Full planning application for single dwelling.

Site to the rear of 12 Sarre Road,
facing Gondar Gardens

Energy Statement
Rev 00

Sustainability strategy

This energy statement has been developed following the energy hierarchy 'Be Lean, Be Clean, Be Green' akin to adopted council strategy. SAP calculations using accredited software have been undertaken to demonstrate the savings associated with the measures incorporated, these focus on building fabric and use of renewable energy sources.

Building Fabric

This is the primary point of focus in reduction of the carbon emission from the development by 19% above the requirements outlined in the building regulations for new build dwellings.

An efficient appropriately designed thermal envelope will greatly mitigate the need for space heating and cooling as heat transmittance through the thermal elements is reduced.

Low air permeability rates will also reduce heating and cooling energy demand by reducing the volume of air that can penetrate the building and aclaculations list this at 5.

As part of a 'fabric first' approach, the building fabric has been carefully considered and elements listed as follows:

External walls -	0.16
Floors	0.18
Roofs	017
Glazed openings	1.62

Overheating

Consideration of the internal spaces overheating due to the glazing has been calculated as slight when measured relative to the Part L1A criteria.

Solar Gain Control and Daylight

With a north south orientation to the building , glazing has been designed to benefit from the excessive solar gains whilst ensuring all habitable rooms are well lit and do not require the use of artificial lighting sources during daylight hours.

At ground floor, the dual aspect nature of the space allows for natural cross ventilation.

Glazing will benefit from low emissitivity coatings to limit over heating without reducing the level of natural daylight into the space.

Renewable energy sources

As recomended in the SAP report, solar hot water panels will be installed to the roof. This in tandem with low energy lights will reduce carbon emissions.

Water efficiency

Water fittings will be specified with the following or similar flow rates to meet the target water consumption of 105 l/p/day:

- Wash basin and kitchen taps – 6.5 l/min
- Showers – 7.5 l/min
- Bath – 120l to overflow
- Dishwasher - 1.2 l/place setting
- Washing machine - 9 l/kg load
- WC – 6/4 litre dual flush

Water meters will be installed to encourage residents to limit their consumption. .

Materials

Brick has been chosen for the external facade, akin to the local context this provides a durable low maintenance building material that has a long life. Insulation as denoted in the SAP calculations will be sustainably sourced, with Thermafleece, a naturally UK produced insulation being adopted.

Low embodied final finishes internally will also be given consideration and adopted in so far as viable and these will also be responsibly sourced, with consideration of cradle to cradle where viable when considering whole life cycle analysis.

Where possible, FSC or equivalent timber will be used. Sourcing of other materials will include products where the manufacturer employs an environmental management system such as ISO 14001 or BES 6001. Where possible, materials will be sourced locally.

Waste Management and Construction

Construction site waste will be managed in such a way to reduce the amount of waste produced as much as possible, and the waste hierarchy will be followed. In addition, at least 85% of waste that does arise will be recycled using an external waste contractor.

Household waste will be recycled through the local authority collection scheme. Internal recycling bins in a kitchen cupboard will be provided to facilitate this, with space for caddies in the bin store.

Conclusion

To conclude, the measures taken will reduce carbon emissions above the building regulations for this 3 bed unit by 19.94%.

SAP Calculations to demonstrate this are as appended,

elmhurst energy

SAP Report Submission for Building Regulations Compliance

Client: Formed Architects

Project: Rear of 12 Sarre Road

Contact: Carlos Val Escudero
Carlos Val
carlos@rjacoustics.com

Report Issue Date: 22/09/2020

EXCELLENCE IN ENERGY ASSESSMENT

PREDICTED ENERGY ASSESSMENT

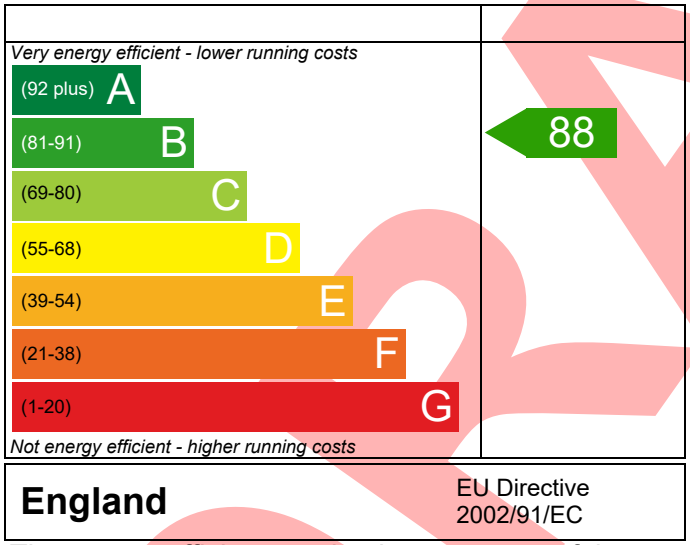
Design SAP
elmhurst energy

Dwelling type:	House, Detached
Date of assessment:	22/09/2020
Produced by:	Carlos Val
Total floor area:	98.99 m²

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.

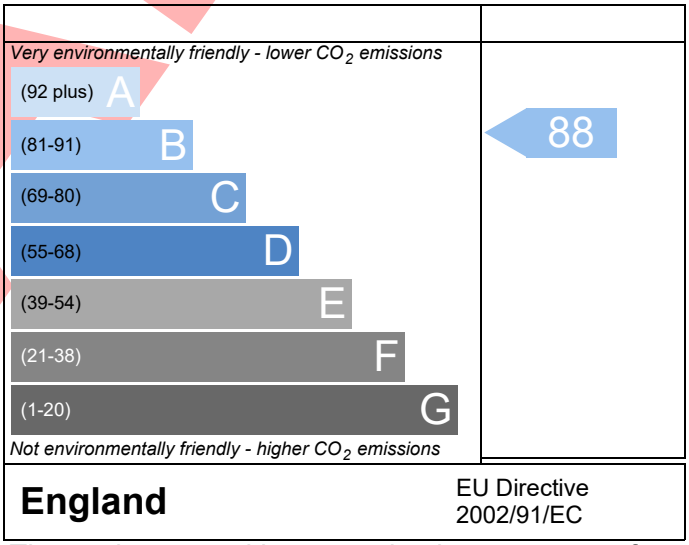
Energy Efficiency Rating



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

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

Design SAP
elmhurst energy

Property Reference	1500	**Issued on Date**	22/09/2020
Assessment Reference	As design 3 bed	**Prop Type Ref**	
Property			

SAP Rating	88 B	**DER**	14.34	**TER**	17.91
Environmental	88 B	**% DER<TER**	19.94		
CO_2 Emissions (t/year)	1.08	**DFEE**	56.94	**TFEE**	57.93
General Requirements Compliance	Pass	**% DFEE<TFEE**	1.71		

Assessor Details	Mr. Carlos Val Escudero, Carlos Val, Tel: 01923 518923, carlos@rjacoustics.com	**Assessor ID**	H664-0001
Client	Formed Architects, 1500		

SUMARY FOR INPUT DATA FOR New Build (As Designed)

Criterion 1 – Achieving the TER and TFEE rate

1a TER and DER

Fuel for main heating	Mains gas		
Fuel factor	1.00 (mains gas)		
Target Carbon Dioxide Emission Rate (TER)	17.91	$kgCO_2/m^2$	
Dwelling Carbon Dioxide Emission Rate (DER)	14.34	$kgCO_2/m^2$	Pass
	-3.57 (-19.9%)	$kgCO_2/m^2$	

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	57.93	$kWh/m^2/yr$	
Dwelling Fabric Energy Efficiency (DFEE)	56.94	$kWh/m^2/yr$	
	-1.0 (-1.7%)	$kWh/m^2/yr$	Pass

Criterion 2 – Limits on design flexibility

Limiting Fabric Standards

2 Fabric U-values

Element	Average	Highest	
External wall	0.16 (max. 0.30)	0.16 (max. 0.70)	Pass
Floor	0.18 (max. 0.25)	0.20 (max. 0.70)	Pass
Roof	0.17 (max. 0.20)	0.17 (max. 0.35)	Pass
Openings	1.61 (max. 2.00)	1.80 (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

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

Main heating system	Boiler system with radiators or underfloor - Mains gas Data from database Worcester Greenstar 8000 Life GR8300iW 50 R NG Efficiency: 89.7% SEDBUK2009 Minimum: 88.0%		Pass
Secondary heating system	None		

5 Cylinder insulation

Hot water storage	Measured cylinder loss: 1.75 kWh/day Permitted by DBSCG 2.24		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
Boiler interlock	Yes		Pass

7 Low energy lights

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

8 Mechanical ventilation

Not applicable

Criterion 3 – Limiting the effects of heat gains in summer

9 Summertime temperature

Overheating risk (Thames Valley)	Medium		Pass

Based on:

Overshading	Average		
Windows facing North East Windows facing South West	10.26 m², No overhang 17.35 m², No overhang		
Air change rate	4.00 ach		
Blinds/curtains	Light-coloured venetian blind, closed 50% of daylight hours		

Criterion 4 – Building performance consistent with DER and DFEE rate

Air permeability and pressure testing

3 Air permeability

Air permeability at 50 pascals	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	1.40	kW	

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

	Typical cost	Typical savings per year	Energy efficiency	Environmental impact	Result
Low energy lights			0	0	Already installed
Solar water heating	£4,000 - £6,000	£44	B 89	B 91	Recommended
Photovoltaic			0	0	Already installed
Wind turbine			0	0	Not applicable
Totals	**£4,000 - £6,000**	**£44**	**B 89**	**B 91**	

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

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

Design SAP
elmhurst energy

Property Reference	1500	**Issued on Date**	22/09/2020
Assessment Reference	As design 3 bed	**Prop Type Ref**	
Property			

SAP Rating	88 B	**DER**	14.34	**TER**	17.91
Environmental	88 B	**% DER<TER**	19.94		
CO_2 Emissions (t/year)	1.08	**DFEE**	56.94	**TFEE**	57.93
General Requirements Compliance	Pass	**% DFEE<TFEE**	1.71		

Assessor Details	Mr. Carlos Val Escudero, Carlos Val, Tel: 01923 518923, carlos@rjacoustics.com	**Assessor ID**	H664-0001
Client	Formed Architects, 1500		

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

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

Detached House, total floor area 99 m²

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

1a TER and DER
Fuel for main heating:Mains gas
Fuel factor:1.00 (mains gas)
Target Carbon Dioxide Emission Rate (TER) 17.91 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 14.34 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)57.9 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)56.9 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.16 (max. 0.30)	0.16 (max. 0.70)	OK
Floor	0.18 (max. 0.25)	0.20 (max. 0.70)	OK
Roof	0.17 (max. 0.20)	0.17 (max. 0.35)	OK
Openings	1.61 (max. 2.00)	1.80 (max. 3.30)	OK

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

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

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4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Worcester Greenstar 8000 Life GR8300iW 50 R NG

Efficiency: 89.7% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: Measured cylinder loss: 1.75 kWh/day
Permitted by DBSCG 2.24 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

Boiler interlock: Yes OK

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

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (Thames Valley): Medium OK
Based on:
Overshading: Average
Windows facing North East: 10.26 m², No overhang
Windows facing South West: 17.35 m², No overhang
Air change rate: 4.00 ach
Blinds/curtains: Light-coloured venetian blind, closed 50% of daylight hours

---
10 Key features
Photovoltaic array 1.40 kW

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3400	(1b)	x 2.6800	(2b) =	94.7112	(1b) - (3b)
First floor	36.8500	(1c)	x 2.7500	(2c) =	101.3375	(1c) - (3c)
Second floor	26.8000	(1d)	x 1.8700	(2d) =	50.1160	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	98.9900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		246.1647	(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							5 * 10	=	50.0000	(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) =	50.0000	/ (5) =	0.2031	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.4531	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3851	(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	0.4911	0.4814	0.4718	0.4237	0.4140	0.3659	0.3659	0.3563	0.3851	0.4140	0.4333	0.4525	(22b)
Effective ac	0.6206	0.6159	0.6113	0.5897	0.5857	0.5669	0.5669	0.5635	0.5742	0.5857	0.5939	0.6024	(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	
Entrance door			2.1100	1.8000	3.7980			(26)
Windows (Uw = 1.60)			27.6100	1.5038	41.5188			(27)
Rooflights (Uw = 1.60)			6.5600	1.5038	9.8647			(27a)
Heat Loss Floor			33.8300	0.1800	6.0894			(28a)
Exposed floor			1.5100	0.2000	0.3020			(28b)
External Wall	163.7900	29.7200	134.0700	0.1600	21.4512			(29a)
Main Roof	33.8300	6.5600	27.2700	0.1700	4.6359			(30)
External Roof 2	9.8200		9.8200	0.1600	1.5712			(30)
Total net area of external elements Aum(A, m2)			242.7800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	89.2312			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							17.3628	(36)
Total fabric heat loss					(33) + (36) =		106.5940	(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	50.4118	50.0314	49.6586	47.9076	47.5800	46.0549	46.0549	45.7724	46.6423	47.5800	48.2427	48.9356	(38)
Heat transfer coeff	157.0057	156.6254	156.2526	154.5015	154.1739	152.6488	152.6488	152.3664	153.2363	154.1739	154.8367	155.5296	(39)
Average = Sum(39)m / 12 =												154.5000	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.5861	1.5822	1.5785	1.5608	1.5575	1.5421	1.5421	1.5392	1.5480	1.5575	1.5642	1.5712	(40)
HLP (average)												1.5608	(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	2.7300	(42)
Average daily hot water use (litres/day)	99.0370	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.9407	104.9792	101.0177	97.0562	93.0947	89.1333	89.1333	93.0947	97.0562	101.0177	104.9792	108.9407	(44)
Energy conte	161.5558	141.2978	145.8066	127.1178	121.9725	105.2530	97.5324	111.9198	113.2565	131.9896	144.0769	156.4582	(45)
Energy content (annual)										Total = Sum(45)m =		1558.2370	(45)
Distribution loss (46)m = 0.15 x (45)m	24.2334	21.1947	21.8710	19.0677	18.2959	15.7880	14.6299	16.7880	16.9885	19.7984	21.6115	23.4687	(46)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Water storage loss:
Store volume 200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.7500 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 0.9450 (55)
Total storage loss

	29.2950	26.4600	29.2950	28.3500	29.2950	28.3500	29.2950	29.2950	28.3500	29.2950	28.3500	29.2950 (56)

If cylinder contains dedicated solar storage

	29.2950	26.4600	29.2950	28.3500	29.2950	28.3500	29.2950	29.2950	28.3500	29.2950	28.3500	29.2950 (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

	214.1132	188.7690	198.3640	177.9798	174.5299	156.1150	150.0898	164.4772	164.1185	184.5470	194.9389	209.0156 (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

	214.1132	188.7690	198.3640	177.9798	174.5299	156.1150	150.0898	164.4772	164.1185	184.5470	194.9389	209.0156 (64)

Total per year (kWh/year) = Sum(64)m = 2177.0580 (64)

Heat gains from water heating, kWh/month

	95.7632	84.9585	90.5266	82.9563	82.6018	75.6862	74.4754	79.2593	78.3474	85.9324	88.5952	94.0683 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	136.4989	136.4989	136.4989	136.4989	136.4989	136.4989	136.4989	136.4989	136.4989	136.4989	136.4989	136.4989	(66)

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

	22.7053	20.1667	16.4006	12.4163	9.2814	7.8357	8.4668	11.0054	14.7714	18.7557	21.8907	23.3364	(67)

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

	254.6845	257.3274	250.6675	236.4895	218.5923	201.7715	190.5341	187.8913	194.5511	208.7291	226.6263	243.4472	(68)

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

	36.6499	36.6499	36.6499	36.6499	36.6499	36.6499	36.6499	36.6499	36.6499	36.6499	36.6499	36.6499	(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)

	-109.1991	-109.1991	-109.1991	-109.1991	-109.1991	-109.1991	-109.1991	-109.1991	-109.1991	-109.1991	-109.1991	-109.1991	(71)

Water heating gains (Table 5)

	128.7140	126.4263	121.6756	115.2170	111.0239	105.1198	100.1014	106.5313	108.8158	115.5006	123.0489	126.4359	(72)

Total internal gains

	473.0535	470.8700	455.6934	431.0725	405.8472	381.6766	366.0519	372.3776	385.0881	409.9351	438.5156	460.1691	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	10.2600	11.2829	0.6300	0.7000	0.7700	35.3787	(75)
Southwest	17.3500	36.7938	0.6300	0.7000	0.7700	195.0951	(79)
Southeast	3.2800	38.2331	0.6300	0.7000	1.0000	49.7730	(82)
Northwest	3.2800	17.4137	0.6300	0.7000	1.0000	22.6697	(82)

Solar gains	302.9165	545.0866	819.2779	1131.9791	1370.0190	1403.8105	1335.3273	1151.8619	927.0646	622.6171	368.2182	255.6925	(83)
Total gains	775.9700	1015.9566	1274.9713	1563.0516	1775.8662	1785.4871	1701.3792	1524.2395	1312.1526	1032.5523	806.7338	715.8616	(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	43.7838	43.8901	43.9948	44.4934	44.5880	45.0335	45.0335	45.1169	44.8608	44.5880	44.3971	44.1993	
alpha	3.9189	3.9260	3.9330	3.9662	3.9725	4.0022	4.0022	4.0078	3.9907	3.9725	3.9598	3.9466	
util living area	0.9940	0.9830	0.9516	0.8632	0.7059	0.5238	0.3889	0.4486	0.7056	0.9302	0.9871	0.9956	(86)
MIT	19.3734	19.6605	20.0738	20.5407	20.8408	20.9631	20.9912	20.9848	20.8837	20.4322	19.8038	19.3257	(87)
Th 2	19.6236	19.6264	19.6292	19.6422	19.6447	19.6561	19.6561	19.6582	19.6517	19.6447	19.6397	19.6345	(88)
util rest of house	0.9919	0.9772	0.9355	0.8219	0.6316	0.4236	0.2731	0.3232	0.6026	0.8986	0.9817	0.9941	(89)
MIT 2	17.5173	17.9341	18.5223	19.1573	19.5112	19.6360	19.6536	19.6534	19.5740	19.0410	18.1543	17.4549	(90)
Living area fraction									fLA = Living area / (4) =			0.2756	(91)
MIT	18.0288	18.4099	18.9499	19.5386	19.8776	20.0017	20.0222	20.0203	19.9349	19.4244	18.6089	17.9704	(92)
Temperature adjustment												-0.1500	
adjusted MIT	17.8788	18.2599	18.7999	19.3886	19.7276	19.8517	19.8722	19.8703	19.7849	19.2744	18.4589	17.8204	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9878	0.9690	0.9228	0.8128	0.6366	0.4388	0.2920	0.3436	0.6139	0.8873	0.9747	0.9908	(94)
Useful gains	766.5032	984.4181	1176.5322	1270.4321	1130.4841	783.4179	496.8825	523.7690	805.5470	916.1736	786.3606	709.2817	(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	2131.9476	2092.4970	1921.8897	1620.4979	1237.6524	801.6702	499.5025	528.7535	871.1355	1337.3687	1758.7697	2118.3809	(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	1015.8906	744.6290	554.5460	252.0474	79.7332	0.0000	0.0000	0.0000	0.0000	313.3691	700.1346	1048.3698	(98)
Space heating												4708.7197	(98)
Space heating per m2											(98) / (4) =	47.5676	(99)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.7000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5191.5322	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	1015.8906	744.6290	554.5460	252.0474	79.7332	0.0000	0.0000	0.0000	0.0000	313.3691	700.1346	1048.3698	(98)
Space heating efficiency (main heating system 1)													
	90.7000	90.7000	90.7000	90.7000	90.7000	0.0000	0.0000	0.0000	0.0000	90.7000	90.7000	90.7000	(210)
Space heating fuel (main heating system)													
	1120.0558	820.9801	611.4068	277.8912	87.9087	0.0000	0.0000	0.0000	0.0000	345.5007	771.9234	1155.8653	(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													
	214.1132	188.7690	198.3640	177.9798	174.5299	156.1150	150.0898	164.4772	164.1185	184.5470	194.9389	209.0156	(64)
Efficiency of water heater												80.0000	(216)
(217)m	88.6363	88.3112	87.6127	85.9425	83.0732	80.0000	80.0000	80.0000	80.0000	86.4161	88.1327	88.7273	(217)
Fuel for water heating, kWh/month													
	241.5638	213.7542	226.4102	207.0916	210.0917	195.1438	187.6122	205.5966	205.1482	213.5562	221.1879	235.5708	(219)
Water heating fuel used												2562.7271	(219)
Annual totals kWh/year													
Space heating fuel - main system												5191.5322	(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)												400.9829	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.40 * 1080 * 0.80) =										-967.2541		-967.2541	(233)
Total delivered energy for all uses												7262.9881	(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	5191.5322	0.2160	1121.3709	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2562.7271	0.2160	553.5491	(264)
Space and water heating			1674.9200	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	400.9829	0.5190	208.1101	(268)
Energy saving/generation technologies				
PV Unit	-967.2541	0.5190	-502.0049	(269)
Total CO2, kg/year			1419.9503	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			14.3400	(273)

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

DER		14.3400	ZC1
Total Floor Area	TFA	98.9900	
Assumed number of occupants	N	2.7300	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		15.2461	ZC2
CO2 emissions from cooking, equation (L16)		1.8640	ZC3
Total CO2 emissions		31.4501	ZC4
Residual CO2 emissions offset from biofuel CHP		0.0000	ZC5
Additional allowable electricity generation, kWh/m²/year		0.0000	ZC6
Resulting CO2 emissions offset from additional allowable electricity generation		0.0000	ZC7
Net CO2 emissions		31.4501	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3400 (1b)	x	2.6800 (2b)	=	94.7112	(1b) - (3b)
First floor	36.8500 (1c)	x	2.7500 (2c)	=	101.3375	(1c) - (3c)
Second floor	26.8000 (1d)	x	1.8700 (2d)	=	50.1160	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	98.9900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	246.1647	(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) =	0.1219	(8)
Pressure test				Yes	
Measured/design AP50				5.0000	
Infiltration rate				0.3719	(18)
Number of sides sheltered				2	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3161	(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	0.4030	0.3951	0.3872	0.3477	0.3398	0.3003	0.3003	0.2924	0.3161	0.3398	0.3556	0.3714	(22b)
Effective ac	0.5812	0.5781	0.5750	0.5604	0.5577	0.5451	0.5451	0.5427	0.5500	0.5577	0.5632	0.5690	(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			2.1100	1.0000	2.1100			(26)
TER Opening Type (Uw = 1.40)			18.2900	1.3258	24.2481			(27)
TER Room Window (Uw = 1.70)			4.3400	1.5918	6.9082			(27a)
Heat Loss Floor			33.8300	0.1300	4.3979			(28a)
Exposed floor			1.5100	0.1300	0.1963			(28b)
External Wall	163.7900	20.4000	143.3900	0.1800	25.8102			(29a)
Main Roof	33.8300	4.3400	29.4900	0.1300	3.8337			(30)
External Roof 2	9.8200		9.8200	0.1300	1.2766			(30)
Total net area of external elements Aum(A, m2)			242.7800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	68.7810			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	14.8627	(36)
Total fabric heat loss (33) + (36) =	83.6437	(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	47.2142	46.9580	46.7069	45.5275	45.3069	44.2797	44.2797	44.0894	44.6753	45.3069	45.7533	46.2200	(38)
Heat transfer coeff	130.8580	130.6018	130.3507	129.1713	128.9506	127.9234	127.9234	127.7332	128.3191	128.9506	129.3970	129.8637	(39)
Average = Sum(39)m / 12 =												129.1702	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3219	1.3193	1.3168	1.3049	1.3027	1.2923	1.2923	1.2904	1.2963	1.3027	1.3072	1.3119	(40)
HLP (average)												1.3049	(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	2.7300 (42)
Average daily hot water use (litres/day)	99.0370 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.9407	104.9792	101.0177	97.0562	93.0947	89.1333	89.1333	93.0947	97.0562	101.0177	104.9792	108.9407	(44)
Energy conte	161.5558	141.2978	145.8066	127.1178	121.9725	105.2530	97.5324	111.9198	113.2565	131.9896	144.0769	156.4582	(45)
Energy content (annual)										Total = Sum(45)m =		1558.2370	(45)
Distribution loss (46)m = 0.15 x (45)m	24.2334	21.1947	21.8710	19.0677	18.2959	15.7880	14.6299	16.7880	16.9885	19.7984	21.6115	23.4687	(46)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Water storage loss:
Store volume 200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.6525 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 0.8924 (55)
Total storage loss

	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637 (56)

If cylinder contains dedicated solar storage

	27.6637	24.9865	27.6637	26.7713	27.6637	26.7713	27.6637	27.6637	26.7713	27.6637	26.7713	27.6637 (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

	212.4819	187.2955	196.7327	176.4011	172.8986	154.5363	148.4585	162.8459	162.5398	182.9156	193.3602	207.3843 (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

	212.4819	187.2955	196.7327	176.4011	172.8986	154.5363	148.4585	162.8459	162.5398	182.9156	193.3602	207.3843 (64)

Total per year (kWh/year) = Sum(64)m = 2157.8505 (64)

Heat gains from water heating, kWh/month

	94.4582	83.7797	89.2216	81.6933	81.2967	74.4233	73.1704	77.9542	77.0844	84.6274	87.3322	92.7632 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	136.4989	136.4989	136.4989	136.4989	136.4989	136.4989	136.4989	136.4989	136.4989	136.4989	136.4989	136.4989	(66)

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

	22.7053	20.1667	16.4006	12.4163	9.2814	7.8357	8.4668	11.0054	14.7714	18.7557	21.8907	23.3364	(67)

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

	254.6845	257.3274	250.6675	236.4895	218.5923	201.7715	190.5341	187.8913	194.5511	208.7291	226.6263	243.4472	(68)

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

	36.6499	36.6499	36.6499	36.6499	36.6499	36.6499	36.6499	36.6499	36.6499	36.6499	36.6499	36.6499	(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)

	-109.1991	-109.1991	-109.1991	-109.1991	-109.1991	-109.1991	-109.1991	-109.1991	-109.1991	-109.1991	-109.1991	-109.1991	(71)

Water heating gains (Table 5)

	126.9599	124.6722	119.9215	113.4629	109.2698	103.3656	98.3473	104.7772	107.0617	113.7465	121.2947	124.6817	(72)

Total internal gains

	471.2994	469.1159	453.9393	429.3184	404.0931	379.9225	364.2978	370.6235	383.3339	408.1810	436.7615	458.4149	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.8000	11.2829	0.6300	0.7000	0.7700	23.4479	(75)
Southwest	11.4900	36.7938	0.6300	0.7000	0.7700	129.2013	(79)
Southeast	2.1700	38.2331	0.6300	0.7000	1.0000	32.9291	(82)
Northwest	2.1700	17.4137	0.6300	0.7000	1.0000	14.9980	(82)

Solar gains	200.5762	360.9266	542.4770	749.5260	907.1413	929.5167	884.1709	762.6910	613.8455	412.2618	243.8153	169.3072	(83)
Total gains	671.8756	830.0425	996.4162	1178.8444	1311.2344	1309.4391	1248.4688	1133.3145	997.1794	820.4428	680.5767	627.7222	(84)

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7. Mean internal temperature (heating season)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	52.5326	52.6356	52.7370	53.2185	53.3096	53.7377	53.7377	53.8177	53.5720	53.3096	53.1257	52.9348	
alpha	4.5022	4.5090	4.5158	4.5479	4.5540	4.5825	4.5825	4.5878	4.5715	4.5540	4.5417	4.5290	
util living area	0.9966	0.9908	0.9730	0.9138	0.7815	0.5959	0.4443	0.5059	0.7686	0.9557	0.9924	0.9975	(86)
MIT	19.6056	19.8217	20.1523	20.5518	20.8390	20.9644	20.9925	20.9868	20.8900	20.4858	19.9640	19.5664	(87)
Th 2	19.8237	19.8257	19.8277	19.8370	19.8387	19.8469	19.8469	19.8484	19.8437	19.8387	19.8352	19.8315	(88)
util rest of house	0.9954	0.9877	0.9637	0.8853	0.7187	0.5006	0.3313	0.3855	0.6797	0.9348	0.9893	0.9966	(89)
MIT 2	17.9877	18.3031	18.7797	19.3381	19.6940	19.8256	19.8445	19.8436	19.7635	19.2650	18.5187	17.9359	(90)

Living area fraction fLA = Living area / (4) = 0.2756 (91)

MIT	18.4336	18.7216	19.1580	19.6726	20.0095	20.1395	20.1608	20.1586	20.0740	19.6015	18.9170	18.3853	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4336	18.7216	19.1580	19.6726	20.0095	20.1395	20.1608	20.1586	20.0740	19.6015	18.9170	18.3853	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9933	0.9835	0.9567	0.8805	0.7288	0.5258	0.3626	0.4188	0.6993	0.9293	0.9858	0.9950	(94)
Useful gains	667.3778	816.3556	953.2764	1037.9751	955.6476	688.4729	452.6538	474.6796	697.2980	762.4637	670.9081	624.5571	(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	1849.4930	1805.1274	1649.9798	1391.5126	1071.5153	708.6287	455.5138	480.1032	766.5734	1160.7436	1529.0830	1842.1525	(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	879.4937	664.4546	518.3474	254.5471	86.2056	0.0000	0.0000	0.0000	0.0000	296.3203	617.8859	905.8910	(98)
Space heating												4223.1455	(98)
Space heating per m2											(98) / (4) =	42.6623	(99)

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4516.7331	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	879.4937	664.4546	518.3474	254.5471	86.2056	0.0000	0.0000	0.0000	0.0000	296.3203	617.8859	905.8910	(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)													
	940.6350	710.6466	554.3822	272.2428	92.1985	0.0000	0.0000	0.0000	0.0000	316.9201	660.8406	968.8674	(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													
	212.4819	187.2955	196.7327	176.4011	172.8986	154.5363	148.4585	162.8459	162.5398	182.9156	193.3602	207.3843	(64)
Efficiency of water heater												79.8000	(216)
(217)m	88.1988	87.9081	87.2803	85.7913	83.0676	79.8000	79.8000	79.8000	79.8000	86.0939	87.6973	88.2946	(217)
Fuel for water heating, kWh/month													
	240.9125	213.0584	225.4034	205.6165	208.1421	193.6545	186.0382	204.0676	203.6840	212.4606	220.4860	234.8777	(219)
Water heating fuel used												2548.4014	(219)
Annual totals kWh/year													
Space heating fuel - main system												4516.7331	(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)												400.9829	(232)
Total delivered energy for all uses												7541.1174	(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	4516.7331	0.2160	975.6144	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2548.4014	0.2160	550.4547	(264)
Space and water heating			1526.0691	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	400.9829	0.5190	208.1101	(268)
Total CO2, kg/m2/year			1773.1042	(272)
Emissions per m2 for space and water heating			15.4164	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			2.1023	(272b)
Emissions per m2 for pumps and fans			0.3932	(272c)
Target Carbon Dioxide Emission Rate (TER) = (15.4164 * 1.00) + 2.1023 + 0.3932, rounded to 2 d.p.			17.9100	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3400 (1b)	x	2.6800 (2b)	=	94.7112 (1b) - (3b)	
First floor	36.8500 (1c)	x	2.7500 (2c)	=	101.3375 (1c) - (3c)	
Second floor	26.8000 (1d)	x	1.8700 (2d)	=	50.1160 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	98.9900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	246.1647	(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) =	0.1219	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3719	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3161	(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	0.4030	0.3951	0.3872	0.3477	0.3398	0.3003	0.3003	0.2924	0.3161	0.3398	0.3556	0.3714	(22b)
Effective ac	0.5812	0.5781	0.5750	0.5604	0.5577	0.5451	0.5451	0.5427	0.5500	0.5577	0.5632	0.5690	(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	
Entrance door			2.1100	1.8000	3.7980			(26)
Windows (Uw = 1.60)			27.6100	1.5038	41.5188			(27)
Rooflights (Uw = 1.60)			6.5600	1.5038	9.8647			(27a)
Heat Loss Floor			33.8300	0.1800	6.0894			(28a)
Exposed floor			1.5100	0.2000	0.3020			(28b)
External Wall	163.7900	29.7200	134.0700	0.1600	21.4512			(29a)
Main Roof	33.8300	6.5600	27.2700	0.1700	4.6359			(30)
External Roof 2	9.8200		9.8200	0.1600	1.5712			(30)
Total net area of external elements Aum(A, m2)			242.7800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	89.2312			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							17.3628	(36)
Total fabric heat loss					(33) + (36) =		106.5940	(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	47.2142	46.9580	46.7069	45.5275	45.3069	44.2797	44.2797	44.0894	44.6753	45.3069	45.7533	46.2200	(38)
Heat transfer coeff	153.8082	153.5520	153.3009	152.1215	151.9008	150.8736	150.8736	150.6834	151.2693	151.9008	152.3472	152.8139	(39)
Average = Sum(39)m / 12 =												152.1204	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.5538	1.5512	1.5487	1.5367	1.5345	1.5241	1.5241	1.5222	1.5281	1.5345	1.5390	1.5437	(40)
HLP (average)												1.5367	(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		2.7300 (42)
Average daily hot water use (litres/day)		99.0370 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.9407	104.9792	101.0177	97.0562	93.0947	89.1333	89.1333	93.0947	97.0562	101.0177	104.9792	108.9407	(44)
Energy conte	161.5558	141.2978	145.8066	127.1178	121.9725	105.2530	97.5324	111.9198	113.2565	131.9896	144.0769	156.4582	(45)
Energy content (annual)										Total = Sum(45)m =		1558.2370	(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)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Water storage loss:
Total storage loss

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

If cylinder contains dedicated solar storage

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)

Primary loss

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)

Heat gains from water heating, kWh/month

34.3306	30.0258	30.9839	27.0125	25.9192	22.3663	20.7256	23.7830	24.0670	28.0478	30.6163	33.2474	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	136.4989	136.4989	136.4989	136.4989	136.4989	136.4989	136.4989	136.4989	136.4989	136.4989	136.4989	136.4989	(66)

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

22.7053	20.1667	16.4006	12.4163	9.2814	7.8357	8.4668	11.0054	14.7714	18.7557	21.8907	23.3364	(67)

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

254.6845	257.3274	250.6675	236.4895	218.5923	201.7715	190.5341	187.8913	194.5511	208.7291	226.6263	243.4472	(68)

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

36.6499	36.6499	36.6499	36.6499	36.6499	36.6499	36.6499	36.6499	36.6499	36.6499	36.6499	36.6499	(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)

-109.1991	-109.1991	-109.1991	-109.1991	-109.1991	-109.1991	-109.1991	-109.1991	-109.1991	-109.1991	-109.1991	-109.1991	(71)

Water heating gains (Table 5)

46.1433	44.6812	41.6450	37.5174	34.8376	31.0643	27.8570	31.9664	33.4264	37.6986	42.5227	44.6873	(72)

Total internal gains

387.4828	386.1249	372.6629	350.3729	326.6609	304.6211	290.8076	294.8127	306.6986	329.1332	354.9894	375.4205	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	10.2600	11.2829	0.6300	0.7000	0.7700	35.3787	(75)
Southwest	17.3500	36.7938	0.6300	0.7000	0.7700	195.0951	(79)
Southeast	3.2800	38.2331	0.6300	0.7000	1.0000	49.7730	(82)
Northwest	3.2800	17.4137	0.6300	0.7000	1.0000	22.6697	(82)

Solar gains	302.9165	545.0866	819.2779	1131.9791	1370.0190	1403.8105	1335.3273	1151.8619	927.0646	622.6171	368.2182	255.6925	(83)
Total gains	690.3993	931.2115	1191.9408	1482.3520	1696.6799	1708.4316	1626.1348	1446.6746	1233.7632	951.7503	723.2077	631.1131	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	44.6940	44.7686	44.8419	45.1896	45.2552	45.5633	45.5633	45.6209	45.4442	45.2552	45.1226	44.9848	
alpha	3.9796	3.9846	3.9895	4.0126	4.0170	4.0376	4.0376	4.0414	4.0296	4.0170	4.0082	3.9990	
util living area	0.9961	0.9872	0.9596	0.8767	0.7215	0.5392	0.4017	0.4661	0.7292	0.9436	0.9911	0.9972	(86)
MIT	19.3378	19.6270	20.0455	20.5204	20.8329	20.9605	20.9905	20.9832	20.8721	20.3956	19.7589	19.2845	(87)
Th 2	19.6474	19.6493	19.6512	19.6601	19.6617	19.6695	19.6695	19.6709	19.6665	19.6617	19.6584	19.6549	(88)
util rest of house	0.9947	0.9827	0.9458	0.8381	0.6485	0.4379	0.2835	0.3378	0.6280	0.9169	0.9873	0.9963	(89)
MIT 2	18.1682	18.4560	18.8651	19.3104	19.5650	19.6546	19.6676	19.6671	19.6068	19.2150	18.5959	18.1207	(90)
Living area fraction									fLA = Living area / (4) =			0.2756	(91)
MIT	18.4905	18.7787	19.1904	19.6439	19.9144	20.0145	20.0322	20.0298	19.9555	19.5403	18.9164	18.4414	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4905	18.7787	19.1904	19.6439	19.9144	20.0145	20.0322	20.0298	19.9555	19.5403	18.9164	18.4414	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9930	0.9789	0.9399	0.8376	0.6634	0.4652	0.3163	0.3734	0.6523	0.9138	0.9844	0.9950	(94)
Useful gains	685.5458	911.5340	1120.3389	1241.5476	1125.5539	794.6852	514.3377	540.2287	804.7301	869.6854	711.9039	627.9335	(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	2182.6123	2131.1086	1945.4557	1634.3735	1247.7733	816.9003	517.8251	546.9547	885.7618	1358.0445	1800.1963	2176.2903	(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	1113.8175	819.5541	613.8869	282.8347	90.9312	0.0000	0.0000	0.0000	0.0000	363.3392	783.5705	1151.9775	(98)
Space heating												5219.9116	(98)
Space heating per m2											(98) / (4) =	52.7317	(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	1418.2120	1116.4648	1145.1938	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.9143	0.9504	0.9274	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1296.6719	1061.1350	1062.0075	0.0000	0.0000	0.0000	0.0000	(102)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	2021.6477	1927.6400	1732.3847	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	521.9826	644.6797	498.7606	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												1665.4229	(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	130.4956	161.1699	124.6902	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												416.3557	(107)
Space cooling per m2												4.2060	(108)
Energy for space heating												52.7317	(99)
Energy for space cooling												4.2060	(108)
Total												56.9377	(109)
Dwelling Fabric Energy Efficiency (DFEE)												56.9	(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	35.3400 (1b)	x	2.6800 (2b)	=	94.7112	(1b) - (3b)
First floor	36.8500 (1c)	x	2.7500 (2c)	=	101.3375	(1c) - (3c)
Second floor	26.8000 (1d)	x	1.8700 (2d)	=	50.1160	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	98.9900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	246.1647	(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) =	0.1219	(8)
Pressure test				Yes	
Measured/design AP50				5.0000	
Infiltration rate				0.3719	(18)
Number of sides sheltered				2	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3161	(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	0.4030	0.3951	0.3872	0.3477	0.3398	0.3003	0.3003	0.2924	0.3161	0.3398	0.3556	0.3714	(22b)
Effective ac	0.5812	0.5781	0.5750	0.5604	0.5577	0.5451	0.5451	0.5427	0.5500	0.5577	0.5632	0.5690	(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			2.1100	1.0000	2.1100			(26)
TER Opening Type (Uw = 1.40)			18.2900	1.3258	24.2481			(27)
TER Room Window (Uw = 1.70)			4.3400	1.5918	6.9082			(27a)
Heat Loss Floor			33.8300	0.1300	4.3979			(28a)
Exposed floor			1.5100	0.1300	0.1963			(28b)
External Wall	163.7900	20.4000	143.3900	0.1800	25.8102			(29a)
Main Roof	33.8300	4.3400	29.4900	0.1300	3.8337			(30)
External Roof 2	9.8200		9.8200	0.1300	1.2766			(30)
Total net area of external elements Aum(A, m2)			242.7800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	68.7810			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							14.8627	(36)
Total fabric heat loss					(33) + (36) =		83.6437	(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	47.2142	46.9580	46.7069	45.5275	45.3069	44.2797	44.2797	44.0894	44.6753	45.3069	45.7533	46.2200	(38)
Heat transfer coeff	130.8580	130.6018	130.3507	129.1713	128.9506	127.9234	127.9234	127.7332	128.3191	128.9506	129.3970	129.8637	(39)
Average = Sum(39)m / 12 =												129.1702	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.3219	1.3193	1.3168	1.3049	1.3027	1.2923	1.2923	1.2904	1.2963	1.3027	1.3072	1.3119	(40)
HLP (average)												1.3049	(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	2.7300	(42)
Average daily hot water use (litres/day)	99.0370	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.9407	104.9792	101.0177	97.0562	93.0947	89.1333	89.1333	93.0947	97.0562	101.0177	104.9792	108.9407	(44)
Energy conte	161.5558	141.2978	145.8066	127.1178	121.9725	105.2530	97.5324	111.9198	113.2565	131.9896	144.0769	156.4582	(45)
Energy content (annual)										Total = Sum(45)m =		1558.2370	(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)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Water storage loss:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month	34.3306	30.0258	30.9839	27.0125	25.9192	22.3663	20.7256	23.7830	24.0670	28.0478	30.6163	33.2474	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	136.4989	136.4989	136.4989	136.4989	136.4989	136.4989	136.4989	136.4989	136.4989	136.4989	136.4989	136.4989	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.7053	20.1667	16.4006	12.4163	9.2814	7.8357	8.4668	11.0054	14.7714	18.7557	21.8907	23.3364	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	254.6845	257.3274	250.6675	236.4895	218.5923	201.7715	190.5341	187.8913	194.5511	208.7291	226.6263	243.4472	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.6499	36.6499	36.6499	36.6499	36.6499	36.6499	36.6499	36.6499	36.6499	36.6499	36.6499	36.6499	(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)	-109.1991	-109.1991	-109.1991	-109.1991	-109.1991	-109.1991	-109.1991	-109.1991	-109.1991	-109.1991	-109.1991	-109.1991	(71)
Water heating gains (Table 5)	46.1433	44.6812	41.6450	37.5174	34.8376	31.0643	27.8570	31.9664	33.4264	37.6986	42.5227	44.6873	(72)
Total internal gains	387.4828	386.1249	372.6629	350.3729	326.6609	304.6211	290.8076	294.8127	306.6986	329.1332	354.9894	375.4205	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	6.8000	11.2829	0.6300	0.7000	0.7700	23.4479	(75)
Southwest	11.4900	36.7938	0.6300	0.7000	0.7700	129.2013	(79)
Southeast	2.1700	38.2331	0.6300	0.7000	1.0000	32.9291	(82)
Northwest	2.1700	17.4137	0.6300	0.7000	1.0000	14.9980	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	200.5762	360.9266	542.4770	749.5260	907.1413	929.5167	884.1709	762.6910	613.8455	412.2618	243.8153	169.3072	(83)
Total gains	588.0590	747.0515	915.1398	1099.8989	1233.8022	1234.1377	1174.9785	1057.5037	920.5441	741.3949	598.8047	544.7277	(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	52.5326	52.6356	52.7370	53.2185	53.3096	53.7377	53.7377	53.8177	53.5720	53.3096	53.1257	52.9348	
alpha	4.5022	4.5090	4.5158	4.5479	4.5540	4.5825	4.5825	4.5878	4.5715	4.5540	4.5417	4.5290	
util living area	0.9980	0.9939	0.9801	0.9301	0.8081	0.6255	0.4703	0.5383	0.8042	0.9688	0.9955	0.9986	(86)
MIT	19.5295	19.7481	20.0856	20.5018	20.8134	20.9568	20.9905	20.9831	20.8659	20.4251	19.8909	19.4907	(87)
Th 2	19.8237	19.8257	19.8277	19.8370	19.8387	19.8469	19.8469	19.8484	19.8437	19.8387	19.8352	19.8315	(88)
util rest of house	0.9973	0.9918	0.9730	0.9055	0.7480	0.5281	0.3515	0.4121	0.7193	0.9531	0.9936	0.9981	(89)
MIT 2	18.4945	18.7136	19.0480	19.4524	19.7219	19.8289	19.8448	19.8441	19.7746	19.3913	18.8640	18.4618	(90)
Living area fraction									fLA = Living area / (4) =			0.2756	(91)
MIT	18.7797	18.9987	19.3339	19.7416	20.0227	20.1397	20.1605	20.1580	20.0753	19.6762	19.1470	18.7454	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7797	18.9987	19.3339	19.7416	20.0227	20.1397	20.1605	20.1580	20.0753	19.6762	19.1470	18.7454	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9964	0.9898	0.9692	0.9031	0.7585	0.5541	0.3845	0.4472	0.7385	0.9502	0.9920	0.9974	(94)
Useful gains	585.9649	739.3985	886.9331	993.3130	935.8929	683.7912	451.8289	472.9366	679.8098	704.4925	593.9988	543.3375	(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	1894.7862	1841.3115	1672.9101	1400.4251	1073.2168	708.6607	455.4736	480.0170	766.7469	1170.3799	1558.8484	1888.9160	(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	973.7631	740.4855	584.7668	293.1207	102.1690	0.0000	0.0000	0.0000	0.0000	346.6202	694.6917	1001.1104	(98)
Space heating												4736.7274	(98)
Space heating per m2											(98) / (4) =	47.8506	(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	1202.4800	946.6332	970.7722	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8973	0.9427	0.9173	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1078.9871	892.4268	890.4853	0.0000	0.0000	0.0000	0.0000	(102)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1494.2445	1425.7783	1298.6847	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	298.9853	396.8135	303.7003	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												999.4992	(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	74.7463	99.2034	75.9251	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												249.8748	(107)
Space cooling per m2												2.5242	(108)
Energy for space heating												47.8506	(99)
Energy for space cooling												2.5242	(108)
Total												50.3748	(109)
Target Fabric Energy Efficiency (TFEE)												57.9	(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	35.3400 (1b)	x	2.6800 (2b)	=	94.7112	(1b) - (3b)
First floor	36.8500 (1c)	x	2.7500 (2c)	=	101.3375	(1c) - (3c)
Second floor	26.8000 (1d)	x	1.8700 (2d)	=	50.1160	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	98.9900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	246.1647	(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							5 * 10	=	50.0000	(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) =	50.0000	/ (5) =	0.2031	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.4531	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3851	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4044	0.3851	0.3851	0.3563	0.3563	0.3177	0.3274	0.3081	0.3177	0.3370	0.3370	0.3659	(22b)
Effective ac	0.5818	0.5742	0.5742	0.5635	0.5635	0.5505	0.5536	0.5475	0.5505	0.5568	0.5568	0.5669	(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	
Entrance door			2.1100	1.8000	3.7980			(26)
Windows (Uw = 1.60)			27.6100	1.5038	41.5188			(27)
Rooflights (Uw = 1.60)			6.5600	1.5038	9.8647			(27a)
Heat Loss Floor			33.8300	0.1800	6.0894			(28a)
Exposed floor			1.5100	0.2000	0.3020			(28b)
External Wall	163.7900	29.7200	134.0700	0.1600	21.4512			(29a)
Main Roof	33.8300	6.5600	27.2700	0.1700	4.6359			(30)
External Roof 2	9.8200		9.8200	0.1600	1.5712			(30)
Total net area of external elements Aum(A, m2)			242.7800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	89.2312			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							17.3628	(36)
Total fabric heat loss					(33) + (36) =		106.5940	(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	47.2599	46.6423	46.6423	45.7724	45.7724	44.7180	44.9703	44.4733	44.7180	45.2302	45.2302	46.0549	(38)
Heat transfer coeff	153.8538	153.2363	153.2363	152.3664	152.3664	151.3120	151.5643	151.0672	151.3120	151.8241	151.8241	152.6488	(39)
Average = Sum(39)m / 12 =												152.2176	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.5542	1.5480	1.5480	1.5392	1.5392	1.5286	1.5311	1.5261	1.5286	1.5337	1.5337	1.5421	(40)
HLP (average)												1.5377	(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	2.7300	(42)
Average daily hot water use (litres/day)	99.0370	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.9407	104.9792	101.0177	97.0562	93.0947	89.1333	89.1333	93.0947	97.0562	101.0177	104.9792	108.9407	(44)
Energy conte	161.5558	141.2978	145.8066	127.1178	121.9725	105.2530	97.5324	111.9198	113.2565	131.9896	144.0769	156.4582	(45)
Energy content (annual)										Total = Sum(45)m =		1558.2370	(45)
Distribution loss (46)m = 0.15 x (45)m	24.2334	21.1947	21.8710	19.0677	18.2959	15.7880	14.6299	16.7880	16.9885	19.7984	21.6115	23.4687	(46)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Water storage loss:

Store volume	200.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):	1.7500	(48)
Temperature factor from Table 2b	0.5400	(49)
Enter (49) or (54) in (55)	0.9450	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Total storage loss	29.2950	26.4600	29.2950	28.3500	29.2950	28.3500	29.2950	29.2950	28.3500	29.2950	28.3500	29.2950	(56)
If cylinder contains dedicated solar storage	29.2950	26.4600	29.2950	28.3500	29.2950	28.3500	29.2950	29.2950	28.3500	29.2950	28.3500	29.2950	(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	214.1132	188.7690	198.3640	177.9798	174.5299	156.1150	150.0898	164.4772	164.1185	184.5470	194.9389	209.0156	(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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Output from w/h	214.1132	188.7690	198.3640	177.9798	174.5299	156.1150	150.0898	164.4772	164.1185	184.5470	194.9389	209.0156	(64)

Total per year (kWh/year) = Sum(64)m = 2177.0580 (64)

RHI water heating demand 2177 (64)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat gains from water heating, kWh/month	95.7632	84.9585	90.5266	82.9563	82.6018	75.6862	74.4754	79.2593	78.3474	85.9324	88.5952	94.0683	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	163.7986	163.7986	163.7986	163.7986	163.7986	163.7986	163.7986	163.7986	163.7986	163.7986	163.7986	163.7986	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	56.7633	50.4166	41.0016	31.0408	23.2034	19.5893	21.1669	27.5135	36.9286	46.8894	54.7268	58.3409	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	380.1262	384.0707	374.1306	352.9694	326.2572	301.1514	284.3793	280.4347	290.3748	311.5360	338.2483	363.3540	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.1098	54.1098	54.1098	54.1098	54.1098	54.1098	54.1098	54.1098	54.1098	54.1098	54.1098	54.1098	(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)	-109.1991	-109.1991	-109.1991	-109.1991	-109.1991	-109.1991	-109.1991	-109.1991	-109.1991	-109.1991	-109.1991	-109.1991	(71)
Water heating gains (Table 5)	128.7140	126.4263	121.6756	115.2170	111.0239	105.1198	100.1014	106.5313	108.8158	115.5006	123.0489	126.4359	(72)
Total internal gains	677.3129	672.6230	648.5172	610.9367	572.1939	537.5699	517.3570	526.1889	547.8286	585.6354	627.7333	659.8402	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	10.2600	12.9236	0.6300	0.7000	0.7700	40.5230	(75)
Southwest	17.3500	40.4699	0.6300	0.7000	0.7700	214.5871	(79)
Southeast	3.2800	43.0236	0.6300	0.7000	1.0000	56.0095	(82)
Northwest	3.2800	20.0668	0.6300	0.7000	1.0000	26.1236	(82)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains	337.2432	547.4506	816.3568	1167.7145	1380.3503	1514.7374	1424.8677	1254.7341	1003.2495	668.6865	420.2566	281.7509	(83)
Total gains	1014.5561	1220.0736	1464.8740	1778.6512	1952.5441	2052.3072	1942.2246	1780.9230	1551.0781	1254.3219	1047.9899	941.5911	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	44.6808	44.8608	44.8608	45.1169	45.1169	45.4313	45.3557	45.5049	45.4313	45.2781	45.2781	45.0335	
alpha	3.9787	3.9907	3.9907	4.0078	4.0078	4.0288	4.0237	4.0337	4.0288	4.0185	4.0185	4.0022	
util living area	0.9821	0.9639	0.9121	0.7797	0.5851	0.3644	0.2413	0.2704	0.5395	0.8488	0.9615	0.9860	(86)
MIT	19.7188	19.9528	20.3384	20.7302	20.9322	20.9923	20.9990	20.9984	20.9638	20.6786	20.1434	19.6729	(87)
Th 2	19.6471	19.6517	19.6517	19.6582	19.6582	19.6661	19.6643	19.6680	19.6661	19.6623	19.6623	19.6561	(88)
util rest of house	0.9761	0.9523	0.8850	0.7230	0.5008	0.2693	0.1376	0.1584	0.4269	0.7908	0.9466	0.9812	(89)
MIT 2	18.0320	18.3672	18.8990	19.3977	19.6106	19.6634	19.6641	19.6678	19.6484	19.3609	18.6510	17.9725	(90)

Living area fraction fLA = Living area / (4) = 0.2756 (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
MIT	18.4969	18.8042	19.2957	19.7649	19.9748	20.0297	20.0320	20.0345	20.0109	19.7240	19.0623	18.4411	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.3469	18.6542	19.1457	19.6149	19.8248	19.8797	19.8820	19.8845	19.8609	19.5740	18.9123	18.2911	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9677	0.9407	0.8726	0.7210	0.5118	0.2847	0.1546	0.1767	0.4441	0.7863	0.9352	0.9740	(94)
Useful gains	981.7837	1147.7786	1278.2406	1282.4122	999.2247	584.3281	300.2610	314.6591	688.8754	986.2767	980.0349	917.1172	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W	2038.0788	2000.3760	1799.8653	1480.2241	1039.8684	587.0396	300.4001	314.8982	705.2561	1210.6466	1656.7465	2013.6114	(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	785.8836	572.9454	388.0888	142.4246	30.2389	0.0000	0.0000	0.0000	0.0000	166.9312	487.2323	815.7917	(98)

Space heating	3389.5365	(98)
RHI space heating demand	3390	(98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3400 (1b)	x	2.6800 (2b)	=	94.7112	(1b) - (3b)
First floor	36.8500 (1c)	x	2.7500 (2c)	=	101.3375	(1c) - (3c)
Second floor	26.8000 (1d)	x	1.8700 (2d)	=	50.1160	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	98.9900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	246.1647	(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							5 * 10	=	50.0000	(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) =	50.0000	/	(5) =	0.2031	(8)
Pressure test				Yes	
Measured/design AP50				5.0000	
Infiltration rate				0.4531	(18)
Number of sides sheltered				2	(19)
Shelter factor			(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =	0.3851	(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	0.4911	0.4814	0.4718	0.4237	0.4140	0.3659	0.3659	0.3563	0.3851	0.4140	0.4333	0.4525	(22b)
Effective ac	0.6206	0.6159	0.6113	0.5897	0.5857	0.5669	0.5669	0.5635	0.5742	0.5857	0.5939	0.6024	(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	
Entrance door			2.1100	1.8000	3.7980			(26)
Windows (Uw = 1.60)			27.6100	1.5038	41.5188			(27)
Rooflights (Uw = 1.60)			6.5600	1.5038	9.8647			(27a)
Heat Loss Floor			33.8300	0.1800	6.0894			(28a)
Exposed floor			1.5100	0.2000	0.3020			(28b)
External Wall	163.7900	29.7200	134.0700	0.1600	21.4512			(29a)
Main Roof	33.8300	6.5600	27.2700	0.1700	4.6359			(30)
External Roof 2	9.8200		9.8200	0.1600	1.5712			(30)
Total net area of external elements Aum(A, m2)			242.7800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	89.2312			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		17.3628	(36)
Total fabric heat loss	(33) + (36) =	106.5940	(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	50.4118	50.0314	49.6586	47.9076	47.5800	46.0549	46.0549	45.7724	46.6423	47.5800	48.2427	48.9356	(38)
Heat transfer coeff	157.0057	156.6254	156.2526	154.5015	154.1739	152.6488	152.6488	152.3664	153.2363	154.1739	154.8367	155.5296	(39)
Average = Sum(39)m / 12 =												154.5000	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.5861	1.5822	1.5785	1.5608	1.5575	1.5421	1.5421	1.5392	1.5480	1.5575	1.5642	1.5712	(40)
HLP (average)												1.5608	(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	2.7300 (42)
Average daily hot water use (litres/day)	99.0370 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.9407	104.9792	101.0177	97.0562	93.0947	89.1333	89.1333	93.0947	97.0562	101.0177	104.9792	108.9407	(44)
Energy conte	161.5558	141.2978	145.8066	127.1178	121.9725	105.2530	97.5324	111.9198	113.2565	131.9896	144.0769	156.4582	(45)
Energy content (annual)										Total = Sum(45)m =		1558.2370	(45)
Distribution loss (46)m = 0.15 x (45)m	24.2334	21.1947	21.8710	19.0677	18.2959	15.7880	14.6299	16.7880	16.9885	19.7984	21.6115	23.4687	(46)

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Water storage loss:

Store volume	200.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):	1.7500	(48)
Temperature factor from Table 2b	0.5400	(49)
Enter (49) or (54) in (55)	0.9450	(55)

Total storage loss	29.2950	26.4600	29.2950	28.3500	29.2950	28.3500	29.2950	29.2950	28.3500	29.2950	28.3500	29.2950	(56)
If cylinder contains dedicated solar storage	29.2950	26.4600	29.2950	28.3500	29.2950	28.3500	29.2950	29.2950	28.3500	29.2950	28.3500	29.2950	(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	214.1132	188.7690	198.3640	177.9798	174.5299	156.1150	150.0898	164.4772	164.1185	184.5470	194.9389	209.0156	(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	214.1132	188.7690	198.3640	177.9798	174.5299	156.1150	150.0898	164.4772	164.1185	184.5470	194.9389	209.0156	(64)

Total per year (kWh/year) = Sum(64)m = 2177.0580 (64)

Heat gains from water heating, kWh/month	95.7632	84.9585	90.5266	82.9563	82.6018	75.6862	74.4754	79.2593	78.3474	85.9324	88.5952	94.0683	(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	163.7986	163.7986	163.7986	163.7986	163.7986	163.7986	163.7986	163.7986	163.7986	163.7986	163.7986	163.7986	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	56.7633	50.4166	41.0016	31.0408	23.2034	19.5893	21.1669	27.5135	36.9286	46.8894	54.7268	58.3409	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	380.1262	384.0707	374.1306	352.9694	326.2572	301.1514	284.3793	280.4347	290.3748	311.5360	338.2483	363.3540	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.1098	54.1098	54.1098	54.1098	54.1098	54.1098	54.1098	54.1098	54.1098	54.1098	54.1098	54.1098	(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)	-109.1991	-109.1991	-109.1991	-109.1991	-109.1991	-109.1991	-109.1991	-109.1991	-109.1991	-109.1991	-109.1991	-109.1991	(71)
Water heating gains (Table 5)	128.7140	126.4263	121.6756	115.2170	111.0239	105.1198	100.1014	106.5313	108.8158	115.5006	123.0489	126.4359	(72)
Total internal gains	677.3129	672.6230	648.5172	610.9367	572.1939	537.5699	517.3570	526.1889	547.8286	585.6354	627.7333	659.8402	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	10.2600	11.2829	0.6300	0.7000	0.7700	35.3787	(75)
Southwest	17.3500	36.7938	0.6300	0.7000	0.7700	195.0951	(79)
Southeast	3.2800	38.2331	0.6300	0.7000	1.0000	49.7730	(82)
Northwest	3.2800	17.4137	0.6300	0.7000	1.0000	22.6697	(82)

Solar gains	302.9165	545.0866	819.2779	1131.9791	1370.0190	1403.8105	1335.3273	1151.8619	927.0646	622.6171	368.2182	255.6925	(83)
Total gains	980.2294	1217.7096	1467.7951	1742.9157	1942.2129	1941.3804	1852.6842	1678.0508	1474.8932	1208.2525	995.9516	915.5327	(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	43.7838	43.8901	43.9948	44.4934	44.5880	45.0335	45.0335	45.1169	44.8608	44.5880	44.3971	44.1993	
alpha	3.9189	3.9260	3.9330	3.9662	3.9725	4.0022	4.0022	4.0078	3.9907	3.9725	3.9598	3.9466	
util living area	0.9866	0.9695	0.9276	0.8256	0.6639	0.4867	0.3585	0.4102	0.6505	0.8939	0.9740	0.9896	(86)
MIT	19.5455	19.8205	20.2044	20.6200	20.8725	20.9716	20.9934	20.9889	20.9134	20.5378	19.9571	19.4960	(87)
Th 2	19.6236	19.6264	19.6292	19.6422	19.6447	19.6561	19.6561	19.6582	19.6517	19.6447	19.6397	19.6345	(88)
util rest of house	0.9822	0.9598	0.9057	0.7786	0.5891	0.3915	0.2510	0.2943	0.5478	0.8517	0.9641	0.9861	(89)
MIT 2	17.7658	18.1608	18.6983	19.2510	19.5404	19.6409	19.6543	19.6548	19.5962	19.1721	18.3716	17.7016	(90)

Living area fraction fLA = Living area / (4) = 0.2756 (91)

MIT	18.2563	18.6182	19.1134	19.6283	19.9075	20.0076	20.0233	20.0224	19.9592	19.5485	18.8085	18.1961	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.1063	18.4682	18.9634	19.4783	19.7575	19.8576	19.8733	19.8724	19.8092	19.3985	18.6585	18.0461	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9751	0.9487	0.8923	0.7722	0.5958	0.4062	0.2687	0.3132	0.5608	0.8423	0.9539	0.9801	(94)
Useful gains	955.7906	1155.2793	1309.7175	1345.8486	1157.1846	788.6791	497.7420	525.5245	827.0567	1017.6995	950.0721	897.2704	(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	2167.6664	2125.1217	1947.4330	1634.3644	1242.2572	802.5697	499.6698	529.0836	874.8603	1356.4945	1789.6834	2153.4817	(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	901.6356	651.7340	474.4604	207.7314	63.2940	0.0000	0.0000	0.0000	0.0000	252.0635	604.5202	934.6212	(98)

Space heating		4090.0602	(98)
Space heating per m2	(98) / (4) =	41.3179	(99)

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8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.7000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4509.4380	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	901.6356	651.7340	474.4604	207.7314	63.2940	0.0000	0.0000	0.0000	0.0000	252.0635	604.5202	934.6212	(98)
Space heating efficiency (main heating system 1)													
	90.7000	90.7000	90.7000	90.7000	90.7000	0.0000	0.0000	0.0000	0.0000	90.7000	90.7000	90.7000	(210)
Space heating fuel (main heating system)													
	994.0856	718.5601	523.1095	229.0313	69.7839	0.0000	0.0000	0.0000	0.0000	277.9091	666.5051	1030.4534	(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													
	214.1132	188.7690	198.3640	177.9798	174.5299	156.1150	150.0898	164.4772	164.1185	184.5470	194.9389	209.0156	(64)
Efficiency of water heater												80.0000	(216)
(217)m	88.4303	88.0549	87.2591	85.4277	82.5932	80.0000	80.0000	80.0000	80.0000	85.8468	87.8354	88.5358	(217)
Fuel for water heating, kWh/month													
	242.1266	214.3764	227.3275	208.3397	211.3128	195.1438	187.6122	205.5966	205.1482	214.9725	221.9367	236.0804	(219)
Water heating fuel used												2569.9733	(219)
Annual totals kWh/year													
Space heating fuel - main system												4509.4380	(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)												400.9829	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.40 * 1080 * 0.80) =										-967.2541		-967.2541	(233)
Total delivered energy for all uses												6588.1401	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4509.4380	3.4800	156.9284	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2569.9733	3.4800	89.4351	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	400.9829	13.1900	52.8896	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-967.2541	13.1900	-127.5808	(252)
Total energy cost			301.5648	(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] =	0.8796	(257)
SAP value		87.7292	
SAP rating (Section 12)		88	(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	4509.4380	0.2160	974.0386	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2569.9733	0.2160	555.1142	(264)
Space and water heating			1529.1528	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	400.9829	0.5190	208.1101	(268)
Energy saving/generation technologies				
PV Unit	-967.2541	0.5190	-502.0049	(269)
Total kg/year			1274.1831	(272)
CO2 emissions per m2			12.8700	(273)
EI value			88.1422	
EI rating			88	(274)
EI band			B	

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9070 = 3.837, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9070 = 0.2381, stars = 4
Water heating energy efficiency	3.48 / 0.8450 = 4.118, stars = 4
Water heating environmental impact	0.216 / 0.8450 = 0.2556, stars = 4

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3400 (1b)	x	2.6800 (2b)	=	94.7112 (1b) - (3b)	
First floor	36.8500 (1c)	x	2.7500 (2c)	=	101.3375 (1c) - (3c)	
Second floor	26.8000 (1d)	x	1.8700 (2d)	=	50.1160 (1d) - (3d)	
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	98.9900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	246.1647	(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							5 * 10	=	50.0000	(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) =	50.0000	/	(5) =	0.2031	(8)
Pressure test				Yes	
Measured/design AP50				5.0000	
Infiltration rate				0.4531	(18)
Number of sides sheltered				2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =			0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =			0.3851	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4044	0.3851	0.3851	0.3563	0.3563	0.3177	0.3274	0.3081	0.3177	0.3370	0.3370	0.3659	(22b)
Effective ac	0.5818	0.5742	0.5742	0.5635	0.5635	0.5505	0.5536	0.5475	0.5505	0.5568	0.5568	0.5669	(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	
Entrance door			2.1100	1.8000	3.7980			(26)
Windows (Uw = 1.60)			27.6100	1.5038	41.5188			(27)
Rooflights (Uw = 1.60)			6.5600	1.5038	9.8647			(27a)
Heat Loss Floor			33.8300	0.1800	6.0894			(28a)
Exposed floor			1.5100	0.2000	0.3020			(28b)
External Wall	163.7900	29.7200	134.0700	0.1600	21.4512			(29a)
Main Roof	33.8300	6.5600	27.2700	0.1700	4.6359			(30)
External Roof 2	9.8200		9.8200	0.1600	1.5712			(30)
Total net area of external elements Aum(A, m2)			242.7800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	89.2312			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							17.3628	(36)
Total fabric heat loss					(33) + (36) =		106.5940	(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	47.2599	46.6423	46.6423	45.7724	45.7724	44.7180	44.9703	44.4733	44.7180	45.2302	45.2302	46.0549	(38)
Heat transfer coeff	153.8538	153.2363	153.2363	152.3664	152.3664	151.3120	151.5643	151.0672	151.3120	151.8241	151.8241	152.6488	(39)
Average = Sum(39)m / 12 =												152.2176	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.5542	1.5480	1.5480	1.5392	1.5392	1.5286	1.5311	1.5261	1.5286	1.5337	1.5337	1.5421	(40)
HLP (average)												1.5377	(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	2.7300	(42)
Average daily hot water use (litres/day)	99.0370	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.9407	104.9792	101.0177	97.0562	93.0947	89.1333	89.1333	93.0947	97.0562	101.0177	104.9792	108.9407	(44)
Energy conte	161.5558	141.2978	145.8066	127.1178	121.9725	105.2530	97.5324	111.9198	113.2565	131.9896	144.0769	156.4582	(45)
Energy content (annual)										Total = Sum(45)m =		1558.2370	(45)
Distribution loss (46)m = 0.15 x (45)m	24.2334	21.1947	21.8710	19.0677	18.2959	15.7880	14.6299	16.7880	16.9885	19.7984	21.6115	23.4687	(46)

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

Water storage loss:
Store volume 200.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day): 1.7500 (48)
Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 0.9450 (55)
Total storage loss

	29.2950	26.4600	29.2950	28.3500	29.2950	28.3500	29.2950	29.2950	28.3500	29.2950	28.3500	29.2950 (56)

If cylinder contains dedicated solar storage

	29.2950	26.4600	29.2950	28.3500	29.2950	28.3500	29.2950	29.2950	28.3500	29.2950	28.3500	29.2950 (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

	214.1132	188.7690	198.3640	177.9798	174.5299	156.1150	150.0898	164.4772	164.1185	184.5470	194.9389	209.0156 (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

	214.1132	188.7690	198.3640	177.9798	174.5299	156.1150	150.0898	164.4772	164.1185	184.5470	194.9389	209.0156 (64)

Total per year (kWh/year) = Sum(64)m = 2177.0580 (64)
Heat gains from water heating, kWh/month

	95.7632	84.9585	90.5266	82.9563	82.6018	75.6862	74.4754	79.2593	78.3474	85.9324	88.5952	94.0683 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	163.7986	163.7986	163.7986	163.7986	163.7986	163.7986	163.7986	163.7986	163.7986	163.7986	163.7986	163.7986	(66)

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

	56.7633	50.4166	41.0016	31.0408	23.2034	19.5893	21.1669	27.5135	36.9286	46.8894	54.7268	58.3409 (67)

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

	380.1262	384.0707	374.1306	352.9694	326.2572	301.1514	284.3793	280.4347	290.3748	311.5360	338.2483	363.3540 (68)

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

	54.1098	54.1098	54.1098	54.1098	54.1098	54.1098	54.1098	54.1098	54.1098	54.1098	54.1098	54.1098 (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)

	-109.1991	-109.1991	-109.1991	-109.1991	-109.1991	-109.1991	-109.1991	-109.1991	-109.1991	-109.1991	-109.1991	-109.1991 (71)

Water heating gains (Table 5)

	128.7140	126.4263	121.6756	115.2170	111.0239	105.1198	100.1014	106.5313	108.8158	115.5006	123.0489	126.4359 (72)

Total internal gains

	677.3129	672.6230	648.5172	610.9367	572.1939	537.5699	517.3570	526.1889	547.8286	585.6354	627.7333	659.8402 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Northeast	10.2600	12.9236	0.6300	0.7000	0.7700	40.5230	(75)
Southwest	17.3500	40.4699	0.6300	0.7000	0.7700	214.5871	(79)
Southeast	3.2800	43.0236	0.6300	0.7000	1.0000	56.0095	(82)
Northwest	3.2800	20.0668	0.6300	0.7000	1.0000	26.1236	(82)

Solar gains	337.2432	547.4506	816.3568	1167.7145	1380.3503	1514.7374	1424.8677	1254.7341	1003.2495	668.6865	420.2566	281.7509 (83)
Total gains	1014.5561	1220.0736	1464.8740	1778.6512	1952.5441	2052.3072	1942.2246	1780.9230	1551.0781	1254.3219	1047.9899	941.5911 (84)

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7. Mean internal temperature (heating season)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	44.6808	44.8608	44.8608	45.1169	45.1169	45.4313	45.3557	45.5049	45.4313	45.2781	45.2781	45.0335	
alpha	3.9787	3.9907	3.9907	4.0078	4.0078	4.0288	4.0237	4.0337	4.0288	4.0185	4.0185	4.0022	
util living area													
	0.9821	0.9639	0.9121	0.7797	0.5851	0.3644	0.2413	0.2704	0.5395	0.8488	0.9615	0.9860	(86)
MIT	19.7188	19.9528	20.3384	20.7302	20.9322	20.9923	20.9990	20.9984	20.9638	20.6786	20.1434	19.6729	(87)
Th 2	19.6471	19.6517	19.6517	19.6582	19.6582	19.6661	19.6643	19.6680	19.6661	19.6623	19.6623	19.6561	(88)
util rest of house													
	0.9761	0.9523	0.8850	0.7230	0.5008	0.2693	0.1376	0.1584	0.4269	0.7908	0.9466	0.9812	(89)
MIT 2	18.0320	18.3672	18.8990	19.3977	19.6106	19.6634	19.6641	19.6678	19.6484	19.3609	18.6510	17.9725	(90)
Living area fraction										fLA = Living area / (4) =		0.2756	(91)
MIT	18.4969	18.8042	19.2957	19.7649	19.9748	20.0297	20.0320	20.0345	20.0109	19.7240	19.0623	18.4411	(92)
Temperature adjustment												-0.1500	
adjusted MIT	18.3469	18.6542	19.1457	19.6149	19.8248	19.8797	19.8820	19.8845	19.8609	19.5740	18.9123	18.2911	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9677	0.9407	0.8726	0.7210	0.5118	0.2847	0.1546	0.1767	0.4441	0.7863	0.9352	0.9740	(94)
Useful gains	981.7837	1147.7786	1278.2406	1282.4122	999.2247	584.3281	300.2610	314.6591	688.8754	986.2767	980.0349	917.1172	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	2038.0788	2000.3760	1799.8653	1480.2241	1039.8684	587.0396	300.4001	314.8982	705.2561	1210.6466	1656.7465	2013.6114	(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													
	785.8836	572.9454	388.0888	142.4246	30.2389	0.0000	0.0000	0.0000	0.0000	166.9312	487.2323	815.7917	(98)
Space heating												3389.5365	(98)
Space heating per m2											(98) / (4) =	34.2412	(99)

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

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.7000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												3737.0855	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	785.8836	572.9454	388.0888	142.4246	30.2389	0.0000	0.0000	0.0000	0.0000	166.9312	487.2323	815.7917	(98)
Space heating efficiency (main heating system 1)													
	90.7000	90.7000	90.7000	90.7000	90.7000	0.0000	0.0000	0.0000	0.0000	90.7000	90.7000	90.7000	(210)
Space heating fuel (main heating system)													
	866.4648	631.6929	427.8818	157.0282	33.3395	0.0000	0.0000	0.0000	0.0000	184.0477	537.1911	899.4396	(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													
	214.1132	188.7690	198.3640	177.9798	174.5299	156.1150	150.0898	164.4772	164.1185	184.5470	194.9389	209.0156	(64)
Efficiency of water heater												80.0000	(216)
(217)m	88.1749	87.7901	86.7743	84.4274	81.4184	80.0000	80.0000	80.0000	80.0000	84.7484	87.3610	88.2915	(217)
Fuel for water heating, kWh/month													
	242.8280	215.0231	228.5976	210.8081	214.3618	195.1438	187.6122	205.5966	205.1482	217.7586	223.1418	236.7336	(219)
Water heating fuel used												2582.7533	(219)
Annual totals kWh/year													
Space heating fuel - main system												3737.0855	(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)												400.9829	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.40 * 1140 * 0.80) =										-1021.5294		-1021.5294	(233)
Total delivered energy for all uses												5774.2923	(238)

10a. Fuel costs - using BEDF prices (465)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3737.0855	3.9500	147.6149	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	2582.7533	3.9500	102.0188	(247)
Pumps and fans for heating	75.0000	18.7000	14.0250	(249)
Energy for lighting	400.9829	18.7000	74.9838	(250)
Additional standing charges			91.0000	(251)
Energy saving/generation technologies				
PV Unit	-1021.5294	18.7000	-191.0260	(252)
Total energy cost			238.6164	(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	3737.0855	0.2160	807.2105	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2582.7533	0.2160	557.8747	(264)
Space and water heating			1365.0852	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	400.9829	0.5190	208.1101	(268)
Energy saving/generation technologies				
PV Unit	-1021.5294	0.5190	-530.1738	(269)
Total kg/year			1081.9466	(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	3737.0855	1.2200	4559.2443	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2582.7533	1.2200	3150.9590	(264)
Space and water heating			7710.2033	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	400.9829	3.0700	1231.0175	(268)
Energy saving/generation technologies				
PV Unit	-1021.5294	3.0700	-3136.0953	(269)
Primary energy kWh/year			6035.3756	(272)

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

Primary energy kWh/m2/year 60.9695 (273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 88
Current environmental impact rating: B 88

(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	-£ 44	-264 kg (24.4%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£44	2.67 kg/m²	B 89	B 91
Total Savings	£44	2.67 kg/m²		

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

Fuel prices for cost data on this page from database revision number 465 TEST (04 Sep 2020)
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	£89	£98	-£9
Mains gas	£341	£288	£53
Space heating	£253	£254	-£2
Water heating	£102	£57	£45
Lighting	£75	£75	£0
Generated (PV)	-£191	-£191	£0
Total cost of fuels	£239	£195	£44
Total cost of uses	£239	£195	£43
Delivered energy	58 kWh/m²	45 kWh/m²	13 kWh/m²
Carbon dioxide emissions	1.1 tonnes	0.8 tonnes	0.3 tonnes
CO2 emissions per m²	11 kg/m²	8 kg/m²	3 kg/m²
Primary energy	61 kWh/m²	46 kWh/m²	15 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3400	(1b)	x 2.6800	(2b) =	94.7112	(1b) - (3b)
First floor	36.8500	(1c)	x 2.7500	(2c) =	101.3375	(1c) - (3c)
Second floor	26.8000	(1d)	x 1.8700	(2d) =	50.1160	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	98.9900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		246.1647	(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							5 * 10	=	50.0000	(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) =	50.0000	/ (5) =	0.2031	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.4531	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3851	(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	0.4911	0.4814	0.4718	0.4237	0.4140	0.3659	0.3659	0.3563	0.3851	0.4140	0.4333	0.4525	(22b)
Effective ac	0.6206	0.6159	0.6113	0.5897	0.5857	0.5669	0.5669	0.5635	0.5742	0.5857	0.5939	0.6024	(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	
Entrance door			2.1100	1.8000	3.7980			(26)
Windows (Uw = 1.60)			27.6100	1.5038	41.5188			(27)
Rooflights (Uw = 1.60)			6.5600	1.5038	9.8647			(27a)
Heat Loss Floor			33.8300	0.1800	6.0894			(28a)
Exposed floor			1.5100	0.2000	0.3020			(28b)
External Wall	163.7900	29.7200	134.0700	0.1600	21.4512			(29a)
Main Roof	33.8300	6.5600	27.2700	0.1700	4.6359			(30)
External Roof 2	9.8200		9.8200	0.1600	1.5712			(30)
Total net area of external elements Aum(A, m2)			242.7800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	89.2312			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							17.3628	(36)
Total fabric heat loss					(33) + (36) =		106.5940	(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	50.4118	50.0314	49.6586	47.9076	47.5800	46.0549	46.0549	45.7724	46.6423	47.5800	48.2427	48.9356	(38)
Heat transfer coeff	157.0057	156.6254	156.2526	154.5015	154.1739	152.6488	152.6488	152.3664	153.2363	154.1739	154.8367	155.5296	(39)
Average = Sum(39)m / 12 =												154.5000	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.5861	1.5822	1.5785	1.5608	1.5575	1.5421	1.5421	1.5392	1.5480	1.5575	1.5642	1.5712	(40)
HLP (average)												1.5608	(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	2.7300	(42)
Average daily hot water use (litres/day)	99.0370	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.9407	104.9792	101.0177	97.0562	93.0947	89.1333	89.1333	93.0947	97.0562	101.0177	104.9792	108.9407	(44)
Energy conte	161.5558	141.2978	145.8066	127.1178	121.9725	105.2530	97.5324	111.9198	113.2565	131.9896	144.0769	156.4582	(45)
Energy content (annual)										Total = Sum(45)m =		1558.2370	(45)
Distribution loss (46)m = 0.15 x (45)m	24.2334	21.1947	21.8710	19.0677	18.2959	15.7880	14.6299	16.7880	16.9885	19.7984	21.6115	23.4687	(46)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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Water storage loss:
Store volume                                                                                                                 200.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                                  1.7500 (48)
  Temperature factor from Table 2b                                                                                             0.5400 (49)
Enter (49) or (54) in (55)                                                                                                     0.9450 (55)
Total storage loss
                29.2950    26.4600    29.2950    28.3500    29.2950    28.3500    29.2950    29.2950    28.3500    29.2950    28.3500    29.2950 (56)
If cylinder contains dedicated solar storage
                18.3094    16.5375    18.3094    17.7188    18.3094    17.7188    18.3094    18.3094    17.7188    18.3094    17.7188    18.3094 (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
               203.1276   178.8465   185.9827   160.5949   150.7500   132.8770   126.0772   141.3952   148.0844   172.1656   184.3077   198.0300 (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                                                                                                            1.1639 (H8)
Utilisation factor                                                                                                             0.5765 (H9)
Collector performance factor                                                                                                   0.8793 (H10)
Dedicated solar storage volume                                                                                                75.0000 (H11)
Effective solar volume                                                                                                       112.5000 (H13)
Daily hot water demand                                                                                                        99.0370 (H14)
Volume ratio Veff/V                                                                                                            1.1359 (H15)
Solar storage volume factor                                                                                                    1.0000 (H16)
Solar input                                                                                                                 -919.3329 (H17)
Solar input    -26.6588   -44.4859   -75.7646  -101.5395  -125.4435  -123.3309  -121.7011  -106.3308   -83.2784   -56.8693   -31.6212   -22.3089 (63)
                                                                                     Solar input (sum of months) = Sum(63)m =  -919.3329 (63)
Output from w/h
               176.4688   134.3606   110.2181    59.0554    25.3065     9.5461     4.3762    35.0643    64.8060   115.2963   152.6865   175.7211 (64)
                                                                                       Total per year (kWh/year) = Sum(64)m =  1062.9059 (64)
Heat gains from water heating, kWh/month
                86.9747    77.0205    80.6215    69.0484    63.5778    57.0959    55.2654    60.7936    65.5201    76.0274    80.0902    85.2798 (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          163.7986   163.7986   163.7986   163.7986   163.7986   163.7986   163.7986   163.7986   163.7986   163.7986   163.7986   163.7986 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                56.7633    50.4166    41.0016    31.0408    23.2034    19.5893    21.1669    27.5135    36.9286    46.8894    54.7268    58.3409 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               380.1262   384.0707   374.1306   352.9694   326.2572   301.1514   284.3793   280.4347   290.3748   311.5360   338.2483   363.3540 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                54.1098    54.1098    54.1098    54.1098    54.1098    54.1098    54.1098    54.1098    54.1098    54.1098    54.1098    54.1098 (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)
              -109.1991  -109.1991  -109.1991  -109.1991  -109.1991  -109.1991  -109.1991  -109.1991  -109.1991  -109.1991  -109.1991  -109.1991 (71)
Water heating gains (Table 5)
               116.9015   114.6138   108.3623    95.9005    85.4541    79.2998    74.2814    81.7118    91.0001   102.1873   111.2364   114.6234 (72)
Total internal gains
               665.5004   660.8105   635.2039   591.6202   546.6240   511.7499   491.5370   501.3695   530.0129   572.3221   615.9208   648.0277 (73)


----------------------------------------------------------------------------------------------------
6. Solar gains
----------------------------------------------------------------------------------------------------
[Jan]                                        Area          Solar flux              g               FF            Access            Gains
                                               m2            Table 6a    Specific data    Specific data         factor                W
                                                                 W/m2      or Table 6b      or Table 6c       Table 6d
----------------------------------------------------------------------------------------------------
Northeast                                 10.2600             11.2829           0.6300           0.7000           0.7700          35.3787 (75)
Southwest                                 17.3500             36.7938           0.6300           0.7000           0.7700         195.0951 (79)
Southeast                                  3.2800             38.2331           0.6300           0.7000           1.0000          49.7730 (82)
Northwest                                  3.2800             17.4137           0.6300           0.7000           1.0000          22.6697 (82)
----------------------------------------------------------------------------------------------------

Solar gains    302.9165   545.0866   819.2779  1131.9791  1370.0190  1403.8105  1335.3273  1151.8619   927.0646   622.6171   368.2182   255.6925 (83)
Total gains    968.4169  1205.8971  1454.4818  1723.5992  1916.6430  1915.5604  1826.8643  1653.2314  1457.0775  1194.9392   984.1391   903.7202 (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             43.7838    43.8901    43.9948    44.4934    44.5880    45.0335    45.0335    45.1169    44.8608    44.5880    44.3971    44.1993
alpha            3.9189     3.9260     3.9330     3.9662     3.9725     4.0022     4.0022     4.0078     3.9907     3.9725     3.9598     3.9466
util living area
                 0.9872     0.9704     0.9294     0.8297     0.6702     0.4925     0.3634     0.4160     0.6563     0.8969     0.9750     0.9900 (86)

MIT             19.5357    19.8114    20.1958    20.6122    20.8682    20.9703    20.9931    20.9884    20.9106    20.5304    19.9478    19.4860 (87)
Th 2            19.6236    19.6264    19.6292    19.6422    19.6447    19.6561    19.6561    19.6582    19.6517    19.6447    19.6397    19.6345 (88)
util rest of house
                 0.9829     0.9610     0.9079     0.7833     0.5954     0.3965     0.2546     0.2986     0.5534     0.8554     0.9654     0.9867 (89)
MIT 2           17.7518    18.1480    18.6869    19.2419    19.5364    19.6402    19.6542    19.6546    19.5942    19.1631    18.3585    17.6873 (90)
Living area fraction                                                                         fLA = Living area / (4) =     0.2756 (91)
MIT             18.2434    18.6064    19.1027    19.6195    19.9034    20.0068    20.0232    20.0221    19.9570    19.5399    18.7965    18.1830 (92)
Temperature adjustment                                                                                                    -0.1500
adjusted MIT    18.0934    18.4564    18.9527    19.4695    19.7534    19.8568    19.8732    19.8721    19.8070    19.3899    18.6465    18.0330 (93)
```

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9759	0.9500	0.8945	0.7765	0.6018	0.4113	0.2724	0.3177	0.5662	0.8458	0.9554	0.9808	(94)
Useful gains	945.1219	1145.6598	1301.0465	1338.4212	1153.5181	787.9222	497.6171	525.2874	825.0612	1010.6750	940.2605	886.3926	(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													
	2165.6427	2123.2783	1945.7728	1633.0092	1241.6284	802.4403	499.6454	529.0389	874.5164	1355.1793	1787.8223	2151.4404	(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													
	908.0675	656.9597	479.6764	212.1034	65.5540	0.0000	0.0000	0.0000	0.0000	256.3113	610.2445	941.1955	(98)
Space heating												4130.1123	(98)
Space heating per m2											(98) / (4) =	41.7225	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.7000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4553.5968	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	908.0675	656.9597	479.6764	212.1034	65.5540	0.0000	0.0000	0.0000	0.0000	256.3113	610.2445	941.1955	(98)
Space heating efficiency (main heating system 1)													
	90.7000	90.7000	90.7000	90.7000	0.0000	0.0000	0.0000	0.0000	0.0000	90.7000	90.7000	90.7000	(210)
Space heating fuel (main heating system)													
	1001.1770	724.3216	528.8605	233.8515	72.2757	0.0000	0.0000	0.0000	0.0000	282.5923	672.8164	1037.7018	(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													
	176.4688	134.3606	110.2181	59.0554	25.3065	9.5461	4.3762	35.0643	64.8060	115.2963	152.6865	175.7211	(64)
Efficiency of water heater												80.0000	(216)
(217)m	88.7681	88.6860	88.4886	88.1328	87.4426	80.0000	80.0000	80.0000	80.0000	87.0861	88.3355	88.8308	(217)
Fuel for water heating, kWh/month													
	198.7974	151.5015	124.5562	67.0074	28.9407	11.9327	5.4702	43.8304	81.0075	132.3934	172.8484	197.8156	(219)
Water heating fuel used												1216.1014	(219)
Annual totals kWh/year													
Space heating fuel - main system												4553.5968	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												400.9829	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.40 * 1080 * 0.80) =										-967.2541		-967.2541	(233)
Total delivered energy for all uses												5328.4271	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4553.5968	3.4800	158.4652	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1216.1014	3.4800	42.3203	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	400.9829	13.1900	52.8896	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-967.2541	13.1900	-127.5808	(252)
Total energy cost			262.5818	(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] =	0.7659	(257)
SAP value	89.3155	
SAP rating (Section 12)	89	(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	4553.5968	0.2160	983.5769	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1216.1014	0.2160	262.6779	(264)
Space and water heating			1246.2548	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	400.9829	0.5190	208.1101	(268)
Energy saving/generation technologies				
PV Unit	-967.2541	0.5190	-502.0049	(269)
Total kg/year			1017.2351	(272)
CO2 emissions per m2			10.2800	(273)
EI value			90.5334	
EI rating			91	(274)
EI band			B	

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3400	(1b)	x 2.6800	(2b) =	94.7112	(1b) - (3b)
First floor	36.8500	(1c)	x 2.7500	(2c) =	101.3375	(1c) - (3c)
Second floor	26.8000	(1d)	x 1.8700	(2d) =	50.1160	(1d) - (3d)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	98.9900					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		246.1647	(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							5 * 10	=	50.0000	(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) =	50.0000	/ (5) =	0.2031	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.4531	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3851	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.2000	4.0000	4.0000	3.7000	3.7000	3.3000	3.4000	3.2000	3.3000	3.5000	3.5000	3.8000	(22)
Wind factor	1.0500	1.0000	1.0000	0.9250	0.9250	0.8250	0.8500	0.8000	0.8250	0.8750	0.8750	0.9500	(22a)
Adj infilt rate	0.4044	0.3851	0.3851	0.3563	0.3563	0.3177	0.3274	0.3081	0.3177	0.3370	0.3370	0.3659	(22b)
Effective ac	0.5818	0.5742	0.5742	0.5635	0.5635	0.5505	0.5536	0.5475	0.5505	0.5568	0.5568	0.5669	(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	
Entrance door			2.1100	1.8000	3.7980			(26)
Windows (Uw = 1.60)			27.6100	1.5038	41.5188			(27)
Rooflights (Uw = 1.60)			6.5600	1.5038	9.8647			(27a)
Heat Loss Floor			33.8300	0.1800	6.0894			(28a)
Exposed floor			1.5100	0.2000	0.3020			(28b)
External Wall	163.7900	29.7200	134.0700	0.1600	21.4512			(29a)
Main Roof	33.8300	6.5600	27.2700	0.1700	4.6359			(30)
External Roof 2	9.8200		9.8200	0.1600	1.5712			(30)
Total net area of external elements Aum(A, m2)			242.7800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	89.2312			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							17.3628	(36)
Total fabric heat loss					(33) + (36) =		106.5940	(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	47.2599	46.6423	46.6423	45.7724	45.7724	44.7180	44.9703	44.4733	44.7180	45.2302	45.2302	46.0549	(38)
Heat transfer coeff	153.8538	153.2363	153.2363	152.3664	152.3664	151.3120	151.5643	151.0672	151.3120	151.8241	151.8241	152.6488	(39)
Average = Sum(39)m / 12 =												152.2176	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.5542	1.5480	1.5480	1.5392	1.5392	1.5286	1.5311	1.5261	1.5286	1.5337	1.5337	1.5421	(40)
HLP (average)												1.5377	(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	2.7300	(42)
Average daily hot water use (litres/day)	99.0370	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	108.9407	104.9792	101.0177	97.0562	93.0947	89.1333	89.1333	93.0947	97.0562	101.0177	104.9792	108.9407	(44)
Energy conte	161.5558	141.2978	145.8066	127.1178	121.9725	105.2530	97.5324	111.9198	113.2565	131.9896	144.0769	156.4582	(45)
Energy content (annual)										Total = Sum(45)m =		1558.2370	(45)
Distribution loss (46)m = 0.15 x (45)m	24.2334	21.1947	21.8710	19.0677	18.2959	15.7880	14.6299	16.7880	16.9885	19.7984	21.6115	23.4687	(46)

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

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Water storage loss:
Store volume                                                                                                                 200.0000 (47)
a) If  manufacturer declared loss factor is known  (kWh/day):                                                                  1.7500 (48)
  Temperature factor from Table 2b                                                                                             0.5400 (49)
Enter (49) or (54) in (55)                                                                                                     0.9450 (55)
Total storage loss
                29.2950    26.4600    29.2950    28.3500    29.2950    28.3500    29.2950    29.2950    28.3500    29.2950    28.3500    29.2950 (56)
If cylinder contains dedicated solar storage
                18.3094    16.5375    18.3094    17.7188    18.3094    17.7188    18.3094    18.3094    17.7188    18.3094    17.7188    18.3094 (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
               203.1276   178.8465   185.9827   160.5949   150.7500   132.8770   126.0772   141.3952   148.0844   172.1656   184.3077   198.0300 (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                                                                                               1140.0998 (H5)
Overshading factor                                                                                                             0.8000 (H6)
Solar energy available                                                                                                      1915.3676 (H7)
Adjustment factor for showers                                                                                                  1.0000 (H7a)
Solar-to-load ratio                                                                                                            1.2292 (H8)
Utilisation factor                                                                                                             0.5567 (H9)
Collector performance factor                                                                                                   0.8793 (H10)
Dedicated solar storage volume                                                                                                75.0000 (H11)
Effective solar volume                                                                                                       112.5000 (H13)
Daily hot water demand                                                                                                        99.0370 (H14)
Volume ratio Veff/V                                                                                                            1.1359 (H15)
Solar storage volume factor                                                                                                    1.0000 (H16)
Solar input                                                                                                                 -937.6045 (H17)
Solar input    -28.8590   -43.3750   -73.0490  -100.9761  -121.6092  -127.9884  -124.9151  -111.5500   -87.0651   -59.2288   -35.0789   -23.9099 (63)
                                                                                           Solar input (sum of months) = Sum(63)m =   -937.6045 (63)
Output from w/h
               174.2686   135.4715   112.9337    59.6188    29.1408     4.8887     1.1621    29.8452    61.0193   112.9368   149.2288   174.1201 (64)
                                                                                             Total per year (kWh/year) = Sum(64)m =   1044.6343 (64)
Heat gains from water heating, kWh/month
                86.9747    77.0205    80.6215    69.0484    63.5778    57.0959    55.2654    60.7936    65.5201    76.0274    80.0902    85.2798 (65)


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5. Internal gains (see Table 5 and 5a)
----------------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                   Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m          163.7986   163.7986   163.7986   163.7986   163.7986   163.7986   163.7986   163.7986   163.7986   163.7986   163.7986   163.7986 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
                56.7633    50.4166    41.0016    31.0408    23.2034    19.5893    21.1669    27.5135    36.9286    46.8894    54.7268    58.3409 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
               380.1262   384.0707   374.1306   352.9694   326.2572   301.1514   284.3793   280.4347   290.3748   311.5360   338.2483   363.3540 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
                54.1098    54.1098    54.1098    54.1098    54.1098    54.1098    54.1098    54.1098    54.1098    54.1098    54.1098    54.1098 (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)
              -109.1991  -109.1991  -109.1991  -109.1991  -109.1991  -109.1991  -109.1991  -109.1991  -109.1991  -109.1991  -109.1991  -109.1991 (71)
Water heating gains (Table 5)
               116.9015   114.6138   108.3623    95.9005    85.4541    79.2998    74.2814    81.7118    91.0001   102.1873   111.2364   114.6234 (72)
Total internal gains
               665.5004   660.8105   635.2039   591.6202   546.6240   511.7499   491.5370   501.3695   530.0129   572.3221   615.9208   648.0277 (73)


----------------------------------------------------------------------------------------------------
6. Solar gains
----------------------------------------------------------------------------------------------------

[Jan]                                        Area         Solar flux              g                 FF             Access             Gains
                                               m2           Table 6a      Specific data      Specific data         factor                 W
                                                               W/m2         or Table 6b        or Table 6c       Table 6d
----------------------------------------------------------------------------------------------------
Northeast                                 10.2600            12.9236             0.6300             0.7000             0.7700           40.5230 (75)
Southwest                                 17.3500            40.4699             0.6300             0.7000             0.7700          214.5871 (79)
Southeast                                  3.2800            43.0236             0.6300             0.7000             1.0000           56.0095 (82)
Northwest                                  3.2800            20.0668             0.6300             0.7000             1.0000           26.1236 (82)
----------------------------------------------------------------------------------------------------

Solar gains    337.2432   547.4506   816.3568  1167.7145  1380.3503  1514.7374  1424.8677  1254.7341  1003.2495   668.6865   420.2566   281.7509 (83)
Total gains   1002.7436  1208.2611  1451.5607  1759.3347  1926.9743  2026.4873  1916.4047  1756.1036  1533.2624  1241.0086  1036.1774   929.7786 (84)


----------------------------------------------------------------------------------------------------
7. Mean internal temperature (heating season)
----------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                                   21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                   Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau             44.6808    44.8608    44.8608    45.1169    45.1169    45.4313    45.3557    45.5049    45.4313    45.2781    45.2781    45.0335
alpha            3.9787     3.9907     3.9907     4.0078     4.0078     4.0288     4.0237     4.0337     4.0288     4.0185     4.0185     4.0022
util living area
                 0.9828     0.9650     0.9142     0.7842     0.5913     0.3689     0.2445     0.2742     0.5449     0.8524     0.9629     0.9866 (86)

MIT             19.7092    19.9439    20.3304    20.7240    20.9296    20.9920    20.9989    20.9983    20.9626    20.6726    20.1345    19.6631 (87)
Th 2            19.6471    19.6517    19.6517    19.6582    19.6582    19.6661    19.6643    19.6680    19.6661    19.6623    19.6623    19.6561 (88)
util rest of house
                 0.9770     0.9537     0.8876     0.7280     0.5066     0.2727     0.1395     0.1606     0.4315     0.7952     0.9483     0.9820 (89)
MIT 2           18.0182    18.3548    18.8886    19.3909    19.6086    19.6633    19.6641    19.6678    19.6477    19.3542    18.6389    17.9584 (90)
Living area fraction                                                                              fLA = Living area / (4) =        0.2756 (91)
MIT             18.4842    18.7927    19.2859    19.7583    19.9726    20.0295    20.0320    20.0345    20.0101    19.7175    19.0510    18.4282 (92)
Temperature adjustment                                                                                                        -0.1500
adjusted MIT    18.3342    18.6427    19.1359    19.6083    19.8226    19.8795    19.8820    19.8845    19.8601    19.5675    18.9010    18.2782 (93)
```

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

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9688	0.9422	0.8751	0.7257	0.5175	0.2883	0.1567	0.1792	0.4488	0.7904	0.9370	0.9750	(94)
Useful gains	971.4330	1138.4779	1270.2798	1276.7095	997.2639	584.1726	300.2509	314.6413	688.1252	980.8516	970.9433	906.5077	(95)
Ext temp.	5.1000	5.6000	7.4000	9.9000	13.0000	16.0000	17.9000	17.8000	15.2000	11.6000	8.0000	5.1000	(96)
Heat loss rate W													
	2036.1362	1998.6200	1798.3702	1479.2152	1039.5387	587.0111	300.3973	314.8935	705.1264	1209.6622	1655.0406	2011.6392	(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													
	792.1392	578.0155	392.8993	145.8041	31.4525	0.0000	0.0000	0.0000	0.0000	170.2350	492.5501	822.2179	(98)
Space heating												3425.3135	(98)
Space heating per m2											(98) / (4) =	34.6026	(99)

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	90.7000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	3776.5309	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	792.1392	578.0155	392.8993	145.8041	31.4525	0.0000	0.0000	0.0000	0.0000	170.2350	492.5501	822.2179	(98)
Space heating efficiency (main heating system 1)													
	90.7000	90.7000	90.7000	90.7000	0.0000	0.0000	0.0000	0.0000	0.0000	90.7000	90.7000	90.7000	(210)
Space heating fuel (main heating system)													
	873.3618	637.2828	433.1856	160.7543	34.6775	0.0000	0.0000	0.0000	0.0000	187.6902	543.0541	906.5246	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	174.2686	135.4715	112.9337	59.6188	29.1408	4.8887	1.1621	29.8452	61.0193	112.9368	149.2288	174.1201	(64)
Efficiency of water heater												80.0000	(216)
(217)m	88.5640	88.4537	88.0701	87.3108	85.2184	80.0000	80.0000	80.0000	80.0000	86.1068	87.9643	88.6284	(217)
Fuel for water heating, kWh/month													
	196.7715	153.1553	128.2315	68.2834	34.1954	6.1108	1.4526	37.3065	76.2741	131.1590	169.6470	196.4609	(219)
Water heating fuel used												1199.0480	(219)
Annual totals kWh/year													
Space heating fuel - main system												3776.5309	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												125.0000	(231)
Electricity for lighting (calculated in Appendix L)												400.9829	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 1.40 * 1140 * 0.80) =										-1021.5294		-1021.5294	(233)
Total delivered energy for all uses												4480.0324	(238)

10a. Fuel costs - using BEDF prices (465)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	3776.5309	3.9500	149.1730	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1199.0480	3.9500	47.3624	(247)
Pumps and fans for heating	75.0000	18.7000	14.0250	(249)
Pump for solar water heating	50.0000	18.7000	9.3500	(249)
Energy for lighting	400.9829	18.7000	74.9838	(250)
Additional standing charges			91.0000	(251)
Energy saving/generation technologies				
PV Unit	-1021.5294	18.7000	-191.0260	(252)
Total energy cost			194.8682	(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	3776.5309	0.2160	815.7307	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1199.0480	0.2160	258.9944	(264)
Space and water heating			1074.7250	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	400.9829	0.5190	208.1101	(268)

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

Energy saving/generation technologies				
PV Unit	-1021.5294	0.5190	-530.1738	(269)
Total kg/year			817.5364	(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	3776.5309	1.2200	4607.3677	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1199.0480	1.2200	1462.8386	(264)
Space and water heating			6070.2063	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	400.9829	3.0700	1231.0175	(268)
Energy saving/generation technologies				
PV Unit	-1021.5294	3.0700	-3136.0953	(269)
Primary energy kWh/year			4548.8786	(272)
Primary energy kWh/m2/year			45.9529	(273)

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

Overheating Calculation Input Data

Dwelling type	Detached House
Number of storeys	3
Cross ventilation possible	Yes
SAP Region	Thames Valley
Front of dwelling faces	North East
Overshading	Average or unknown
Thermal mass parameter	250.0
Night ventilation	Yes
Ventilation rate during hot weather (ach)	4.00 (Windows half open)

Overheating Calculation

Summer ventilation heat loss coefficient		324.94 (P1)
Transmission heat loss coefficient		106.59 (37)
Summer heat loss coefficient		431.53 (P2)

Overhangs

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

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer
North East	0.850	0.90	1.000	0.765 (P8)
South East	1.000	1.00	1.000	1.000 (P8)
South West	0.850	0.90	1.000	0.765 (P8)
North West	1.000	1.00	1.000	1.000 (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 East	10.2600	98.8453	0.6300	0.7000	0.7650	307.9256
South West	17.3500	119.9223	0.6300	0.7000	0.7650	631.7455
South East	3.2800	196.8859	0.6300	0.7000	1.0000	256.3124
North West	3.2800	171.0993	0.6300	0.7000	1.0000	222.7426
total:						1418.7260

	Jun	Jul	Aug	
Solar gains	1508	1419	1249	(P3)
Internal gains	535	514	523	
Total summer gains	2043	1933	1772	(P5)
Summer gain/loss ratio	4.73	4.48	4.11	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 250.0)	0.25	0.25	0.25	
Threshold temperature	20.98	22.63	22.16	(P7)
Likelihood of high internal temperature	Slight	Medium	Medium	
Assessment of likelihood of high internal temperature:	Medium			

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

Design SAP
elmhurst energy

Property Reference	1500	**Issued on Date**	22/09/2020
Assessment Reference	As design 3 bed	**Prop Type Ref**	
Property			

SAP Rating	88 B	**DER**	14.34	**TER**	17.91
Environmental	88 B	**% DER<TER**	19.94		
CO_2 Emissions (t/year)	1.08	**DFEE**	56.94	**TFEE**	57.93
General Requirements Compliance	Pass	**% DFEE<TFEE**	1.71		

Assessor Details	Mr. Carlos Val Escudero, Carlos Val, Tel: 01923 518923, carlos@rjacoustics.com	**Assessor ID**	H664-0001
Client	Formed Architects, 1500		

SUMARY FOR INPUT DATA FOR New Build (As Designed)

Criterion 1 – Achieving the TER and TFEE rate

1a TER and DER

Fuel for main heating	Mains gas		
Fuel factor	1.00 (mains gas)		
Target Carbon Dioxide Emission Rate (TER)	17.91	$kgCO_2/m^2$	
Dwelling Carbon Dioxide Emission Rate (DER)	14.34	$kgCO_2/m^2$	Pass
	-3.57 (-19.9%)	$kgCO_2/m^2$	

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	57.93	$kWh/m^2/yr$	
Dwelling Fabric Energy Efficiency (DFEE)	56.94	$kWh/m^2/yr$	
	-1.0 (-1.7%)	$kWh/m^2/yr$	Pass

Criterion 2 – Limits on design flexibility

Limiting Fabric Standards

2 Fabric U-values

Element	Average	Highest	
External wall	0.16 (max. 0.30)	0.16 (max. 0.70)	Pass
Floor	0.18 (max. 0.25)	0.20 (max. 0.70)	Pass
Roof	0.17 (max. 0.20)	0.17 (max. 0.35)	Pass
Openings	1.61 (max. 2.00)	1.80 (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	Boiler system with radiators or underfloor - Mains gas Data from database Worcester Greenstar 8000 Life GR8300iW 50 R NG Efficiency: 89.7% SEDBUK2009 Minimum: 88.0%	Pass

Secondary heating system	None		
5 Cylinder insulation			
Hot water storage	Measured cylinder loss: 1.75 kWh/day Permitted by DBSCG 2.24		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
Boiler interlock	Yes		Pass
7 Low energy lights			
Percentage of fixed lights with low-energy fittings	100	%	
Minimum	75	%	Pass
8 Mechanical ventilation			
Not applicable			

Criterion 3 – Limiting the effects of heat gains in summer

9 Summertime temperature

Overheating risk (Thames Valley)	Medium		Pass
Based on:			
Overshading	Average		
Windows facing North East Windows facing South West	10.26 m², No overhang 17.35 m², No overhang		
Air change rate	4.00 ach		
Blinds/curtains	Light-coloured venetian blind, closed 50% of daylight hours		

Criterion 4 – Building performance consistent with DER and DFEE rate

Air permeability and pressure testing

3 Air permeability

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

10 Key features

Photovoltaic array	1.40	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)

Design SAP
elmhurst energy

Property Reference	1500	**Issued on Date**	22/09/2020
Assessment Reference	As design 3 bed	**Prop Type Ref**	
Property			

SAP Rating	88 B	**DER**	14.34	**TER**	17.91
Environmental	88 B	**% DER<TER**	19.94		
CO_2 Emissions (t/year)	1.08	**DFEE**	56.94	**TFEE**	57.93
General Requirements Compliance	Pass	**% DFEE<TFEE**	1.71		

Assessor Details	Mr. Carlos Val Escudero, Carlos Val, Tel: 01923 518923, carlos@rjacoustics.com	**Assessor ID**	H664-0001
Client	Formed Architects, 1500		

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

Orientation	North East
Property Tenure	Unknown
Transaction Type	New dwelling
Terrain Type	Suburban
1.0 Property Type	House, Detached
2.0 Number of Storeys	3
3.0 Date Built	2020
4.0 Sheltered Sides	2
5.0 Sunlight/Shade	Average or unknown

6.0 Measurements

	Heat Loss Perimeter	Internal Floor Area	Average Storey Height
Ground Floor:	25.17 m	35.34 m²	2.68 m
1st Storey:	25.17 m	36.85 m²	2.75 m
2nd Storey:	20.92 m	26.80 m²	1.87 m

7.0 Living Area	27.28	m²
8.0 Thermal Mass Parameter	Simple calculation - Medium	
Thermal Mass	250.00	kJ/m²K

9.0 External Walls

Description	Type	Construction	U-Value (W/m²K)	Gross Area (m²)	Nett Area (m²)
External Wall	Cavity Wall	Cavity wall; dense plaster, lightweight aggregate block, filled cavity, any outside structure	0.16	163.79	134.07

10.0 External Roofs

Description	Type	Construction	U-Value (W/m²K)	Gross Area (m²)	Nett Area (m²)
Main Roof	External Slope Roof	Plasterboard, insulated slope	0.17	33.83	27.27
External Roof 2	External Flat Roof	Plasterboard, insulated flat roof	0.16	9.82	9.82

11.0 Heat Loss Floors

Description	Type	Construction	U-Value (W/m²K)	Area (m²)
Heat Loss Floor	Ground Floor - Solid	Slab on ground, screed over insulation	0.18	33.83
Exposed floor	Exposed Floor - Timber	Timber exposed floor, insulation between joists	0.20	1.51

12.0 Opening Types

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

Design SAP
elmhurst energy

Description	Data Source	Type	Glazing	Glazing Gap	Argon Filled	G-value	Frame Type	Frame Factor	U Value (W/m²K)
Entrance door	Manufacturer	Solid Door							1.80
Windows	Manufacturer	Window	Double Low-E Soft 0.05			0.63		0.70	1.60
Rooflights	Manufacturer	Roof Window	Double Low-E Soft 0.05			0.63		0.70	1.60

13.0 Openings

Name	Opening Type	Location	Orientation	Curtain Type	Overhang Ratio	Wide Overhang	Width (m)	Height (m)	Count	Area (m²)	Curtain Closed
Entrance	Solid Door	[1] External Wall	North East							2.11	
NE windows	Window	[1] External Wall	North East	Light-coloured venetian blind	0.00					10.26	50
SW windows	Window	[1] External Wall	South West	Light-coloured venetian blind	0.00					17.35	50
NW rooflight	Roof Window	[1] Main Roof	North West	None						3.28	
SE rooflight	Roof Window	[1] Main Roof	South East	None						3.28	

14.0 Conservatory	None	
15.0 Draught Proofing	100	%
16.0 Draught Lobby	No	

17.0 Thermal Bridging — Calculate Bridges

17.1 List of Bridges

Source Type	Bridge Type	Length	Psi	Imported	Reference:
Independently assessed	E2 Other lintels (including other steel lintels)	17.13	0.050	No	Catnic
Table K1 - Approved	E3 Sill	6.78	0.040	No	
Table K1 - Approved	E4 Jamb	32.72	0.050	No	
Table K1 - Approved	E5 Ground floor (normal)	25.17	0.160	No	
Table K1 - Default	E20 Exposed floor (normal)	6.25	0.320	No	
Table K1 - Approved	E6 Intermediate floor within a dwelling	42.97	0.070	No	
Table K1 - Approved	E11 Eaves (insulation at rafter level)	11.58	0.040	No	
Table K1 - Approved	E13 Gable (insulation at rafter level)	11.00	0.040	No	
Table K1 - Approved	E16 Corner (normal)	34.88	0.090	No	
Table K1 - Approved	E17 Corner (inverted – internal area greater than external area)	9.12	-0.090	No	
Table K1 - Default	R1 Head of roof window	6.84	0.080	No	
Table K1 - Default	R2 Sill of roof window	6.84	0.060	No	
Table K1 - Default	R3 Jamb of roof window	11.52	0.080	No	
Table K1 - Default	R4 Ridge (vaulted ceiling)	5.79	0.080	No	

Y-value	0.072	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 half open
Cross ventilation possible	Yes
Night Ventilation	Yes
Air change rate	4.00

Mechanical Ventilation

Mechanical Ventilation System Present	No

20.0 Fans, Open Fireplaces, Flues

	MHS	SHS	Other	Total
Number of Chimneys	0		0	0
Number of open flues	0		0	0
Number of intermittent fans				5
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	11	
Total number of L.E.L. fittings	11	
Percentage of L.E.L. fittings	100.00	%
External		
External lights fitted	Yes	
Light and motion sensor	Yes	
23.0 Electricity Tariff	Standard	
24.0 Main Heating 1	Database	
Percentage of Heat	100	%
Database Ref. No.	18627	
Fuel Type	Mains gas	
Main Heating	BGB	
SAP Code	102	
In Winter	90.7	
In Summer	80.0	
Controls	CBI Time and temperature zone control	
PCDF Controls	0	
Delayed Start Stat	Yes	
Sap Code	2110	
Flue Type	Balanced	
Fan Assisted Flue	Yes	
Is MHS Pumped	Pump in heated space	
Heat Emitter	Radiators	
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	

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	200.00	L
Loss	1.75	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
1.40	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	£44	B 89	