10232.2000	(28a)
Main Walls	125.8600	45.0800	80.7800	0.2000	16.1560	60.0000	4846.8000	(29a)
Flat Roof	93.0200		93.0200	0.1400	13.0228	9.0000	837.1800	(30)
Total net area of external elements Aum(A, m2)			311.9000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	102.1524			(33)
Internal Wall 1			121.2200			9.0000	1090.9800	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		17007.1600	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							182.8334	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							21.5460	(36)
Total fabric heat loss					(33) + (36) =		123.6984	(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	50.6948	50.4288	50.1687	49.4234	49.4234	48.5114	48.7307	48.5114	48.5114	49.1866	48.9557	49.9144	(38)
Heat transfer coeff	174.3932	174.1272	173.8670	173.1217	173.1217	172.2098	172.4290	172.2098	172.2098	172.8850	172.6541	173.6128	(39)
Average = Sum(39)m / 12 =												173.0701	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.8748	1.8719	1.8691	1.8611	1.8611	1.8513	1.8537	1.8513	1.8513	1.8586	1.8561	1.8664	(40)
HLP (average)												1.8606	(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	2.6648	(42)
Average daily hot water use (litres/day)	97.4900	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.2390	103.3394	99.4398	95.5402	91.6406	87.7410	87.7410	91.6406	95.5402	99.4398	103.3394	107.2390	(44)
Energy conte	159.0323	139.0907	143.5291	125.1322	120.0673	103.6090	96.0089	110.1716	111.4874	129.9279	141.8264	154.0143	(45)
Energy content (annual)										Total = Sum(45)m =		1533.8973	(45)
Distribution loss (46)m = 0.15 x (45)m	23.8548	20.8636	21.5294	18.7698	18.0101	15.5413	14.4013	16.5257	16.7231	19.4892	21.2740	23.1021	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.8600	(48)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Item	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ref
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.0044	(55)
Total storage loss	31.1364	28.1232	31.1364	30.1320	31.1364	30.1320	31.1364	31.1364	30.1320	31.1364	30.1320	31.1364	(56)
If cylinder contains dedicated solar storage	31.1364	28.1232	31.1364	30.1320	31.1364	30.1320	31.1364	31.1364	30.1320	31.1364	30.1320	31.1364	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month	213.4311	188.2251	197.9279	177.7762	174.4661	156.2530	150.4077	164.5704	164.1314	184.3267	194.4704	208.4131	(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	213.4311	188.2251	197.9279	177.7762	174.4661	156.2530	150.4077	164.5704	164.1314	184.3267	194.4704	208.4131	(64)
Total per year (kWh/year) = Sum(64)m =												2174.3993	(64)
RHI water heating demand												2174	(64)
Heat gains from water heating, kWh/month	96.3973	85.5552	91.2425	83.7216	83.4414	76.5652	75.4420	80.1511	79.1848	86.7201	89.2725	94.7288	(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	Ref
(66)m	159.8905	159.8905	159.8905	159.8905	159.8905	159.8905	159.8905	159.8905	159.8905	159.8905	159.8905	159.8905	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	54.4990	48.4056	39.3660	29.8026	22.2778	18.8079	20.3226	26.4160	35.4556	45.0190	52.5438	56.0137	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	364.9632	368.7504	359.2068	338.8897	313.2430	289.1387	273.0356	269.2484	278.7920	299.1091	324.7558	348.8601	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.6539	53.6539	53.6539	53.6539	53.6539	53.6539	53.6539	53.6539	53.6539	53.6539	53.6539	53.6539	(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)	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	(71)
Water heating gains (Table 5)	129.5663	127.3142	122.6377	116.2801	112.1524	106.3405	101.4005	107.7300	109.9789	116.5592	123.9896	127.3237	(72)
Total internal gains	655.9792	651.4209	628.1613	591.9231	554.6240	521.2378	501.7094	510.3452	531.1771	567.6380	608.2399	639.1482	(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	Ref
North	6.0800	11.5821	0.6300	0.7000	0.7700	21.5209	(74)
East	7.7500	21.5869	0.6300	0.7000	0.7700	51.1287	(76)
South	11.5000	49.2853	0.6300	0.7000	0.7700	173.2157	(78)
West	17.2500	21.5869	0.6300	0.7000	0.7700	113.8025	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ref
Solar gains	359.6679	580.7120	865.8347	1202.8075	1379.7008	1489.8736	1421.6730	1286.5356	1065.9159	722.4319	451.6817	297.8080	(83)
Total gains	1015.6471	1232.1329	1493.9960	1794.7307	1934.3248	2011.1115	1923.3824	1796.8807	1597.0930	1290.0699	1059.9215	936.9562	(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	Ref
tau	27.0894	27.1308	27.1714	27.2884	27.2884	27.4329	27.3980	27.4329	27.4329	27.3257	27.3623	27.2112	
alpha	2.8060	2.8087	2.8114	2.8192	2.8192	2.8289	2.8265	2.8289	2.8289	2.8217	2.8242	2.8141	
util living area	0.9607	0.9349	0.8722	0.7531	0.5903	0.3836	0.2387	0.2725	0.5294	0.8066	0.9305	0.9674	(86)
Tweekday	17.4513	17.7621	18.3353	18.8620	19.1695	19.2835	19.2931	19.2945	19.2518	18.8725	18.1102	17.3857	
Tweekend	19.9908	20.1328	20.4003	20.6618	20.8363	20.9183	20.9351	20.9334	20.8842	20.6540	20.2847	19.9590	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	11	0	0	0	0	0	0	0	0	0	0	0	
MIT	19.7166	19.6585	20.0745	20.4720	20.7474	20.8745	20.8999	20.8972	20.8192	20.4660	19.8831	19.3934	(87)
Th 2	19.4181	19.4201	19.4220	19.4275	19.4275	19.4343	19.4327	19.4343	19.4343	19.4293	19.4310	19.4239	(88)
util rest of house	0.9501	0.9180	0.8393	0.6938	0.4978	0.2636	0.1014	0.1275	0.4018	0.7416	0.9086	0.9584	(89)
Tweekday	17.4513	17.7621	18.3353	18.8620	19.1695	19.2835	19.2931	19.2945	19.2518	18.8725	18.1102	17.3857	
Tweekend	17.4513	17.7621	18.3353	18.8620	19.1695	19.2835	19.2931	19.2945	19.2518	18.8725	18.1102	17.3857	
MIT 2	17.4513	17.7621	18.3353	18.8620	19.1695	19.2835	19.2931	19.2945	19.2518	18.8725	18.1102	17.3857	(90)
Living area fraction — fLA = Living area / (4) =												0.4406	(91)
MIT	18.4493	18.5976	19.1015	19.5713	19.8647	19.9844	20.0010	20.0006	19.9423	19.5745	18.8912	18.2702	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4493	18.5976	19.1015	19.5713	19.8647	19.9844	20.0010	20.0006	19.9423	19.5745	18.8912	18.2702	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ref
Utilisation	0.9416	0.9069	0.8314	0.6999	0.5253	0.3071	0.1519	0.1809	0.4459	0.7486	0.8990	0.9496	(94)
Useful gains	956.3484	1117.4632	1242.1023	1256.0496	1016.0151	617.6751	292.0745	325.1278	712.1708	965.7630	952.8951	889.6897	(95)
Ext temp.	5.2000	5.7000	7.7000	10.2000	13.3000	16.3000	18.3000	18.1000	15.5000	11.9000	8.2000	5.2000	(96)
Heat loss rate W	2310.5860	2245.8144	1982.3453	1622.3697	1136.4852	634.4939	293.2968	327.2960	765.0107	1326.8065	1845.8823	2269.1503	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)

Space heating kWh

CALCULATION OF HEAT DEMAND 09 Jan 2014

	1007.5528	758.2520	550.7407	263.7505	89.6298	0.0000	0.0000	0.0000	0.0000	268.6164	642.9508	1026.3187 (98)
Space heating												4607.8117 (98)
RHI space heating demand												4608 (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	93.0200 (1b)	x	2.9000 (2b)	=	269.7580	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.0200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	269.7580	(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							2 * 10 =	20.0000	(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) =	20.0000 / (5) =	0.0741	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3241	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3241	(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	0.4133	0.4052	0.3971	0.3566	0.3485	0.3079	0.3079	0.2998	0.3241	0.3485	0.3647	0.3809	(22b)
Effective ac	0.5854	0.5821	0.5788	0.5636	0.5607	0.5474	0.5474	0.5449	0.5525	0.5607	0.5665	0.5725	(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	
Door			2.5000	1.4000	3.5000			(26)
Windows (Uw = 1.40)			42.5800	1.3258	56.4508			(27)
Floor			93.0200	0.1400	13.0228	110.0000	10232.2000	(28a)
Main Walls	125.8600	45.0800	80.7800	0.2000	16.1560	60.0000	4846.8000	(29a)
Flat Roof	93.0200		93.0200	0.1400	13.0228	9.0000	837.1800	(30)
Total net area of external elements Aum(A, m2)			311.9000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	102.1524			(33)
Internal Wall 1			121.2200			9.0000	1090.9800	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		17007.1600	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							182.8334	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							21.5460	(36)
Total fabric heat loss					(33) + (36) =		123.6984	(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	52.1124	51.8172	51.5278	50.1687	49.9144	48.7307	48.7307	48.5114	49.1866	49.9144	50.4288	50.9666	(38)
Heat transfer coeff	175.8107	175.5155	175.2262	173.8670	173.6128	172.4290	172.4290	172.2098	172.8850	173.6128	174.1272	174.6650	(39)
Average = Sum(39)m / 12 =												173.8658	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.8900	1.8869	1.8837	1.8691	1.8664	1.8537	1.8537	1.8513	1.8586	1.8664	1.8719	1.8777	(40)
HLP (average)												1.8691	(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	2.6648	(42)
Average daily hot water use (litres/day)	97.4900	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.2390	103.3394	99.4398	95.5402	91.6406	87.7410	87.7410	91.6406	95.5402	99.4398	103.3394	107.2390	(44)
Energy conte	159.0323	139.0907	143.5291	125.1322	120.0673	103.6090	96.0089	110.1716	111.4874	129.9279	141.8264	154.0143	(45)
Energy content (annual)										Total = Sum(45)m =		1533.8973	(45)
Distribution loss (46)m = 0.15 x (45)m	23.8548	20.8636	21.5294	18.7698	18.0101	15.5413	14.4013	16.5257	16.7231	19.4892	21.2740	23.1021	(46)

Water storage loss:		
Store volume	210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):	1.8600	(48)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.0044	(55)
Total storage loss													
	31.1364	28.1232	31.1364	30.1320	31.1364	30.1320	31.1364	31.1364	30.1320	31.1364	30.1320	31.1364	(56)
If cylinder contains dedicated solar storage													
	31.1364	28.1232	31.1364	30.1320	31.1364	30.1320	31.1364	31.1364	30.1320	31.1364	30.1320	31.1364	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	213.4311	188.2251	197.9279	177.7762	174.4661	156.2530	150.4077	164.5704	164.1314	184.3267	194.4704	208.4131	(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													
	213.4311	188.2251	197.9279	177.7762	174.4661	156.2530	150.4077	164.5704	164.1314	184.3267	194.4704	208.4131	(64)
								Total per year (kWh/year) = Sum(64)m =				2174.3993	(64)
Heat gains from water heating, kWh/month													
	96.3973	85.5552	91.2425	83.7216	83.4414	76.5652	75.4420	80.1511	79.1848	86.7201	89.2725	94.7288	(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	159.8905	159.8905	159.8905	159.8905	159.8905	159.8905	159.8905	159.8905	159.8905	159.8905	159.8905	159.8905	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	54.4990	48.4056	39.3660	29.8026	22.2778	18.8079	20.3226	26.4160	35.4556	45.0190	52.5438	56.0137	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	364.9632	368.7504	359.2068	338.8897	313.2430	289.1387	273.0356	269.2484	278.7920	299.1091	324.7558	348.8601	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.6539	53.6539	53.6539	53.6539	53.6539	53.6539	53.6539	53.6539	53.6539	53.6539	53.6539	53.6539	(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)													
	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	(71)
Water heating gains (Table 5)													
	129.5663	127.3142	122.6377	116.2801	112.1524	106.3405	101.4005	107.7300	109.9789	116.5592	123.9896	127.3237	(72)
Total internal gains													
	655.9792	651.4209	628.1613	591.9231	554.6240	521.2378	501.7094	510.3452	531.1771	567.6380	608.2399	639.1482	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	6.0800	10.6334	0.6300	0.7000	0.7700	19.7582	(74)
East	7.7500	19.6403	0.6300	0.7000	0.7700	46.5180	(76)
South	11.5000	46.7521	0.6300	0.7000	0.7700	164.3124	(78)
West	17.2500	19.6403	0.6300	0.7000	0.7700	103.5400	(80)

Solar gains	334.1286	600.4056	890.3764	1195.5342	1406.6164	1421.6730	1360.4750	1202.0985	997.4710	683.5144	406.2452	281.8529	(83)
Total gains	990.1079	1251.8266	1518.5377	1787.4573	1961.2404	1942.9108	1862.1844	1712.4436	1528.6481	1251.1524	1014.4851	921.0011	(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	26.8710	26.9162	26.9606	27.1714	27.2112	27.3980	27.3980	27.4329	27.3257	27.2112	27.1308	27.0473	
alpha	2.7914	2.7944	2.7974	2.8114	2.8141	2.8265	2.8265	2.8289	2.8217	2.8141	2.8087	2.8032	
util living area													
	0.9676	0.9400	0.8889	0.7944	0.6625	0.5120	0.3877	0.4330	0.6414	0.8548	0.9476	0.9730	(86)
Tweekday	17.2149	17.5983	18.1231	18.6835	19.0545	19.2386	19.2835	19.2797	19.1658	18.6536	17.8319	17.1446	
Tweekend	19.8881	20.0622	20.3051	20.5738	20.7702	20.8804	20.9189	20.9115	20.8250	20.5458	20.1611	19.8537	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	11	0	0	0	0	0	0	0	0	0	0	0	
MIT	19.5860	19.5493	19.9276	20.3346	20.6454	20.8162	20.8749	20.8634	20.7267	20.2990	19.6900	19.2309	(87)
Th 2	19.4077	19.4098	19.4120	19.4220	19.4239	19.4327	19.4327	19.4343	19.4293	19.4239	19.4201	19.4161	(88)
util rest of house													
	0.9591	0.9251	0.8618	0.7461	0.5868	0.4056	0.2579	0.2977	0.5357	0.8073	0.9317	0.9659	(89)
Tweekday	17.2149	17.5983	18.1231	18.6835	19.0545	19.2386	19.2835	19.2797	19.1658	18.6536	17.8319	17.1446	
Tweekend	17.2149	17.5983	18.1231	18.6835	19.0545	19.2386	19.2835	19.2797	19.1658	18.6536	17.8319	17.1446	
MIT 2	17.2149	17.5983	18.1231	18.6835	19.0545	19.2386	19.2835	19.2797	19.1658	18.6536	17.8319	17.1446	(90)
Living area fraction									fLA = Living area / (4) =			0.4406	(91)
MIT	18.2595	18.4578	18.9180	19.4109	19.7553	19.9337	19.9846	19.9774	19.8534	19.3785	18.6505	18.0637	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2595	18.4578	18.9180	19.4109	19.7553	19.9337	19.9846	19.9774	19.8534	19.3785	18.6505	18.0637	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9511	0.9137	0.8517	0.7457	0.6041	0.4414	0.3052	0.3467	0.5669	0.8057	0.9217	0.9577	(94)
Useful gains	941.6891	1143.8197	1293.3665	1332.9888	1184.7131	857.6456	568.3329	593.7400	866.5358	1008.0145	935.0803	882.0328	(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													
	2454.2283	2379.6028	2175.9656	1827.4966	1398.5094	919.6768	583.5965	616.0619	994.6847	1524.0592	2011.2605	2421.5084	(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													
	1125.3291	830.4463	656.6537	356.0456	159.0644	0.0000	0.0000	0.0000	0.0000	383.9372	774.8498	1145.3699	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Space heating 5431.6961 (98)
Space heating per m2 (98) / (4) = 58.3928 (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 %) 264.0440 (206)
Efficiency of secondary/supplementary heating system, % 100.0000 (208)
Space heating requirement 2057.1174 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1125.3291	830.4463	656.6537	356.0456	159.0644	0.0000	0.0000	0.0000	0.0000	383.9372	774.8498	1145.3699	(98)
Space heating efficiency (main heating system 1)													
	264.0440	264.0440	264.0440	264.0440	264.0440	0.0000	0.0000	0.0000	0.0000	264.0440	264.0440	264.0440	(210)
Space heating fuel (main heating system)													
	426.1899	314.5105	248.6910	134.8433	60.2416	0.0000	0.0000	0.0000	0.0000	145.4065	293.4548	433.7799	(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

	213.4311	188.2251	197.9279	177.7762	174.4661	156.2530	150.4077	164.5704	164.1314	184.3267	194.4704	208.4131	(64)
Efficiency of water heater												280.3450	(216)
(217)m	280.3450	280.3450	280.3450	280.3450	280.3450	280.3450	280.3450	280.3450	280.3450	280.3450	280.3450	280.3450	(217)
Fuel for water heating, kWh/month													
	76.1316	67.1405	70.6016	63.4134	62.2326	55.7360	53.6509	58.7028	58.5462	65.7499	69.3683	74.3417	(219)
Water heating fuel used												775.6155	(219)

Annual totals kWh/year
Space heating fuel - main system 2057.1174 (211)
Space heating fuel - secondary 0.0000 (215)

Electricity for pumps and fans:
Total electricity for the above, kWh/year 0.0000 (231)
Electricity for lighting (calculated in Appendix L) 384.9880 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV Unit 0 (0.80 * 1.00 * 1080 * 0.80) = -690.8958 -690.8958 (233)
Total delivered energy for all uses 2526.8251 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2057.1174	13.1900	271.3338	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	775.6155	13.1900	102.3037	(247)
Pumps and fans for heating	0.0000	0.0000	0.0000	(249)
Energy for lighting	384.9880	13.1900	50.7799	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-690.8958	13.1900	-91.1292	(252)
Total energy cost			333.2882	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12): 0.4200 (256)
Energy cost factor (ECF) [(255) x (256)] / [(4) + 45.0] = 1.0142 (257)
SAP value 85.8518
SAP rating (Section 12) 86 (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	2057.1174	0.5190	1067.6439	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	775.6155	0.5190	402.5444	(264)
Space and water heating			1470.1884	(265)
Pumps and fans	0.0000	0.0000	0.0000	(267)
Energy for lighting	384.9880	0.5190	199.8088	(268)
Energy saving/generation technologies				
PV Unit	-690.8958	0.5190	-358.5749	(269)
Total kg/year			1311.4222	(272)
CO2 emissions per m2			14.1000	(273)
EI value			87.2677	
EI rating			87	(274)
EI band			B	

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency	13.19 × (1 + 0.29 × 0.25) / 2.6404 = 5.358, stars = 3
Main heating environmental impact	0.519 × (1 + 0.29 × 0.25) / 2.6404 = 0.2108, stars = 5
Water heating energy efficiency	13.19 / 2.8035 = 4.705, stars = 4
Water heating environmental impact	0.519 / 2.8035 = 0.1851, stars = 5

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	93.0200 (1b)	x	2.9000 (2b)	=	269.7580	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.0200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	269.7580	(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							2 * 10 =	20.0000	(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) =	20.0000 / (5) =	0.0741	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3241	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3241	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.6000	4.5000	4.4000	4.1000	4.1000	3.7000	3.8000	3.7000	3.7000	4.0000	3.9000	4.3000	(22)
Wind factor	1.1500	1.1250	1.1000	1.0250	1.0250	0.9250	0.9500	0.9250	0.9250	1.0000	0.9750	1.0750	(22a)
Adj infilt rate	0.3728	0.3647	0.3566	0.3322	0.3322	0.2998	0.3079	0.2998	0.2998	0.3241	0.3160	0.3485	(22b)
Effective ac	0.5695	0.5665	0.5636	0.5552	0.5552	0.5449	0.5474	0.5449	0.5449	0.5525	0.5499	0.5607	(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	
Door			2.5000	1.4000	3.5000			(26)
Windows (Uw = 1.40)			42.5800	1.3258	56.4508			(27)
Floor			93.0200	0.1400	13.0228	110.0000	10232.2000	(28a)
Main Walls	125.8600	45.0800	80.7800	0.2000	16.1560	60.0000	4846.8000	(29a)
Flat Roof	93.0200		93.0200	0.1400	13.0228	9.0000	837.1800	(30)
Total net area of external elements Aum(A, m2)			311.9000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	102.1524			(33)
Internal Wall 1			121.2200			9.0000	1090.9800	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		17007.1600	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							182.8334	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							21.5460	(36)
Total fabric heat loss					(33) + (36) =		123.6984	(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	50.6948	50.4288	50.1687	49.4234	49.4234	48.5114	48.7307	48.5114	48.5114	49.1866	48.9557	49.9144	(38)
Heat transfer coeff	174.3932	174.1272	173.8670	173.1217	173.1217	172.2098	172.4290	172.2098	172.2098	172.8850	172.6541	173.6128	(39)
Average = Sum(39)m / 12 =												173.0701	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.8748	1.8719	1.8691	1.8611	1.8611	1.8513	1.8537	1.8513	1.8513	1.8586	1.8561	1.8664	(40)
HLP (average)												1.8606	(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		2.6648 (42)
Average daily hot water use (litres/day)		97.4900 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.2390	103.3394	99.4398	95.5402	91.6406	87.7410	87.7410	91.6406	95.5402	99.4398	103.3394	107.2390	(44)
Energy conte	159.0323	139.0907	143.5291	125.1322	120.0673	103.6090	96.0089	110.1716	111.4874	129.9279	141.8264	154.0143	(45)
Energy content (annual)										Total = Sum(45)m =		1533.8973	(45)
Distribution loss (46)m = 0.15 x (45)m	23.8548	20.8636	21.5294	18.7698	18.0101	15.5413	14.4013	16.5257	16.7231	19.4892	21.2740	23.1021	(46)

Water storage loss:		
Store volume		210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):		1.8600 (48)

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

Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.0044	(55)
Total storage loss													
	31.1364	28.1232	31.1364	30.1320	31.1364	30.1320	31.1364	31.1364	30.1320	31.1364	30.1320	31.1364	(56)
If cylinder contains dedicated solar storage													
	31.1364	28.1232	31.1364	30.1320	31.1364	30.1320	31.1364	31.1364	30.1320	31.1364	30.1320	31.1364	(57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	213.4311	188.2251	197.9279	177.7762	174.4661	156.2530	150.4077	164.5704	164.1314	184.3267	194.4704	208.4131	(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													
	213.4311	188.2251	197.9279	177.7762	174.4661	156.2530	150.4077	164.5704	164.1314	184.3267	194.4704	208.4131	(64)
								Total per year (kWh/year) = Sum(64)m =				2174.3993	(64)
Heat gains from water heating, kWh/month													
	96.3973	85.5552	91.2425	83.7216	83.4414	76.5652	75.4420	80.1511	79.1848	86.7201	89.2725	94.7288	(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	159.8905	159.8905	159.8905	159.8905	159.8905	159.8905	159.8905	159.8905	159.8905	159.8905	159.8905	159.8905	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	54.4990	48.4056	39.3660	29.8026	22.2778	18.8079	20.3226	26.4160	35.4556	45.0190	52.5438	56.0137	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	364.9632	368.7504	359.2068	338.8897	313.2430	289.1387	273.0356	269.2484	278.7920	299.1091	324.7558	348.8601	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.6539	53.6539	53.6539	53.6539	53.6539	53.6539	53.6539	53.6539	53.6539	53.6539	53.6539	53.6539	(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)													
	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	(71)
Water heating gains (Table 5)													
	129.5663	127.3142	122.6377	116.2801	112.1524	106.3405	101.4005	107.7300	109.9789	116.5592	123.9896	127.3237	(72)
Total internal gains													
	655.9792	651.4209	628.1613	591.9231	554.6240	521.2378	501.7094	510.3452	531.1771	567.6380	608.2399	639.1482	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	6.0800	11.5821	0.6300	0.7000	0.7700	21.5209	(74)
East	7.7500	21.5869	0.6300	0.7000	0.7700	51.1287	(76)
South	11.5000	49.2853	0.6300	0.7000	0.7700	173.2157	(78)
West	17.2500	21.5869	0.6300	0.7000	0.7700	113.8025	(80)

Solar gains	359.6679	580.7120	865.8347	1202.8075	1379.7008	1489.8736	1421.6730	1286.5356	1065.9159	722.4319	451.6817	297.8080	(83)
Total gains	1015.6471	1232.1329	1493.9960	1794.7307	1934.3248	2011.1115	1923.3824	1796.8807	1597.0930	1290.0699	1059.9215	936.9562	(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	27.0894	27.1308	27.1714	27.2884	27.2884	27.4329	27.3980	27.4329	27.4329	27.3257	27.3623	27.2112	
alpha	2.8060	2.8087	2.8114	2.8192	2.8192	2.8289	2.8265	2.8289	2.8289	2.8217	2.8242	2.8141	
util living area													
	0.9607	0.9349	0.8722	0.7531	0.5903	0.3836	0.2387	0.2725	0.5294	0.8066	0.9305	0.9674	(86)
Tweekday	17.4513	17.7621	18.3353	18.8620	19.1695	19.2835	19.2931	19.2945	19.2518	18.8725	18.1102	17.3857	
Tweekend	19.9908	20.1328	20.4003	20.6618	20.8363	20.9183	20.9351	20.9334	20.8842	20.6540	20.2847	19.9590	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	11	0	0	0	0	0	0	0	0	0	0	0	
MIT	19.7166	19.6585	20.0745	20.4720	20.7474	20.8745	20.8999	20.8972	20.8192	20.4660	19.8831	19.3934	(87)
Th 2	19.4181	19.4201	19.4220	19.4275	19.4275	19.4343	19.4327	19.4343	19.4343	19.4293	19.4310	19.4239	(88)
util rest of house													
	0.9501	0.9180	0.8393	0.6938	0.4978	0.2636	0.1014	0.1275	0.4018	0.7416	0.9086	0.9584	(89)
Tweekday	17.4513	17.7621	18.3353	18.8620	19.1695	19.2835	19.2931	19.2945	19.2518	18.8725	18.1102	17.3857	
Tweekend	17.4513	17.7621	18.3353	18.8620	19.1695	19.2835	19.2931	19.2945	19.2518	18.8725	18.1102	17.3857	
MIT 2	17.4513	17.7621	18.3353	18.8620	19.1695	19.2835	19.2931	19.2945	19.2518	18.8725	18.1102	17.3857	(90)
Living area fraction									fLA = Living area / (4) =			0.4406	(91)
MIT	18.4493	18.5976	19.1015	19.5713	19.8647	19.9844	20.0010	20.0006	19.9423	19.5745	18.8912	18.2702	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4493	18.5976	19.1015	19.5713	19.8647	19.9844	20.0010	20.0006	19.9423	19.5745	18.8912	18.2702	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9416	0.9069	0.8314	0.6999	0.5253	0.3071	0.1519	0.1809	0.4459	0.7486	0.8990	0.9496	(94)
Useful gains	956.3484	1117.4632	1242.1023	1256.0496	1016.0151	617.6751	292.0745	325.1278	712.1708	965.7630	952.8951	889.6897	(95)
Ext temp.	5.2000	5.7000	7.7000	10.2000	13.3000	16.3000	18.3000	18.1000	15.5000	11.9000	8.2000	5.2000	(96)
Heat loss rate W													
	2310.5860	2245.8144	1982.3453	1622.3697	1136.4852	634.4939	293.2968	327.2960	765.0107	1326.8065	1845.8823	2269.1503	(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													
	1007.5528	758.2520	550.7407	263.7505	89.6298	0.0000	0.0000	0.0000	0.0000	268.6164	642.9508	1026.3187	(98)

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

Space heating 4607.8117 (98)
Space heating per m2 (98) / (4) = 49.5357 (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 %) 264.0307 (206)
Efficiency of secondary/supplementary heating system, % 100.0000 (208)
Space heating requirement 1745.1805 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1007.5528	758.2520	550.7407	263.7505	89.6298	0.0000	0.0000	0.0000	0.0000	268.6164	642.9508	1026.3187	(98)
Space heating efficiency (main heating system 1)													
	264.0307	264.0307	264.0307	264.0307	264.0307	0.0000	0.0000	0.0000	0.0000	264.0307	264.0307	264.0307	(210)
Space heating fuel (main heating system)													
	381.6045	287.1833	208.5897	99.8939	33.9467	0.0000	0.0000	0.0000	0.0000	101.7368	243.5137	388.7119	(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													
	213.4311	188.2251	197.9279	177.7762	174.4661	156.2530	150.4077	164.5704	164.1314	184.3267	194.4704	208.4131	(64)
Efficiency of water heater												280.3450	(216)
(217)m	280.3450	280.3450	280.3450	280.3450	280.3450	280.3450	280.3450	280.3450	280.3450	280.3450	280.3450	280.3450	(217)
Fuel for water heating, kWh/month													
	76.1316	67.1405	70.6016	63.4134	62.2326	55.7360	53.6509	58.7028	58.5462	65.7499	69.3683	74.3417	(219)
Water heating fuel used												775.6155	(219)
Annual totals kWh/year													
Space heating fuel - main system												1745.1805	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
Total electricity for the above, kWh/year												0.0000	(231)
Electricity for lighting (calculated in Appendix L)												384.9880	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.00 * 1118 * 0.80) =										-715.7312		-715.7312	(233)
Total delivered energy for all uses												2190.0528	(238)

10a. Fuel costs - using BEDF prices (451)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1745.1805	17.5600	306.4537	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	775.6155	17.5600	136.1981	(247)
Pumps and fans for heating	0.0000	0.0000	0.0000	(249)
Energy for lighting	384.9880	17.5600	67.6039	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-715.7312	17.5600	-125.6824	(252)
Total energy cost			384.5733	(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	1745.1805	0.5190	905.7487	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	775.6155	0.5190	402.5444	(264)
Space and water heating			1308.2931	(265)
Pumps and fans	0.0000	0.0000	0.0000	(267)
Energy for lighting	384.9880	0.5190	199.8088	(268)
Energy saving/generation technologies				
PV Unit	-715.7312	0.5190	-371.4645	(269)
Total kg/year			1136.6374	(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	1745.1805	3.0700	5357.7042	(261)
Space heating - secondary	0.0000	3.0700	0.0000	(263)
Water heating (other fuel)	775.6155	3.0700	2381.1396	(264)
Space and water heating			7738.8438	(265)
Pumps and fans	0.0000	0.0000	0.0000	(267)
Energy for lighting	384.9880	3.0700	1181.9131	(268)
Energy saving/generation technologies				

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

PV Unit	-715.7312	3.0700	-2197.2948 (269)
Primary energy kWh/year			6723.4620 (272)
Primary energy kWh/m2/year			72.2797 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 86
Current environmental impact rating: B 87

(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	+ 1.6	-£ 50	-147 kg (12.9%)

		Typical annual savings		Energy efficiency	Environmental impact
Recommended measures					
Solar water heating		£50	1.58 kg/m²	B 87	B 89
	Total Savings	£50	1.58 kg/m²		

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

Fuel prices for cost data on this page from database revision number 451 TEST (05 Nov 2019)
Recommendation texts revision number 4.9c (22 Feb 2014)

Typical heating and lighting costs of this home (per year, Thames Valley):

	Current	Potential	Saving
Electricity	£510	£460	£50
Space heating	£306	£307	-£0
Water heating	£136	£86	£50
Lighting	£68	£68	£0
Generated (PV)	-£126	-£126	£0
Total cost of fuels	£384	£334	£50
Total cost of uses	£384	£335	£50
Delivered energy	24 kWh/m²	20 kWh/m²	3 kWh/m²
Carbon dioxide emissions	1.1 tonnes	1.0 tonnes	0.1 tonnes
CO2 emissions per m²	12 kg/m²	11 kg/m²	2 kg/m²
Primary energy	72 kWh/m²	63 kWh/m²	9 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	93.0200 (1b)	x	2.9000 (2b)	=	269.7580	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.0200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	269.7580	(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							2 * 10 =	20.0000	(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) =	20.0000 / (5) =	0.0741	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3241	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3241	(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	0.4133	0.4052	0.3971	0.3566	0.3485	0.3079	0.3079	0.2998	0.3241	0.3485	0.3647	0.3809	(22b)
Effective ac	0.5854	0.5821	0.5788	0.5636	0.5607	0.5474	0.5474	0.5449	0.5525	0.5607	0.5665	0.5725	(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	
Door			2.5000	1.4000	3.5000			(26)
Windows (Uw = 1.40)			42.5800	1.3258	56.4508			(27)
Floor			93.0200	0.1400	13.0228	110.0000	10232.2000	(28a)
Main Walls	125.8600	45.0800	80.7800	0.2000	16.1560	60.0000	4846.8000	(29a)
Flat Roof	93.0200		93.0200	0.1400	13.0228	9.0000	837.1800	(30)
Total net area of external elements Aum(A, m2)			311.9000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	102.1524			(33)
Internal Wall 1			121.2200			9.0000	1090.9800	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		17007.1600	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							182.8334	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							21.5460	(36)
Total fabric heat loss					(33) + (36) =		123.6984	(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	52.1124	51.8172	51.5278	50.1687	49.9144	48.7307	48.7307	48.5114	49.1866	49.9144	50.4288	50.9666	(38)
Heat transfer coeff	175.8107	175.5155	175.2262	173.8670	173.6128	172.4290	172.4290	172.2098	172.8850	173.6128	174.1272	174.6650	(39)
Average = Sum(39)m / 12 =												173.8658	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.8900	1.8869	1.8837	1.8691	1.8664	1.8537	1.8537	1.8513	1.8586	1.8664	1.8719	1.8777	(40)
HLP (average)												1.8691	(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	2.6648	(42)
Average daily hot water use (litres/day)	97.4900	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.2390	103.3394	99.4398	95.5402	91.6406	87.7410	87.7410	91.6406	95.5402	99.4398	103.3394	107.2390	(44)
Energy conte	159.0323	139.0907	143.5291	125.1322	120.0673	103.6090	96.0089	110.1716	111.4874	129.9279	141.8264	154.0143	(45)
Energy content (annual)										Total = Sum(45)m =		1533.8973	(45)
Distribution loss (46)m = 0.15 x (45)m	23.8548	20.8636	21.5294	18.7698	18.0101	15.5413	14.4013	16.5257	16.7231	19.4892	21.2740	23.1021	(46)

Water storage loss:		
Store volume	210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):	1.8600	(48)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												1.0044	(55)
Total storage loss													
	31.1364	28.1232	31.1364	30.1320	31.1364	30.1320	31.1364	31.1364	30.1320	31.1364	30.1320	31.1364	(56)
If cylinder contains dedicated solar storage													
	31.1364	28.1232	31.1364	30.1320	31.1364	30.1320	31.1364	31.1364	30.1320	31.1364	30.1320	31.1364	(57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month													
	213.4311	188.2251	196.5322	171.0226	161.6718	143.6462	137.3808	152.4740	158.7286	182.9309	194.4704	208.4131	(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												1.1823	(H8)
Utilisation factor												0.5708	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												97.4900	(H14)
Volume ratio Veff/V												0.7693	(H15)
Solar storage volume factor												0.9475	(H16)
Solar input												-862.4655	(H17)
Solar input	-25.0098	-41.7341	-71.0780	-95.2585	-117.6839	-115.7020	-114.1730	-99.7535	-78.1270	-53.3515	-29.6652	-20.9289	(63)
								Solar input (sum of months) = Sum(63)m =				-862.4655	(63)
Output from w/h													
	188.4213	146.4910	125.4542	75.7640	43.9879	27.9442	23.2078	52.7205	80.6016	129.5794	164.8052	187.4842	(64)
								Total per year (kWh/year) = Sum(64)m =				1246.4613	(64)
Heat gains from water heating, kWh/month													
	96.3973	85.5552	90.1259	78.3188	73.2060	66.4798	65.0205	70.4740	74.8625	85.6035	89.2725	94.7288	(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	159.8905	159.8905	159.8905	159.8905	159.8905	159.8905	159.8905	159.8905	159.8905	159.8905	159.8905	159.8905	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	54.4990	48.4056	39.3660	29.8026	22.2778	18.8079	20.3226	26.4160	35.4556	45.0190	52.5438	56.0137	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	364.9632	368.7504	359.2068	338.8897	313.2430	289.1387	273.0356	269.2484	278.7920	299.1091	324.7558	348.8601	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	53.6539	53.6539	53.6539	53.6539	53.6539	53.6539	53.6539	53.6539	53.6539	53.6539	53.6539	53.6539	(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)													
	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	(71)
Water heating gains (Table 5)													
	129.5663	127.3142	121.1369	108.7761	98.3951	92.3331	87.3931	94.7231	103.9757	115.0584	123.9896	127.3237	(72)
Total internal gains													
	655.9792	651.4209	626.6605	584.4191	540.8667	507.2304	487.7019	497.3382	525.1739	566.1372	608.2399	639.1482	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	6.0800	10.6334	0.6300	0.7000	0.7700	19.7582	(74)
East	7.7500	19.6403	0.6300	0.7000	0.7700	46.5180	(76)
South	11.5000	46.7521	0.6300	0.7000	0.7700	164.3124	(78)
West	17.2500	19.6403	0.6300	0.7000	0.7700	103.5400	(80)

Solar gains	334.1286	600.4056	890.3764	1195.5342	1406.6164	1421.6730	1360.4750	1202.0985	997.4710	683.5144	406.2452	281.8529	(83)
Total gains	990.1079	1251.8266	1517.0369	1779.9533	1947.4831	1928.9034	1848.1770	1699.4367	1522.6449	1249.6516	1014.4851	921.0011	(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	26.8710	26.9162	26.9606	27.1714	27.2112	27.3980	27.3980	27.4329	27.3257	27.2112	27.1308	27.0473	
alpha	2.7914	2.7944	2.7974	2.8114	2.8141	2.8265	2.8265	2.8289	2.8217	2.8141	2.8087	2.8032	
util living area													
	0.9676	0.9400	0.8891	0.7958	0.6654	0.5148	0.3903	0.4358	0.6429	0.8551	0.9476	0.9730	(86)
Tweekday	17.2149	17.5983	18.1220	18.6800	19.0515	19.2378	19.2833	19.2794	19.1648	18.6527	17.8319	17.1446	
Tweekend	19.8881	20.0622	20.3046	20.5720	20.7683	20.8795	20.9186	20.9110	20.8242	20.5453	20.1611	19.8537	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	11	0	0	0	0	0	0	0	0	0	0	0	
MIT	19.5860	19.5493	19.9267	20.3316	20.6424	20.8149	20.8744	20.8627	20.7255	20.2983	19.6900	19.2309	(87)
Th 2	19.4077	19.4098	19.4120	19.4220	19.4239	19.4327	19.4327	19.4343	19.4293	19.4239	19.4201	19.4161	(88)
util rest of house													
	0.9591	0.9251	0.8621	0.7477	0.5897	0.4082	0.2597	0.2998	0.5372	0.8077	0.9317	0.9659	(89)
Tweekday	17.2149	17.5983	18.1220	18.6800	19.0515	19.2378	19.2833	19.2794	19.1648	18.6527	17.8319	17.1446	
Tweekend	17.2149	17.5983	18.1220	18.6800	19.0515	19.2378	19.2833	19.2794	19.1648	18.6527	17.8319	17.1446	
MIT 2	17.2149	17.5983	18.1220	18.6800	19.0515	19.2378	19.2833	19.2794	19.1648	18.6527	17.8319	17.1446	(90)
Living area fraction										fLA = Living area / (4) =		0.4406	(91)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

MIT	18.2595	18.4578	18.9171	19.4076	19.7524	19.9326	19.9842	19.9769	19.8524	19.3777	18.6505	18.0637	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2595	18.4578	18.9171	19.4076	19.7524	19.9326	19.9842	19.9769	19.8524	19.3777	18.6505	18.0637	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9511	0.9137	0.8520	0.7472	0.6068	0.4440	0.3073	0.3491	0.5684	0.8060	0.9217	0.9577	(94)
Useful gains	941.6891	1143.8197	1292.4540	1329.9141	1181.7320	856.5247	567.9995	593.2666	865.4730	1007.2425	935.0803	882.0328	(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	2454.2283	2379.6028	2175.7936	1826.9339	1397.9946	919.4916	583.5385	615.9809	994.5026	1523.9164	2011.2605	2421.5084	(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	1125.3291	830.4463	657.2046	357.8543	160.8994	0.0000	0.0000	0.0000	0.0000	384.4054	774.8498	1145.3699	(98)
Space heating												5436.3588	(98)
Space heating per m2											(98) / (4) =	58.4429	(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 %)												264.0440	(206)
Efficiency of secondary/supplementary heating system, %												100.0000	(208)
Space heating requirement												2058.8833	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1125.3291	830.4463	657.2046	357.8543	160.8994	0.0000	0.0000	0.0000	0.0000	384.4054	774.8498	1145.3699	(98)
Space heating efficiency (main heating system 1)	264.0440	264.0440	264.0440	264.0440	264.0440	0.0000	0.0000	0.0000	0.0000	264.0440	264.0440	264.0440	(210)
Space heating fuel (main heating system)	426.1899	314.5105	248.8996	135.5282	60.9366	0.0000	0.0000	0.0000	0.0000	145.5838	293.4548	433.7799	(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	188.4213	146.4910	125.4542	75.7640	43.9879	27.9442	23.2078	52.7205	80.6016	129.5794	164.8052	187.4842	(64)
Efficiency of water heater												280.3450	(216)
(217)m	280.3450	280.3450	280.3450	280.3450	280.3450	280.3450	280.3450	280.3450	280.3450	280.3450	280.3450	280.3450	(217)
Fuel for water heating, kWh/month	67.2105	52.2538	44.7499	27.0253	15.6906	9.9678	8.2783	18.8056	28.7509	46.2214	58.7866	66.8762	(219)
Water heating fuel used												444.6169	(219)
Annual totals kWh/year													
Space heating fuel - main system												2058.8833	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												50.0000	(231)
Electricity for lighting (calculated in Appendix L)												384.9880	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.00 * 1080 * 0.80) =										-690.8958		-690.8958	(233)
Total delivered energy for all uses												2247.5925	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	2058.8833	13.1900	271.5667	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	444.6169	13.1900	58.6450	(247)
Pumps and fans for heating	0.0000	0.0000	0.0000	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	384.9880	13.1900	50.7799	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-690.8958	13.1900	-91.1292	(252)
Total energy cost			296.4574	(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] =	0.9021	(257)
SAP value		87.4153	
SAP rating (Section 12)		87	(258)
SAP band		B	

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

	Energy kWh/year	Emission factor kg CO2/kWh	Emissions kg CO2/year	
Space heating - main system 1	2058.8833	0.5190	1068.5604	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	444.6169	0.5190	230.7562	(264)
Space and water heating			1299.3166	(265)
Pumps and fans	50.0000	0.5190	25.9500	(267)
Energy for lighting	384.9880	0.5190	199.8088	(268)
Energy saving/generation technologies				
PV Unit	-690.8958	0.5190	-358.5749	(269)
Total kg/year			1166.5005	(272)
CO2 emissions per m2			12.5400	(273)
EI value			88.6748	
EI rating			89	(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	93.0200 (1b)	x	2.9000 (2b)	=	269.7580	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	93.0200					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	269.7580	(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							2 * 10 =	20.0000	(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) =	20.0000 / (5) =	0.0741	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3241	(18)
Number of sides sheltered		0	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	1.0000	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3241	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.6000	4.5000	4.4000	4.1000	4.1000	3.7000	3.8000	3.7000	3.7000	4.0000	3.9000	4.3000	(22)
Wind factor	1.1500	1.1250	1.1000	1.0250	1.0250	0.9250	0.9500	0.9250	0.9250	1.0000	0.9750	1.0750	(22a)
Adj infilt rate	0.3728	0.3647	0.3566	0.3322	0.3322	0.2998	0.3079	0.2998	0.2998	0.3241	0.3160	0.3485	(22b)
Effective ac	0.5695	0.5665	0.5636	0.5552	0.5552	0.5449	0.5474	0.5449	0.5449	0.5525	0.5499	0.5607	(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	
Door			2.5000	1.4000	3.5000			(26)
Windows (Uw = 1.40)			42.5800	1.3258	56.4508			(27)
Floor			93.0200	0.1400	13.0228	110.0000	10232.2000	(28a)
Main Walls	125.8600	45.0800	80.7800	0.2000	16.1560	60.0000	4846.8000	(29a)
Flat Roof	93.0200		93.0200	0.1400	13.0228	9.0000	837.1800	(30)
Total net area of external elements Aum(A, m2)			311.9000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	102.1524			(33)
Internal Wall 1			121.2200			9.0000	1090.9800	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		17007.1600	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							182.8334	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							21.5460	(36)
Total fabric heat loss					(33) + (36) =		123.6984	(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	50.6948	50.4288	50.1687	49.4234	49.4234	48.5114	48.7307	48.5114	48.5114	49.1866	48.9557	49.9144	(38)
Heat transfer coeff	174.3932	174.1272	173.8670	173.1217	173.1217	172.2098	172.4290	172.2098	172.2098	172.8850	172.6541	173.6128	(39)
Average = Sum(39)m / 12 =												173.0701	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.8748	1.8719	1.8691	1.8611	1.8611	1.8513	1.8537	1.8513	1.8513	1.8586	1.8561	1.8664	(40)
HLP (average)												1.8606	(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												2.6648	(42)
Average daily hot water use (litres/day)												97.4900	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	107.2390	103.3394	99.4398	95.5402	91.6406	87.7410	87.7410	91.6406	95.5402	99.4398	103.3394	107.2390	(44)
Energy conte	159.0323	139.0907	143.5291	125.1322	120.0673	103.6090	96.0089	110.1716	111.4874	129.9279	141.8264	154.0143	(45)
Energy content (annual)										Total = Sum(45)m =		1533.8973	(45)
Distribution loss (46)m = 0.15 x (45)m	23.8548	20.8636	21.5294	18.7698	18.0101	15.5413	14.4013	16.5257	16.7231	19.4892	21.2740	23.1021	(46)
Water storage loss:													
Store volume												210.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.8600	(48)

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

	Value	Ref
Temperature factor from Table 2b	0.5400	(49)
Enter (49) or (54) in (55)	1.0044	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ref
Total storage loss	31.1364	28.1232	31.1364	30.1320	31.1364	30.1320	31.1364	31.1364	30.1320	31.1364	30.1320	31.1364	(56)
If cylinder contains dedicated solar storage	31.1364	28.1232	31.1364	30.1320	31.1364	30.1320	31.1364	31.1364	30.1320	31.1364	30.1320	31.1364	(57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624	(59)
Total heat required for water heating calculated for each month	213.4311	188.2251	196.5322	171.0226	161.6718	143.6462	137.3808	152.4740	158.7286	182.9309	194.4704	208.4131	(62)

	Value	Ref
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	1118.3300	(H5)
Overshading factor	0.8000	(H6)
Solar energy available	1878.7945	(H7)
Adjustment factor for showers	1.0000	(H7a)
Solar-to-load ratio	1.2249	(H8)
Utilisation factor	0.5580	(H9)
Collector performance factor	0.8793	(H10)
Dedicated solar storage volume	75.0000	(H11)
Effective solar volume	75.0000	(H13)
Daily hot water demand	97.4900	(H14)
Volume ratio Veff/V	0.7693	(H15)
Solar storage volume factor	0.9475	(H16)
Solar input	-873.4576	(H17)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ref
Solar input	-26.4943	-39.7228	-67.9602	-94.0664	-113.1254	-118.7522	-116.8810	-104.7163	-82.0363	-55.4801	-32.4608	-21.7615	(63)
Solar input (sum of months) = Sum(63)m =												-873.4576	(63)
Output from w/h	186.9368	148.5022	128.5720	76.9561	48.5464	24.8940	20.4998	47.7577	76.6923	127.4508	162.0096	186.6516	(64)
Total per year (kWh/year) = Sum(64)m =												1235.4693	(64)
Heat gains from water heating, kWh/month	96.3973	85.5552	90.1259	78.3188	73.2060	66.4798	65.0205	70.4740	74.8625	85.6035	89.2725	94.7288	(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	Ref
(66)m	159.8905	159.8905	159.8905	159.8905	159.8905	159.8905	159.8905	159.8905	159.8905	159.8905	159.8905	159.8905	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	54.4990	48.4056	39.3660	29.8026	22.2778	18.8079	20.3226	26.4160	35.4556	45.0190	52.5438	56.0137	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	364.9632	368.7504	359.2068	338.8897	313.2430	289.1387	273.0356	269.2484	278.7920	299.1091	324.7558	348.8601	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	53.6539	53.6539	53.6539	53.6539	53.6539	53.6539	53.6539	53.6539	53.6539	53.6539	53.6539	53.6539	(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)	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	-106.5937	(71)
Water heating gains (Table 5)	129.5663	127.3142	121.1369	108.7761	98.3951	92.3331	87.3931	94.7231	103.9757	115.0584	123.9896	127.3237	(72)
Total internal gains	655.9792	651.4209	626.6605	584.4191	540.8667	507.2304	487.7019	497.3382	525.1739	566.1372	608.2399	639.1482	(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	Ref
North	6.0800	11.5821	0.6300	0.7000	0.7700	21.5209	(74)
East	7.7500	21.5869	0.6300	0.7000	0.7700	51.1287	(76)
South	11.5000	49.2853	0.6300	0.7000	0.7700	173.2157	(78)
West	17.2500	21.5869	0.6300	0.7000	0.7700	113.8025	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ref
Solar gains	359.6679	580.7120	865.8347	1202.8075	1379.7008	1489.8736	1421.6730	1286.5356	1065.9159	722.4319	451.6817	297.8080	(83)
Total gains	1015.6471	1232.1329	1492.4952	1787.2267	1920.5674	1997.1040	1909.3750	1783.8738	1591.0898	1288.5691	1059.9215	936.9562	(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	Ref
tau	27.0894	27.1308	27.1714	27.2884	27.2884	27.4329	27.3980	27.4329	27.4329	27.3257	27.3623	27.2112	
alpha	2.8060	2.8087	2.8114	2.8192	2.8192	2.8289	2.8265	2.8289	2.8289	2.8217	2.8242	2.8141	
util living area	0.9607	0.9349	0.8724	0.7546	0.5932	0.3859	0.2404	0.2744	0.5309	0.8069	0.9305	0.9674	(86)
Tweekday	17.4513	17.7621	18.3343	18.8592	19.1678	19.2833	19.2931	19.2945	19.2514	18.8718	18.1102	17.3857	
Tweekend	19.9908	20.1328	20.3998	20.6603	20.8350	20.9180	20.9351	20.9333	20.8838	20.6536	20.2847	19.9590	
24 / 16	0	0	0	0	0	0	0	0	0	0	0	0	
24 / 9	0	0	0	0	0	0	0	0	0	0	0	0	
16 / 9	11	0	0	0	0	0	0	0	0	0	0	0	
MIT	19.7166	19.6585	20.0737	20.4695	20.7454	20.8740	20.8998	20.8971	20.8186	20.4654	19.8831	19.3934	(87)
Th 2	19.4181	19.4201	19.4220	19.4275	19.4275	19.4343	19.4327	19.4343	19.4343	19.4293	19.4310	19.4239	(88)
util rest of house	0.9501	0.9180	0.8396	0.6955	0.5006	0.2654	0.1021	0.1285	0.4031	0.7421	0.9086	0.9584	(89)
Tweekday	17.4513	17.7621	18.3343	18.8592	19.1678	19.2833	19.2931	19.2945	19.2514	18.8718	18.1102	17.3857	
Tweekend	17.4513	17.7621	18.3343	18.8592	19.1678	19.2833	19.2931	19.2945	19.2514	18.8718	18.1102	17.3857	
MIT 2	17.4513	17.7621	18.3343	18.8592	19.1678	19.2833	19.2931	19.2945	19.2514	18.8718	18.1102	17.3857	(90)

Living area fraction fLA = Living area / (4) = 0.4406 (91)

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

MIT	18.4493	18.5976	19.1006	19.5686	19.8628	19.9841	20.0009	20.0005	19.9418	19.5739	18.8912	18.2702	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4493	18.5976	19.1006	19.5686	19.8628	19.9841	20.0009	20.0005	19.9418	19.5739	18.8912	18.2702	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9416	0.9069	0.8317	0.7014	0.5280	0.3091	0.1530	0.1822	0.4473	0.7490	0.8990	0.9496	(94)
Useful gains	956.3484	1117.4632	1241.2544	1253.5125	1014.0901	617.3367	292.0426	325.0742	711.6760	965.1438	952.8951	889.6897	(95)
Ext temp.	5.2000	5.7000	7.7000	10.2000	13.3000	16.3000	18.3000	18.1000	15.5000	11.9000	8.2000	5.2000	(96)
Heat loss rate W	2310.5860	2245.8144	1982.1869	1621.9145	1136.1613	634.4362	293.2887	327.2836	764.9273	1326.6944	1845.8823	2269.1503	(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	1007.5528	758.2520	551.2538	265.2494	90.8210	0.0000	0.0000	0.0000	0.0000	268.9937	642.9508	1026.3187	(98)
Space heating												4611.3923	(98)
Space heating per m2											(98) / (4) =	49.5742	(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 %)	264.0307	(206)
Efficiency of secondary/supplementary heating system, %	100.0000	(208)
Space heating requirement	1746.5367	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1007.5528	758.2520	551.2538	265.2494	90.8210	0.0000	0.0000	0.0000	0.0000	268.9937	642.9508	1026.3187	(98)
Space heating efficiency (main heating system 1)	264.0307	264.0307	264.0307	264.0307	264.0307	0.0000	0.0000	0.0000	0.0000	264.0307	264.0307	264.0307	(210)
Space heating fuel (main heating system)	381.6045	287.1833	208.7840	100.4616	34.3979	0.0000	0.0000	0.0000	0.0000	101.8797	243.5137	388.7119	(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	186.9368	148.5022	128.5720	76.9561	48.5464	24.8940	20.4998	47.7577	76.6923	127.4508	162.0096	186.6516	(64)
Efficiency of water heater												280.3450	(216)
(217)m	280.3450	280.3450	280.3450	280.3450	280.3450	280.3450	280.3450	280.3450	280.3450	280.3450	280.3450	280.3450	(217)
Fuel for water heating, kWh/month	66.6810	52.9712	45.8621	27.4505	17.3167	8.8798	7.3123	17.0353	27.3564	45.4621	57.7894	66.5793	(219)
Water heating fuel used												440.6960	(219)
Annual totals kWh/year													
Space heating fuel - main system												1746.5367	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												50.0000	(231)
Electricity for lighting (calculated in Appendix L)												384.9880	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.00 * 1118 * 0.80) =										-715.7312		-715.7312	(233)
Total delivered energy for all uses												1906.4894	(238)

10a. Fuel costs - using BEDF prices (451)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1746.5367	17.5600	306.6918	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	440.6960	17.5600	77.3862	(247)
Pumps and fans for heating	0.0000	0.0000	0.0000	(249)
Pump for solar water heating	50.0000	17.5600	8.7800	(249)
Energy for lighting	384.9880	17.5600	67.6039	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-715.7312	17.5600	-125.6824	(252)
Total energy cost			334.7795	(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	1746.5367	0.5190	906.4525	(261)
Space heating - secondary	0.0000	0.5190	0.0000	(263)
Water heating (other fuel)	440.6960	0.5190	228.7212	(264)
Space and water heating			1135.1738	(265)
Pumps and fans	50.0000	0.5190	25.9500	(267)

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

Energy for lighting	384.9880	0.5190	199.8088 (268)
Energy saving/generation technologies			
PV Unit	-715.7312	0.5190	-371.4645 (269)
Total kg/year			989.4680 (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	1746.5367	3.0700	5361.8675 (261)
Space heating - secondary	0.0000	3.0700	0.0000 (263)
Water heating (other fuel)	440.6960	3.0700	1352.9368 (264)
Space and water heating			6714.8043 (265)
Pumps and fans	50.0000	3.0700	153.5000 (267)
Energy for lighting	384.9880	3.0700	1181.9131 (268)
Energy saving/generation technologies			
PV Unit	-715.7312	3.0700	-2197.2948 (269)
Primary energy kWh/year			5852.9226 (272)
Primary energy kWh/m2/year			62.9211 (273)

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

Overheating Calculation Input Data

Dwelling type	Detached Bungalow
Number of storeys	1
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	South
Overshading	Average or unknown
Thermal mass parameter	182.8 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	6.00 (Windows fully open)

Overheating Calculation

Summer ventilation heat loss coefficient	534.12 (P1)
Transmission heat loss coefficient	123.70 (37)
Summer heat loss coefficient	657.82 (P2)

Overhangs

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

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer
North	1.000	0.90	1.000	0.900 (P8)
East	1.000	0.90	1.000	0.900 (P8)
South	1.000	0.90	1.000	0.900 (P8)
West	1.000	0.90	1.000	0.900 (P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North	6.0800	81.1852	0.6300	0.7000	0.9000	176.3210
East	7.7500	117.5071	0.6300	0.7000	0.9000	325.3039
South	11.5000	112.2060	0.6300	0.7000	0.9000	460.9327
West	17.2500	117.5071	0.6300	0.7000	0.9000	724.0636
total:						1686.6212

	Jun	Jul	Aug	
Solar gains	1782	1687	1521	(P3)
Internal gains	521	502	510	
Total summer gains	2304	2188	2032	(P5)
Summer gain/loss ratio	3.50	3.33	3.09	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 182.8)	0.72	0.72	0.72	
Threshold temperature	20.22	21.95	21.61	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

---

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

Energy Calculations Ltd
SAP ◆ CODE ◆ SBEM ◆ DESIGN

Property Reference	014651c	**Issued on Date**	14/11/2019
Assessment Reference	001	**Prop Type Ref**	
Property	17, Frognal , LONDON, NW3 6AR		

SAP Rating	86 B	**DER**	15.31	**TER**	32.05
Environmental	87 B	**% DER<TER**	52.23		
CO_2 Emissions (t/year)	1.14	**DFEE**	72.95	**TFEE**	74.22
General Requirements Compliance	Pass	**% DFEE<TFEE**	1.72		

Assessor Details	Mr. Matthew Carter, Energy Calculations Limited, Tel: 01754 761035, mcarter@energycalculations.co.uk	**Assessor ID**	7869-0001
Client			

SUMARY FOR INPUT DATA FOR New Build (As Designed)

Criterion 1 – Achieving the TER and TFEE rate

1a TER and DER

Fuel for main heating	Electricity		
Fuel factor	1.55 (electricity)		
Target Carbon Dioxide Emission Rate (TER)	32.05	$kgCO_2/m^2$	
Dwelling Carbon Dioxide Emission Rate (DER)	15.31	$kgCO_2/m^2$	Pass
	-16.74 (-52.2%)	$kgCO_2/m^2$	

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	74.22	$kWh/m^2/yr$	
Dwelling Fabric Energy Efficiency (DFEE)	72.95	$kWh/m^2/yr$	
	-1.3 (-1.8%)	$kWh/m^2/yr$	Pass

Criterion 2 – Limits on design flexibility

Limiting Fabric Standards

2 Fabric U-values

Element	Average	Highest	
External wall	0.20 (max. 0.30)	0.20 (max. 0.70)	Pass
Floor	0.14 (max. 0.25)	0.14 (max. 0.70)	Pass
Roof	0.14 (max. 0.20)	0.14 (max. 0.35)	Pass
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	Pass

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)	
Maximum	10.0	Pass

Limiting System Efficiencies

4 Heating efficiency

Main heating system	Heat pump with radiators or underfloor - Electric Panasonic WH-MDC05H3E5	
Secondary heating system	None	

5 Cylinder insulation

Hot water storage	Measured cylinder loss: 1.86 kWh/day Permitted by DBSCG 2.30		Pass
Primary pipework insulated	Yes		Pass

6 Controls

Space heating controls	Time and temperature zone control		Pass
Hot water controls	Cylinderstat		Pass
	Independent timer for DHW		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 (Thames Valley)	Slight		Pass

Based on:

Overshading	Average		
Windows facing North	6.08 m², No overhang		
Windows facing East	7.75 m², No overhang		
Windows facing South	11.50 m², No overhang		
Windows facing West	17.25 m², No overhang		
Air change rate	6.00 ach		
Blinds/curtains	None		

Criterion 4 – Building performance consistent with DER and DFEE rate

Air permeability and pressure testing

3 Air permeability

Air permeability at 50 pascals	5.00 (design value)		
Maximum	10.0		Pass

10 Key features

Photovoltaic array	1.00	kW	

This report has not been submitted through the Elmhurst Energy members' portal, therefore results are subject to change when the dwelling is completed.

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

Energy Calculations Ltd
SAP ◆ CODE ◆ SBEM ◆ DESIGN

Property Reference	014651c	**Issued on Date**	14/11/2019
Assessment Reference	001	**Prop Type Ref**	
Property	17, Frognal , LONDON, NW3 6AR		

SAP Rating	86 B	**DER**	15.31	**TER**	32.05
Environmental	87 B	**% DER<TER**	52.23		
CO_2 Emissions (t/year)	1.14	**DFEE**	72.95	**TFEE**	74.22
General Requirements Compliance	Pass	**% DFEE<TFEE**	1.72		

Assessor Details	Mr. Matthew Carter, Energy Calculations Limited, Tel: 01754 761035, mcarter@energycalculations.co.uk	**Assessor ID**	7869-0001
Client			

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

Orientation	South
Property Tenure	Unknown
Transaction Type	New dwelling
Terrain Type	Urban
1.0 Property Type	Bungalow, Detached
2.0 Number of Storeys	1
3.0 Date Built	2019
4.0 Sheltered Sides	0
5.0 Sunlight/Shade	Average or unknown

6.0 Measurements

	Heat Loss Perimeter	Internal Floor Area	Average Storey Height
Ground Floor:	43.40 m	93.02 m²	2.90 m

7.0 Living Area	40.98	m²
8.0 Thermal Mass Parameter	Precise calculation	
Thermal Mass	182.83	kJ/m²K

9.0 External Walls

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Gross Area (m²)	Nett Area (m²)
Main Walls	Cavity Wall	Cavity wall : plasterboard on dabs, AAC block, filled cavity, any outside structure	0.20	60.00	125.86	80.78

9.2 Internal Walls

Description	Construction	Kappa (kJ/m²K)	Area (m²)
Internal Wall 1	Plasterboard on timber frame	9.00	121.22

10.0 External Roofs

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Gross Area (m²)	Nett Area (m²)
Flat Roof	External Flat Roof	Plasterboard, insulated flat roof	0.14	9.00	93.02	93.02

11.0 Heat Loss Floors

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Area (m²)
Floor	Ground Floor - Solid	Slab on ground, screed over insulation	0.14	110.00	93.02

12.0 Opening Types

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

Energy Calculations Ltd
SAP ◆ CODE ◆ SBEM ◆ DESIGN

Description	Data Source	Type	Glazing	Glazing Gap	Argon Filled	G-value	Frame Type	Frame Factor	U Value (W/m²K)
Door	Manufacturer	Solid Door							1.40
Windows	Manufacturer	Window	Double Low-E Soft 0.05			0.63		0.70	1.40

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] Main Walls	South							2.50	
Front Windows	Window	[1] Main Walls	South	None	0.00					11.50	
Side Windows	Window	[1] Main Walls	East	None	0.00					7.75	
Side Windows	Window	[1] Main Walls	West	None	0.00					17.25	
Rear Windows	Window	[1] Main Walls	North	None	0.00					6.08	

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
Table K1 - Approved	E2 Other lintels (including other steel lintels)	23.00	0.300	No
Table K1 - Approved	E3 Sill	9.40	0.040	No
Table K1 - Approved	E4 Jamb	56.20	0.050	No
Table K1 - Approved	E5 Ground floor (normal)	43.40	0.160	No
Table K1 - Default	E14 Flat roof	43.40	0.080	No
Table K1 - Approved	E16 Corner (normal)	17.40	0.090	No
Table K1 - Approved	E17 Corner (inverted – internal area greater than external area)	5.80	-0.090	No

Y-value	0.069	W/m²K

18.0 Pressure Testing	Yes	
Designed AP_{50}	5.00	m³/(h.m²) @ 50 Pa
Property Tested ?		
As Built AP_{50}		m³/(h.m²) @ 50 Pa

19.0 Mechanical Ventilation

Summer Overheating

Windows open in hot weather	Windows fully open
Cross ventilation possible	Yes
Night Ventilation	No
Air change rate	6.00

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				2
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	9	
Total number of L.E.L. fittings	9	
Percentage of L.E.L. fittings	100.00	%
External		
External lights fitted	No	
23.0 Electricity Tariff	Standard	
24.0 Main Heating 1	Database	
Percentage of Heat	100	%
Database Ref. No.	103510	
Fuel Type	Electricity	
Main Heating	PET	
SAP Code	224	
In Winter	277.9	
In Summer	295.1	
Controls	CHD Time and temperature zone control	
PCDF Controls	0	
Sap Code	2207	
Is MHS Pumped	Pump in heated space	
Heat Emitter	Underfloor	
Underfloor Heating	Yes - Pipes in thin screed	
Flow Temperature	Normal (> 45°C)	
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	
Immersion Only Heating Hot Water	Yes	
29.0 Hot Water Cylinder	Hot Water Cylinder	
Cylinder Stat	Yes	
Cylinder In Heated Space	Yes	
Independent Time Control	Yes	
Insulation Type	Measured Loss	
Cylinder Volume	210.00	L
Loss	1.86	kWh/day

Pipes insulation	Fully insulated primary pipework
31.0 Thermal Store	None
32.0 Photovoltaic Unit	One Dwelling

PV Cells kWp	Orientation	Elevation	Overshading	Connected to Dwelling
1.00	South	30°	Modest	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	£50	B 87	