elmhurst energy



SAP Report Submission for Building Regulations Compliance

Client: ABL Homes Ltd

Project: Plot 1, 2 Kiln Lane
Farnham, Surrey, GU10 3LR

Contact: Scott Spearing | BEAT Solutions
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Report Issue Date: 04/05/2021

EXCELLENCE IN ENERGY ASSESSMENT

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

Design SAP
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Property Reference	SAP-1201 - Plot 1	**Issued on Date**	04/05/2021
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SAP Rating	85 B	**DER**	15.76	**TER**	16.08
Environmental	86 B	**% DER<TER**	1.98		
CO_2 Emissions (t/year)	1.63	**DFEE**	47.03	**TFEE**	51.37
General Requirements Compliance	Pass	**% DFEE<TFEE**	8.45		

Assessor Details	Mr. Scott Spearing, Scott Spearing, Tel: 01489 565920, scott@beatsolutions.co.uk	**Assessor ID**	p775-0001
Client	ABL Homes Ltd, ABL HOMES		

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)	16.08	$kgCO_2/m^2$	
Dwelling Carbon Dioxide Emission Rate (DER)	15.76	$kgCO_2/m^2$	Pass
	-0.32 (-2.0%)	$kgCO_2/m^2$	

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	51.37	$kWh/m^2/yr$	
Dwelling Fabric Energy Efficiency (DFEE)	47.03	$kWh/m^2/yr$	
	-4.4 (-8.6%)	$kWh/m^2/yr$	Pass

Criterion 2 – Limits on design flexibility

Limiting Fabric Standards

2 Fabric U-values

Element	Average	Highest	
External wall	0.24 (max. 0.30)	0.24 (max. 0.70)	Pass
Party wall	0.00 (max. 0.20)	-	Pass
Floor	0.12 (max. 0.25)	0.16 (max. 0.70)	Pass
Roof	0.13 (max. 0.20)	0.17 (max. 0.35)	Pass
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	Pass

2a Thermal bridging

Thermal bridging calculated from linear thermal transmittances for each junction

3 Air permeability

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

Limiting System Efficiencies

4 Heating efficiency

Main heating system	Boiler system with radiators or underfloor - Mains gas Data from database Ideal LOGIC COMBI ESP1 35 Combi boiler Efficiency: 89.6% SEDBUK2009 Minimum: 88.0%		Pass
Secondary heating system	None		

5 Cylinder insulation

Hot water storage	No cylinder		

6 Controls

Space heating controls	Time and temperature zone control		Pass
Hot water controls	No cylinder		
Boiler interlock	Yes		Pass

7 Low energy lights

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

8 Mechanical ventilation

Not applicable

Criterion 3 – Limiting the effects of heat gains in summer

9 Summertime temperature

Overheating risk (Thames Valley)	Slight	Pass

Based on:

Overshading	Average	
Windows facing East	8.74 m², No overhang	
Windows facing South	1.89 m², No overhang	
Windows facing West	9.81 m², No overhang	
Air change rate	5.00 ach	
Blinds/curtains	None	

Criterion 4 – Building performance consistent with DER and DFEE rate

Party Walls

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

Air permeability and pressure testing

3 Air permeability

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

10 Key features

Party wall U-value	0.00	W/m²K
Roof U-value	0.10	W/m²K
Floor U-value	0.12	W/m²K

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

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Orientation	East
Property Tenure	Unknown
Transaction Type	New dwelling
Terrain Type	Suburban
1.0 Property Type	House, Semi-Detached
2.0 Number of Storeys	2
3.0 Date Built	2021
4.0 Sheltered Sides	1
5.0 Sunlight/Shade	Average or unknown

6.0 Measurements

	Heat Loss Perimeter	Internal Floor Area	Average Storey Height
Ground Floor:	24.22 m	58.83 m²	2.36 m
1st Storey:	24.47 m	63.08 m²	2.32 m

7.0 Living Area	17.20	m²
8.0 Thermal Mass Parameter	Precise calculation	
Thermal Mass	160.56	kJ/m²K

9.0 External Walls

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Gross Area (m²)	Nett Area (m²)
External Walls	Cavity Wall	Cavity wall : plasterboard on dabs, AAC block, filled cavity, any outside structure	0.24	60.00	102.11	81.20
Dormer Walls & Cheeks	Timber Frame	Timber framed wall (one layer of plasterboard)	0.23	9.00	4.02	2.58

9.1 Party Walls

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Area (m²)
Party Wall	Filled Cavity with Edge Sealing	Single plasterboard on dabs on both sides, dense blocks, cavity or cavity fill	0.00	70.00	33.06

9.2 Internal Walls

Description	Construction	Kappa (kJ/m²K)	Area (m²)
Internal Wall - Masonry	Dense block, plasterboard on dabs	75.00	56.07
Internal Wall - Timber	Plasterboard on timber frame	9.00	100.83

10.0 External Roofs

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Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Gross Area (m²)	Nett Area (m²)
Pitched Cold Roof	External Plane Roof	Plasterboard, insulated at ceiling level	0.10	9.00	43.20	43.20
Sloping Roof	External Slope Roof	Plasterboard, insulated slope	0.17	9.00	27.59	27.59

10.2 Internal Ceilings

Description	Construction	Kappa (kJ/m²K)	Area (m²)
Internal Ceiling	Plasterboard ceiling, carpeted chipboard floor	9.00	58.83

11.0 Heat Loss Floors

Description	Type	Construction	U-Value (W/m²K)	Kappa (kJ/m²K)	Area (m²)
Ground Floor	Ground Floor - Solid	Suspended concrete floor, carpeted	0.12	75.00	58.83
Exposed Floor	Exposed Floor - Timber	Timber exposed floor, insulation between joists	0.16	20.00	4.25

11.2 Internal Floors

Description	Construction	Kappa (kJ/m²K)	Area (m²)
Internal Floor	Plasterboard ceiling, carpeted chipboard floor	18.00	58.83

12.0 Opening Types

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

13.0 Openings

Name	Opening Type	Location	Orientation	Curtain Type	Overhang Ratio	Wide Overhang	Width (m)	Height (m)	Count	Area (m²)	Curtain Closed
Front Door	Solid Door	[1] External Walls	East							1.91	
Front Elevation	Window	[1] External Walls	East	None	0.00					7.30	
Front Dormer	Window	[2] Dormer Walls & Cheeks	East	None	0.00					1.44	
Side Elevation	Window	[1] External Walls	South	None	0.00					1.89	
Rear Elevation	Window	[1] External Walls	West	None	0.00					9.81	

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)	15.27	0.230	Yes	Keystone Standard
Independently assessed	E3 Sill	14.36	0.034	Yes	CD0027
Independently assessed	E4 Jamb	36.30	0.040	No	CD0028
Table K1 - Approved	E5 Ground floor (normal)	24.22	0.160	Yes	
Table K1 - Default	E20 Exposed floor (normal)	4.23	0.320	No	
Table K1 - Default	E21 Exposed floor (inverted)	4.23	0.320	No	
Independently assessed	E6 Intermediate floor within a dwelling	20.24	0.000	No	CD0029
Table K1 - Approved	E10 Eaves (insulation at ceiling level)	3.04	0.060	No	
Independently assessed	E11 Eaves (insulation at rafter level)	5.03	0.034	No	CD0034
Independently assessed	E12 Gable (insulation at ceiling level)	10.80	0.073	No	CD0031
Table K1 - Approved	E13 Gable (insulation at rafter level)	13.30	0.040	No	
Independently assessed	E16 Corner (normal)	21.14	0.058	No	CD0035
Table K1 - Approved	E17 Corner (inverted – internal area greater than external area)	4.17	-0.090	No	
Table K1 - Default	E25 Staggered party wall between dwellings	7.21	0.120	No	
Table K1 - Default	P1 Party wall - Ground floor	7.51	0.160	No	
Table K1 - Default	P2 Party wall - Intermediate floor within a dwelling	7.51	0.000	No	
Table K1 - Default	P4 Party wall - Roof (insulation at ceiling level)	3.37	0.240	No	
Table K1 - Default	P5 Party wall - Roof (insulation at rafter level)	5.52	0.080	No	
Table K1 - Default	R6 Flat ceiling	16.91	0.060	No	

Y-value	0.079	W/m²K

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

19.0 Mechanical Ventilation

Summer Overheating

Windows open in hot weather	Windows fully open
Cross ventilation possible	No
Night Ventilation	Yes
Air change rate	5.00

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				4
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	50	
Total number of L.E.L. fittings	50	
Percentage of L.E.L. fittings	100.00	%

External

External lights fitted	No	

23.0 Electricity Tariff	Standard	

24.0 Main Heating 1	Database	
Description	Gas Boiler	
Percentage of Heat	100	%
Database Ref. No.	17929	
Fuel Type	Mains gas	
Main Heating	BGW	
SAP Code	104	
In Winter	90.5	
In Summer	87.3	
Controls	CBI Time and temperature zone control	
PCDF Controls	0	
Delayed Start Stat	No	
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)	
Combi boiler type	Standard Combi	
Combi keep hot type	None	
25.0 Main Heating 2	None	
Community Heating	None	
28.0 Water Heating	HWP From main heating 1	
Water Heating	Main Heating 1	
Flue Gas Heat Recovery System	No	
Waste Water Heat Recovery Instantaneous System 1	No	
Waste Water Heat Recovery Instantaneous System 2	No	
Waste Water Heat Recovery Storage System	No	
Solar Panel	No	
Water use <= 125 litres/person/day	Yes	
SAP Code	901	
29.0 Hot Water Cylinder	None	

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	£30	B 86	
	Typical Cost	**Typical savings per year**	**Ratings after improvement SAP rating**	**Environmental Impact**
Solar photovoltaic panels, 2.5 kWp	£3,500 - £5,500	£357	A 94	

U-VALUE CALCULATOR REPORT

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Building Elements

Roof Pitched Cold Roof

Roof Type: Pitched Roof, insulated flat ceiling

Layer	Description	Thickness (mm)	Conductivity (W/m²K)	Resistance (m²K/W)	Fraction (%)
Ext surface				0.0400	
Layer 1	**Mineral wool**				
	Main construction	200	0.0400	5.0000	100.00
	Corrections - Air Gap: Level 0, Fasteners: None or plastic				
Layer 2	**Mineral wool**				
	Main construction	200	0.0400	5.0000	91.67
	Main construction	200	0.1300	1.5385	8.33
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Layer 3	**Plasterboard, standard**				
	Main construction	12.5	0.2100	0.0595	100.00
Layer 4	**Plaster, standard**				
	Main construction	3	0.4000	0.0075	100.00
Int surface				0.1000	

Total resistance: **Upper limit =** 9.788 m² K/W **Lower limit =** 9.418 m² K/W **Average =** 9.603 m² K/W

Total correction = 0.0019 m² K/W **U-value (unrounded) =** 0.1 W/m² K

Unheated space: None

Total thickness: 416 mm **U-value: 0.10 W/m² K** **Kappa: n/a**

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Building Elements

Roof Sloping Roof

Roof Type: Pitched Roof, insulated sloping ceiling

Layer	Description	Thickness (mm)	Conductivity (W/m²K)	Resistance (m²K/W)	Fraction (%)
Ext surface				0.0400	
Layer 1	**Celotex GA4000**				
	Main construction	100	0.0220	4.5455	91.67
	Main construction	100	0.1300	0.7692	8.33
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Layer 2	**Celotex PL4050 [62.5mm]**				
	Main construction	62.5	0.0272	2.3000	100.00
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Layer 3	**Plaster, standard**				
	Main construction	3	0.4000	0.0075	100.00
Int surface				0.1000	

Total resistance: **Upper limit =** 6.370 m² K/W **Lower limit =** 5.673 m² K/W **Average =** 6.022 m² K/W

Total correction = 0.0043 m² K/W **U-value (unrounded) =** 0.17 W/m² K

Unheated space: None

Total thickness: 166 mm **U-value: 0.17 W/m² K** **Kappa: n/a**

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Building Elements

Wall External Walls

Wall Type: Standard Wall

Layer	Description	Thickness (mm)	Conductivity (W/m²K)	Resistance (m²K/W)	Fraction (%)
Ext surface				0.0400	
Layer 1	**Brick, outer leaf**				
	Main construction	102.5	0.7700	0.1331	82.81
	Main construction	102.5	0.9407	0.1090	17.19
Layer 2	**Earthwool Dritherm 32 Ultimate**				
	Main construction	100	0.0320	3.1250	100.00
	Corrections - Air Gap: Level 0, Fasteners: None or plastic				
Layer 3	**Thermalite Hi-Strength 7**				
	Main construction	100	0.1900	0.5263	93.43
	Main construction	100	0.8803	0.1136	6.57
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Layer 4	**airspace/plaster dabs**				
	Main construction	15	0.0882	0.1700	80.00
	Main construction	15	0.0882	0.1700	20.00
	Corrections - Cavity Unventilated, Emissivity: Normal				
Layer 5	**Plasterboard, standard**				
	Main construction	12.5	0.2100	0.0595	100.00
Layer 6	**Plaster, standard**				
	Main construction	3	0.4000	0.0075	100.00
Int surface				0.1300	

Total resistance: **Upper limit =** 4.157 m² K/W **Lower limit =** 4.085 m² K/W **Average =** 4.121 m² K/W

Total correction = 0.0001 m² K/W **U-value (unrounded) =** 0.24 W/m² K

Unheated space: None

Total thickness: 333 mm **U-value: 0.24 W/m² K** **Kappa: n/a**

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Building Elements

Wall Dormer Walls & Cheeks

Wall Type: Timber framed Wall with I-beams

Layer	Description	Thickness (mm)	Conductivity (W/m²K)	Resistance (m²K/W)	Fraction (%)
Ext surface				0.0400	
Layer 1	**Tiling, clay**				
	Main construction	12	1.0000	0.0120	100.00
Layer 2	**airspace/timber battens**				
	Main construction	25	0.1389	0.1800	93.67
	Main construction	25	0.1300	0.1923	6.33
	Corrections - Cavity Unventilated, Emissivity: Normal				
Layer 3	**Breather membrane**				
	Main construction	1	0.0000	0.0000	100.00
Layer 4	**Orientated Strand Board**				
	Main construction	12.5	0.1300	0.0962	100.00
Layer 5	**Timber Stud Void**				
	Main construction	30	0.1667	0.1800	87.50
	Main construction	30	0.1300	0.2308	12.50
	Corrections - Cavity Unventilated, Emissivity: Normal				
Layer 6	**Celotex GA4000**				
	Main construction	70	0.0220	3.1818	87.50
	Main construction	70	0.1300	0.5385	12.50
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Layer 7	**Celotex TB4000**				
	Main construction	30	0.0220	1.3636	100.00
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Layer 8	**Plasterboard, standard**				
	Main construction	12.5	0.2100	0.0595	100.00
Layer 9	**Plaster, standard**				
	Main construction	3	0.4000	0.0075	100.00
Int surface				0.1300	

Total resistance: **Upper limit =** 4.668 m² K/W **Lower limit =** 4.046 m² K/W **Average =** 4.357 m² K/W

Total correction = 0.0030 m² K/W **U-value (unrounded) =** 0.23 W/m² K

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Unheated space: None

Total thickness: 196 mm **U-value: 0.23 W/m² K** **Kappa: n/a**

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Building Elements

Floor Ground Floor

Floor Type: Suspended Floor
Area = 58.83 m², Perimeter = 24.22 m, Wall thickness = 320.00 mm, Soil: Unknown
Depth of underfloor space below ground:0.200 m Floor wind shielding: Average (suburban)
Floor height above ground:h = 0.200 m
U-value of walls above ground:Uw = 1.500 m
Ventilation openings per perimeter length:e = 0.0015 %
Mean wind speed:v = 5.000 m/s
Resistance on solum:Rg = 0.000 m²K/W

Layer	Description	Thickness (mm)	Conductivity (W/m²K)	Resistance (m²K/W)	Fraction (%)
Ext surface				0.1700	
Layer 1	**Blockwork, dense**				
	Main construction	100	1.5900	0.0629	82.95
	Main construction	100	2.3000	0.0435	17.05
Layer 2	**Celotex XR4000**				
	Main construction	150	0.0220	6.8182	100.00
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Layer 3	**Screed**				
	Main construction	75	1.1500	0.0652	100.00
Int surface				0.1700	

Total resistance: **Upper limit =** 7.283 m² K/W **Lower limit =** 7.282 m² K/W **Average =** 7.282 m² K/W
Total correction = 0.0088 m² K/W **U-value (unrounded) =** 0.12 W/m² K

Unheated space: None

Total thickness: 325 mm **U-value: 0.12 W/m² K** **Kappa: n/a**

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Building Elements

Floor Exposed Floor

Floor Type: Exposed Floor

Layer	Description	Thickness (mm)	Conductivity (W/m²K)	Resistance (m²K/W)	Fraction (%)
Ext surface				0.0400	
Layer 1	**Chipboard**				
	Main construction	22	0.1300	0.1692	100.00
Layer 2	**Mineral wool**				
	Main construction	200	0.0400	5.0000	87.50
	Main construction	200	0.1300	1.5385	12.50
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Layer 3	**Celotex TB4000**				
	Main construction	25	0.0220	1.1364	100.00
	Corrections - Air Gap: Level 1, Fasteners: None or plastic				
Layer 4	**airspace/timber battens**				
	Main construction	22	0.1222	0.1800	89.63
	Main construction	22	0.1196	0.1840	10.37
	Corrections - Cavity Unventilated, Emissivity: Normal				
Layer 5	**External Finish**				
	Main construction	18	0.1800	0.1000	100.00
Int surface				0.1700	

Total resistance: **Upper limit =** 6.015 m² K/W **Lower limit =** 5.698 m² K/W **Average =** 5.857 m² K/W

Total correction = 0.0048 m² K/W **U-value (unrounded) =** 0.16 W/m² K

Unheated space: GarageSingle1Outside

Total thickness: 287 mm **U-value: 0.16 W/m² K** **Kappa: n/a**

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

Design SAP
elmhurst energy

Property Reference	SAP-1201 - Plot 1	**Issued on Date**	04/05/2021
Assessment Reference	Rev -	**Prop Type Ref**	
Property	Plot 1, 2 Kiln Lane, Farnham, Surrey, GU10 3LR		

SAP Rating	85 B	**DER**	15.76	**TER**	16.08
Environmental	86 B	**% DER<TER**	1.98		
CO_2 Emissions (t/year)	1.63	**DFEE**	47.03	**TFEE**	51.37
General Requirements Compliance	Pass	**% DFEE<TFEE**	8.45		

Assessor Details	Mr. Scott Spearing, Scott Spearing, Tel: 01489 565920, scott@beatsolutions.co.uk	**Assessor ID**	p775-0001
Client	ABL Homes Ltd, ABL HOMES		

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

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

Semi-Detached House, total floor area 122 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) 16.08 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 15.76 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)51.4 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)47.0 kWh/m²/yrOK

---
2 Fabric U-values

Element	Average	Highest	
External wall	0.24 (max. 0.30)	0.24 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.12 (max. 0.25)	0.16 (max. 0.70)	OK
Roof	0.13 (max. 0.20)	0.17 (max. 0.35)	OK
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	OK

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

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

---
4 Heating efficiency
Main heating system: Boiler system with radiators or underfloor - Mains gas
Data from database
Ideal LOGIC COMBI ESP1 35
Combi boiler
Efficiency: 89.6% SEDBUK2009
Minimum: 88.0% OK

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage: No cylinder

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

Hot water controls: No cylinder

Boiler interlock: Yes OK

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

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (Thames Valley): Slight OK
Based on:
Overshading: Average
Windows facing East: 8.74 m², No overhang
Windows facing South: 1.89 m², No overhang
Windows facing West: 9.81 m², No overhang
Air change rate: 5.00 ach
Blinds/curtains: None

---
10 Key features
Party wall U-value 0.00 W/m²K
Roof U-value 0.10 W/m²K
Floor U-value 0.12 W/m²K

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	58.8300 (1b)	x	2.3600 (2b)	=	138.8388	(1b) - (3b)
First floor	63.0800 (1c)	x	2.3200 (2c)	=	146.3456	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.9100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	285.1844	(5)

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1403	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3903	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3610	(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	0.4603	0.4512	0.4422	0.3971	0.3881	0.3429	0.3429	0.3339	0.3610	0.3881	0.4061	0.4242	(22b)
Effective ac	0.6059	0.6018	0.5978	0.5788	0.5753	0.5588	0.5588	0.5558	0.5652	0.5753	0.5825	0.5900	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Front Door			1.9100	1.4000	2.6740			(26)
Windows (Uw = 1.40)			20.4400	1.3258	27.0985			(27)
Ground Floor			58.8300	0.1200	7.0596	75.0000	4412.2500	(28a)
Exposed Floor			4.2500	0.1600	0.6800	20.0000	85.0000	(28b)
External Walls	102.1100	20.9100	81.2000	0.2400	19.4880	60.0000	4872.0000	(29a)
Dormer Walls & Cheeks	4.0200	1.4400	2.5800	0.2300	0.5934	9.0000	23.2200	(29a)
Pitched Cold Roof	43.2000		43.2000	0.1000	4.3200	9.0000	388.8000	(30)
Sloping Roof	27.5900		27.5900	0.1700	4.6903	9.0000	248.3100	(30)
Total net area of external elements Aum(A, m2)			240.0000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		66.6038			(33)
Party Wall			33.0600	0.0000	0.0000	70.0000	2314.2000	(32)
Internal Wall - Masonry			56.0700			75.0000	4205.2500	(32c)
Internal Wall - Timber			100.8300			9.0000	907.4700	(32c)
Internal Floor			58.8300			18.0000	1058.9400	(32d)
Internal Ceiling			58.8300			18.0000	1058.9400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	19574.3800 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		160.5642 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		18.8912 (36)
Total fabric heat loss	(33) + (36) =	85.4950 (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	57.0237	56.6367	56.2572	54.4751	54.1417	52.5895	52.5895	52.3021	53.1874	54.1417	54.8162	55.5214	(38)
Heat transfer coeff	142.5187	142.1316	141.7522	139.9701	139.6367	138.0845	138.0845	137.7971	138.6824	139.6367	140.3112	141.0164	(39)
Average = Sum(39)m / 12 =												139.9685	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1690	1.1659	1.1628	1.1481	1.1454	1.1327	1.1327	1.1303	1.1376	1.1454	1.1509	1.1567	(40)
HLP (average)												1.1481	(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	2.8704 (42)
Average daily hot water use (litres/day)	102.3720 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

	112.6092	108.5144	104.4195	100.3246	96.2297	92.1348	92.1348	96.2297	100.3246	104.4195	108.5144	112.6092	(44)
Energy conte	166.9963	146.0560	150.7167	131.3985	126.0800	108.7974	100.8168	115.6888	117.0704	136.4343	148.9287	161.7270	(45)
Energy content (annual)										Total = Sum(45)m =		1610.7108	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.0494	21.9084	22.6075	19.7098	18.9120	16.3196	15.1225	17.3533	17.5606	20.4651	22.3393	24.2590	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1574	12.7758	14.1183	13.6282	14.0477	13.5534	13.9795	14.0237	13.5938	14.0840	13.6702	14.1447	(61)
Total heat required for water heating calculated for each month													
	181.1536	158.8318	164.8350	145.0266	140.1277	122.3508	114.7963	129.7125	130.6642	150.5183	162.5990	175.8717	(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													
	181.1536	158.8318	164.8350	145.0266	140.1277	122.3508	114.7963	129.7125	130.6642	150.5183	162.5990	175.8717	(64)
Total per year (kWh/year) = Sum(64)m =												1776.4874	(64)
Heat gains from water heating, kWh/month													
	59.0656	51.7576	53.6429	47.0970	45.4335	39.5635	37.0165	41.9724	42.3244	48.8854	52.9364	57.3104	(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	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.5183	23.5533	19.1548	14.5014	10.8400	9.1516	9.8886	12.8536	17.2520	21.9054	25.5669	27.2553	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	287.6793	290.6645	283.1419	267.1271	246.9112	227.9112	215.2181	212.2329	219.7555	235.7703	255.9861	274.9861	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	(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)													
	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	(71)
Water heating gains (Table 5)													
	79.3892	77.0202	72.1006	65.4125	61.0666	54.9493	49.7533	56.4146	58.7838	65.7062	73.5227	77.0301	(72)
Total internal gains													
	462.6428	460.2940	443.4533	416.0970	387.8738	361.0681	343.9160	350.5570	364.8474	392.4379	424.1317	448.3275	(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	
East	8.7400	19.6403	0.6300	0.7000	0.7700	52.4603	(76)
South	1.8900	46.7521	0.6300	0.7000	0.7700	27.0044	(78)
West	9.8100	19.6403	0.6300	0.7000	0.7700	58.8828	(80)

Solar gains	138.3474	262.0368	415.0394	586.8193	707.4868	720.1704	687.2292	597.3168	476.0365	306.1528	170.8411	114.8974	(83)
Total gains	600.9902	722.3308	858.4927	1002.9164	1095.3606	1081.2385	1031.1452	947.8738	840.8839	698.5907	594.9728	563.2249	(84)

7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	38.1517	38.2556	38.3580	38.8464	38.9391	39.3768	39.3768	39.4589	39.2071	38.9391	38.7519	38.5581	
alpha	3.5434	3.5504	3.5572	3.5898	3.5959	3.6251	3.6251	3.6306	3.6138	3.5959	3.5835	3.5705	
util living area													
	0.9943	0.9885	0.9734	0.9317	0.8436	0.6989	0.5503	0.6079	0.8308	0.9613	0.9901	0.9955	(86)
MIT	19.0945	19.3158	19.6940	20.1840	20.5972	20.8618	20.9567	20.9377	20.7217	20.1605	19.5382	19.0608	(87)
Th 2	19.9448	19.9474	19.9499	19.9617	19.9639	19.9742	19.9742	19.9762	19.9703	19.9639	19.9594	19.9548	(88)
util rest of house													
	0.9930	0.9859	0.9670	0.9142	0.8023	0.6196	0.4376	0.4955	0.7704	0.9482	0.9873	0.9944	(89)
MIT 2	17.3882	17.7120	18.2619	18.9678	19.5306	19.8603	19.9510	19.9396	19.7078	18.9478	18.0454	17.3451	(90)
Living area fraction									fLA = Living area / (4) =			0.1411	(91)
MIT	17.6290	17.9383	18.4639	19.1394	19.6811	20.0016	20.0929	20.0804	19.8509	19.1189	18.2560	17.5872	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.6290	17.9383	18.4639	19.1394	19.6811	20.0016	20.0929	20.0804	19.8509	19.1189	18.2560	17.5872	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9884	0.9782	0.9541	0.8966	0.7891	0.6220	0.4514	0.5079	0.7621	0.9334	0.9804	0.9906	(94)
Useful gains	593.9917	706.5726	819.0927	899.1759	864.3765	672.4836	465.4733	481.3803	640.8177	652.0322	583.3161	557.9403	(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													
	1899.6253	1853.1528	1695.9148	1433.2127	1114.4514	745.8725	482.3122	507.1501	797.5450	1189.5466	1565.3178	1887.8127	(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													
	971.3914	770.5019	652.3557	384.5065	186.0557	0.0000	0.0000	0.0000	0.0000	399.9107	707.0412	989.4251	(98)
Space heating												5061.1880	(98)
Space heating per m2											(98) / (4) =	41.5158	(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 %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	5592.4730	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	971.3914	770.5019	652.3557	384.5065	186.0557	0.0000	0.0000	0.0000	0.0000	399.9107	707.0412	989.4251	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	1073.3606	851.3833	720.8350	424.8690	205.5864	0.0000	0.0000	0.0000	0.0000	441.8903	781.2610	1093.2874	(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													
	181.1536	158.8318	164.8350	145.0266	140.1277	122.3508	114.7963	129.7125	130.6642	150.5183	162.5990	175.8717	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9816	89.9366	89.8358	89.6005	89.0970	87.3000	87.3000	87.3000	87.3000	89.6019	89.8840	90.0021	(217)
Fuel for water heating, kWh/month													
	201.3230	176.6042	183.4848	161.8592	157.2755	140.1498	131.4963	148.5825	149.6726	167.9857	180.8987	195.4084	(219)
Water heating fuel used												1994.7407	(219)
Annual totals kWh/year													
Space heating fuel - main system												5592.4730	(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)												468.3206	(232)
Total delivered energy for all uses												8130.5342	(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	5592.4730	0.2160	1207.9742	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1994.7407	0.2160	430.8640	(264)
Space and water heating			1638.8381	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.3206	0.5190	243.0584	(268)
Total CO2, kg/year			1920.8215	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			15.7600	(273)

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

DER		15.7600	ZC1
Total Floor Area	TFA	121.9100	
Assumed number of occupants	N	2.8704	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		13.9835	ZC2
CO2 emissions from cooking, equation (L16)		1.5412	ZC3
Total CO2 emissions		31.2847	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		31.2847	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	58.8300	(1b)	x 2.3600	(2b) =	138.8388	(1b) - (3b)
First floor	63.0800	(1c)	x 2.3200	(2c) =	146.3456	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.9100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		285.1844	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1403	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3903	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3610	(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	0.4603	0.4512	0.4422	0.3971	0.3881	0.3429	0.3429	0.3339	0.3610	0.3881	0.4061	0.4242	(22b)
Effective ac	0.6059	0.6018	0.5978	0.5788	0.5753	0.5588	0.5588	0.5558	0.5652	0.5753	0.5825	0.5900	(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			1.9100	1.0000	1.9100			(26)
TER Opening Type (Uw = 1.40)			20.4400	1.3258	27.0985			(27)
Ground Floor			58.8300	0.1300	7.6479			(28a)
Exposed Floor			4.2500	0.1300	0.5525			(28b)
External Walls	102.1100	20.9100	81.2000	0.1800	14.6160			(29a)
Dormer Walls & Cheeks	4.0200	1.4400	2.5800	0.1800	0.4644			(29a)
Pitched Cold Roof	43.2000		43.2000	0.1300	5.6160			(30)
Sloping Roof	27.5900		27.5900	0.1300	3.5867			(30)
Total net area of external elements Aum(A, m2)			240.0000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		61.4920			(33)

Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	16.3958	(36)
Total fabric heat loss (33) + (36) =	77.8878	(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	57.0237	56.6367	56.2572	54.4751	54.1417	52.5895	52.5895	52.3021	53.1874	54.1417	54.8162	55.5214	(38)
Heat transfer coeff	134.9115	134.5244	134.1450	132.3629	132.0295	130.4773	130.4773	130.1899	131.0752	132.0295	132.7040	133.4092	(39)
Average = Sum(39)m / 12 =												132.3613	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1066	1.1035	1.1004	1.0857	1.0830	1.0703	1.0703	1.0679	1.0752	1.0830	1.0885	1.0943	(40)
HLP (average)												1.0857	(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	2.8704 (42)
Average daily hot water use (litres/day)	102.3720 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.6092	108.5144	104.4195	100.3246	96.2297	92.1348	92.1348	96.2297	100.3246	104.4195	108.5144	112.6092	(44)
Energy conte	166.9963	146.0560	150.7167	131.3985	126.0800	108.7974	100.8168	115.6888	117.0704	136.4343	148.9287	161.7270	(45)
Energy content (annual)										Total = Sum(45)m =		1610.7108	(45)
Distribution loss (46)m = 0.15 x (45)m	25.0494	21.9084	22.6075	19.7098	18.9120	16.3196	15.1225	17.3533	17.5606	20.4651	22.3393	24.2590	(46)

Water storage loss:

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Total storage loss

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

If cylinder contains dedicated solar storage

0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss 50.9589	46.0274	50.9589	49.3151	49.0376	45.4364	46.9509	49.0376	49.3151	50.9589	49.3151	50.9589	(61)

Total heat required for water heating calculated for each month

217.9552	192.0834	201.6756	180.7135	175.1176	154.2338	147.7677	164.7264	166.3855	187.3932	198.2438	212.6859	(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

217.9552	192.0834	201.6756	180.7135	175.1176	154.2338	147.7677	164.7264	166.3855	187.3932	198.2438	212.6859	(64)
							Total per year (kWh/year) = Sum(64)m =				2198.9815	(64)

Heat gains from water heating, kWh/month

68.2660	60.0705	62.8530	56.0188	54.1810	47.5342	45.2593	50.7259	51.2547	58.1041	61.8476	66.5139	(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	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	(66)

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

26.5183	23.5533	19.1548	14.5014	10.8400	9.1516	9.8886	12.8536	17.2520	21.9054	25.5669	27.2553	(67)

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

287.6793	290.6645	283.1419	267.1271	246.9112	227.9112	215.2181	212.2329	219.7555	235.7703	255.9861	274.9861	(68)

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

37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	(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)

-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	(71)

Water heating gains (Table 5)

91.7553	89.3906	84.4799	77.8038	72.8239	66.0198	60.8324	68.1800	71.1871	78.0970	85.8994	89.4005	(72)

Total internal gains

475.0089	472.6644	455.8326	428.4883	399.6312	372.1386	354.9951	362.3224	377.2506	404.8287	436.5084	460.6979	(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	
East	8.7400	19.6403	0.6300	0.7000	0.7700	52.4603	(76)
South	1.8900	46.7521	0.6300	0.7000	0.7700	27.0044	(78)
West	9.8100	19.6403	0.6300	0.7000	0.7700	58.8828	(80)

Solar gains	138.3474	262.0368	415.0394	586.8193	707.4868	720.1704	687.2292	597.3168	476.0365	306.1528	170.8411	114.8974	(83)
Total gains	613.3563	734.7012	870.8720	1015.3077	1107.1179	1092.3090	1042.2243	959.6393	853.2871	710.9815	607.3495	575.5952	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	62.7520	62.9326	63.1106	63.9603	64.1218	64.8846	64.8846	65.0279	64.5887	64.1218	63.7959	63.4587	
alpha	5.1835	5.1955	5.2074	5.2640	5.2748	5.3256	5.3256	5.3352	5.3059	5.2748	5.2531	5.2306	
util living area	0.9991	0.9976	0.9915	0.9647	0.8808	0.7118	0.5403	0.6041	0.8648	0.9848	0.9980	0.9994	(86)
MIT	19.7264	19.8867	20.1592	20.5151	20.8029	20.9550	20.9914	20.9850	20.8700	20.4752	20.0351	19.7034	(87)
Th 2	19.9954	19.9980	20.0005	20.0125	20.0147	20.0252	20.0252	20.0271	20.0212	20.0147	20.0102	20.0055	(88)
util rest of house	0.9988	0.9968	0.9884	0.9512	0.8371	0.6239	0.4261	0.4863	0.7990	0.9768	0.9972	0.9992	(89)
MIT 2	18.2839	18.5201	18.9186	19.4358	19.8193	19.9949	20.0220	20.0208	19.9132	19.3882	18.7464	18.2575	(90)
Living area fraction									fLA = Living area / (4) =			0.1411	(91)
MIT	18.4875	18.7129	19.0936	19.5881	19.9581	20.1304	20.1587	20.1568	20.0482	19.5415	18.9282	18.4615	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4875	18.7129	19.0936	19.5881	19.9581	20.1304	20.1587	20.1568	20.0482	19.5415	18.9282	18.4615	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9981	0.9951	0.9844	0.9437	0.8341	0.6340	0.4422	0.5027	0.8012	0.9714	0.9958	0.9987	(94)
Useful gains	612.2123	731.1094	857.2612	958.1542	923.4839	692.5611	460.8389	482.4290	683.6139	690.6466	604.8031	574.8225	(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	1914.0514	1858.1721	1689.3686	1414.7053	1090.3117	721.5893	464.3330	489.1024	779.6652	1180.5481	1569.6476	1902.6144	(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	968.5683	757.3861	619.0879	328.7168	124.1198	0.0000	0.0000	0.0000	0.0000	364.4867	694.6880	987.8772	(98)
Space heating												4844.9308	(98)
Space heating per m2											(98) / (4) =	39.7419	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.4000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												5187.2921	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	968.5683	757.3861	619.0879	328.7168	124.1198	0.0000	0.0000	0.0000	0.0000	364.4867	694.6880	987.8772	(98)
Space heating efficiency (main heating system 1)													
	93.4000	93.4000	93.4000	93.4000	93.4000	0.0000	0.0000	0.0000	0.0000	93.4000	93.4000	93.4000	(210)
Space heating fuel (main heating system)													
	1037.0110	810.9059	662.8350	351.9452	132.8906	0.0000	0.0000	0.0000	0.0000	390.2427	743.7773	1057.6843	(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													
	217.9552	192.0834	201.6756	180.7135	175.1176	154.2338	147.7677	164.7264	166.3855	187.3932	198.2438	212.6859	(64)
Efficiency of water heater												80.3000	(216)
(217)m	88.3585	88.1568	87.6899	86.5388	84.2021	80.3000	80.3000	80.3000	80.3000	86.6973	87.9442	88.4296	(217)
Fuel for water heating, kWh/month													
	246.6713	217.8884	229.9873	208.8237	207.9729	192.0719	184.0196	205.1387	207.2049	216.1466	225.4200	240.5144	(219)
Water heating fuel used												2581.8596	(219)
Annual totals kWh/year													
Space heating fuel - main system												5187.2921	(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)												468.3206	(232)
Total delivered energy for all uses												8312.4723	(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	5187.2921	0.2160	1120.4551	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	2581.8596	0.2160	557.6817	(264)
Space and water heating			1678.1368	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.3206	0.5190	243.0584	(268)
Total CO2, kg/m2/year			1960.1202	(272)
Emissions per m2 for space and water heating			13.7654	(272a)
Fuel factor (mains gas)			1.0000	
Emissions per m2 for lighting			1.9938	(272b)
Emissions per m2 for pumps and fans			0.3193	(272c)
Target Carbon Dioxide Emission Rate (TER) = (13.7654 * 1.00) + 1.9938 + 0.3193, rounded to 2 d.p.			16.0800	(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	58.8300 (1b)	x	2.3600 (2b)	=	138.8388	(1b) - (3b)
First floor	63.0800 (1c)	x	2.3200 (2c)	=	146.3456	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.9100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	285.1844	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1403	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3903	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3610	(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	0.4603	0.4512	0.4422	0.3971	0.3881	0.3429	0.3429	0.3339	0.3610	0.3881	0.4061	0.4242	(22b)
Effective ac	0.6059	0.6018	0.5978	0.5788	0.5753	0.5588	0.5588	0.5558	0.5652	0.5753	0.5825	0.5900	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Front Door			1.9100	1.4000	2.6740			(26)
Windows (Uw = 1.40)			20.4400	1.3258	27.0985			(27)
Ground Floor			58.8300	0.1200	7.0596	75.0000	4412.2500	(28a)
Exposed Floor			4.2500	0.1600	0.6800	20.0000	85.0000	(28b)
External Walls	102.1100	20.9100	81.2000	0.2400	19.4880	60.0000	4872.0000	(29a)
Dormer Walls & Cheeks	4.0200	1.4400	2.5800	0.2300	0.5934	9.0000	23.2200	(29a)
Pitched Cold Roof	43.2000		43.2000	0.1000	4.3200	9.0000	388.8000	(30)
Sloping Roof	27.5900		27.5900	0.1700	4.6903	9.0000	248.3100	(30)
Total net area of external elements Aum(A, m2)			240.0000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		66.6038			(33)
Party Wall			33.0600	0.0000	0.0000	70.0000	2314.2000	(32)
Internal Wall - Masonry			56.0700			75.0000	4205.2500	(32c)
Internal Wall - Timber			100.8300			9.0000	907.4700	(32c)
Internal Floor			58.8300			18.0000	1058.9400	(32d)
Internal Ceiling			58.8300			9.0000	529.4700	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	19044.9100 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		156.2211 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		18.8912 (36)
Total fabric heat loss	(33) + (36) =	85.4950 (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	57.0237	56.6367	56.2572	54.4751	54.1417	52.5895	52.5895	52.3021	53.1874	54.1417	54.8162	55.5214	(38)
Heat transfer coeff	142.5187	142.1316	141.7522	139.9701	139.6367	138.0845	138.0845	137.7971	138.6824	139.6367	140.3112	141.0164	(39)
Average = Sum(39)m / 12 =												139.9685	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1690	1.1659	1.1628	1.1481	1.1454	1.1327	1.1327	1.1303	1.1376	1.1454	1.1509	1.1567	(40)
HLP (average)												1.1481	(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	2.8704 (42)
Average daily hot water use (litres/day)	102.3720 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	112.6092	108.5144	104.4195	100.3246	96.2297	92.1348	92.1348	96.2297	100.3246	104.4195	108.5144	112.6092	(44)
Energy conte	166.9963	146.0560	150.7167	131.3985	126.0800	108.7974	100.8168	115.6888	117.0704	136.4343	148.9287	161.7270	(45)
Energy content (annual)										Total = Sum(45)m =		1610.7108	(45)
Distribution loss (46)m = 0.15 x (45)m													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Primary loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(59)
Heat gains from water heating, kWh/month													
	35.4867	31.0369	32.0273	27.9222	26.7920	23.1195	21.4236	24.5839	24.8775	28.9923	31.6474	34.3670	(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	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.5183	23.5533	19.1548	14.5014	10.8400	9.1516	9.8886	12.8536	17.2520	21.9054	25.5669	27.2553	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	287.6793	290.6645	283.1419	267.1271	246.9112	227.9112	215.2181	212.2329	219.7555	235.7703	255.9861	274.9861	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	(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)													
	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	(71)
Water heating gains (Table 5)													
	47.6972	46.1859	43.0474	38.7808	36.0107	32.1103	28.7951	33.0428	34.5520	38.9681	43.9547	46.1922	(72)
Total internal gains													
	427.9507	426.4596	411.4001	386.4653	359.8180	335.2292	319.9578	324.1853	337.6156	362.6999	391.5636	414.4896	(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	
East	8.7400	19.6403	0.6300	0.7000	0.7700	52.4603	(76)
South	1.8900	46.7521	0.6300	0.7000	0.7700	27.0044	(78)
West	9.8100	19.6403	0.6300	0.7000	0.7700	58.8828	(80)

Solar gains	138.3474	262.0368	415.0394	586.8193	707.4868	720.1704	687.2292	597.3168	476.0365	306.1528	170.8411	114.8974	(83)
Total gains	566.2982	688.4965	826.4395	973.2846	1067.3048	1055.3996	1007.1870	921.5021	813.6521	668.8526	562.4047	529.3870	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	37.1197	37.2208	37.3204	37.7956	37.8858	38.3117	38.3117	38.3916	38.1465	37.8858	37.7037	37.5152	
alpha	3.4746	3.4814	3.4880	3.5197	3.5257	3.5541	3.5541	3.5594	3.5431	3.5257	3.5136	3.5010	
util living area													
	0.9948	0.9893	0.9747	0.9341	0.8484	0.7066	0.5591	0.6186	0.8384	0.9639	0.9910	0.9959	(86)
MIT	19.0202	19.2471	19.6357	20.1405	20.5690	20.8482	20.9511	20.9297	20.6981	20.1146	19.4749	18.9864	(87)
Th 2	19.9448	19.9474	19.9499	19.9617	19.9639	19.9742	19.9742	19.9762	19.9703	19.9639	19.9594	19.9548	(88)
util rest of house													
	0.9936	0.9868	0.9686	0.9174	0.8084	0.6284	0.4461	0.5063	0.7801	0.9517	0.9885	0.9950	(89)
MIT 2	18.1282	18.3558	18.7426	19.2436	19.6447	19.8875	19.9559	19.9473	19.7732	19.2282	18.5926	18.1018	(90)
Living area fraction										fLA = Living area / (4) =		0.1411	(91)
MIT	18.2541	18.4816	18.8686	19.3701	19.7751	20.0230	20.0963	20.0859	19.9037	19.3533	18.7171	18.2266	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.2541	18.4816	18.8686	19.3701	19.7751	20.0230	20.0963	20.0859	19.9037	19.3533	18.7171	18.2266	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9909	0.9821	0.9603	0.9056	0.7999	0.6325	0.4604	0.5194	0.7756	0.9422	0.9843	0.9927	(94)
Useful gains	561.1274	676.1403	793.6187	881.4296	853.7663	667.5629	463.6963	478.6182	631.0968	630.1824	553.5724	525.5366	(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													
	1988.7172	1930.3718	1753.2769	1465.5047	1127.5814	748.8365	482.7867	507.9075	804.8693	1222.2794	1630.0098	1977.9838	(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													
	1062.1269	842.8436	713.9857	420.5341	203.7184	0.0000	0.0000	0.0000	0.0000	440.5202	775.0350	1080.6207	(98)
Space heating												5539.3845	(98)
Space heating per m2											(98) / (4) =	45.4383	(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

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	1297.9944	1021.8254	1047.2578	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7953	0.8613	0.8284	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1032.3217	880.0697	867.5119	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1349.4138	1290.4934	1192.6056	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	228.3063	305.3552	241.8696	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												775.5311	(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	57.0766	76.3388	60.4674	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling												193.8828	(107)
Space cooling per m2												1.5904	(108)
Energy for space heating												45.4383	(99)
Energy for space cooling												1.5904	(108)
Total												47.0287	(109)
Dwelling Fabric Energy Efficiency (DFEE)												47.0	(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	58.8300	(1b)	x 2.3600	(2b) =	138.8388	(1b) - (3b)
First floor	63.0800	(1c)	x 2.3200	(2c) =	146.3456	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.9100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) =		285.1844	(5)

2. Ventilation rate

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

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000	/ (5) =	0.1403	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3903	(18)
Number of sides sheltered			1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3610	(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	0.4603	0.4512	0.4422	0.3971	0.3881	0.3429	0.3429	0.3339	0.3610	0.3881	0.4061	0.4242	(22b)
Effective ac	0.6059	0.6018	0.5978	0.5788	0.5753	0.5588	0.5588	0.5558	0.5652	0.5753	0.5825	0.5900	(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			1.9100	1.0000	1.9100			(26)
TER Opening Type (Uw = 1.40)			20.4400	1.3258	27.0985			(27)
Ground Floor			58.8300	0.1300	7.6479			(28a)
Exposed Floor			4.2500	0.1300	0.5525			(28b)
External Walls	102.1100	20.9100	81.2000	0.1800	14.6160			(29a)
Dormer Walls & Cheeks	4.0200	1.4400	2.5800	0.1800	0.4644			(29a)
Pitched Cold Roof	43.2000		43.2000	0.1300	5.6160			(30)
Sloping Roof	27.5900		27.5900	0.1300	3.5867			(30)
Total net area of external elements Aum(A, m2)			240.0000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		61.4920			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							16.3958	(36)
Total fabric heat loss					(33) + (36) =		77.8878	(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	57.0237	56.6367	56.2572	54.4751	54.1417	52.5895	52.5895	52.3021	53.1874	54.1417	54.8162	55.5214	(38)
Heat transfer coeff	134.9115	134.5244	134.1450	132.3629	132.0295	130.4773	130.4773	130.1899	131.0752	132.0295	132.7040	133.4092	(39)
Average = Sum(39)m / 12 =												132.3613	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1066	1.1035	1.1004	1.0857	1.0830	1.0703	1.0703	1.0679	1.0752	1.0830	1.0885	1.0943	(40)
HLP (average)												1.0857	(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	2.8704	(42)
Average daily hot water use (litres/day)	102.3720	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	112.6092	108.5144	104.4195	100.3246	96.2297	92.1348	92.1348	96.2297	100.3246	104.4195	108.5144	112.6092	(44)
Energy conte	166.9963	146.0560	150.7167	131.3985	126.0800	108.7974	100.8168	115.6888	117.0704	136.4343	148.9287	161.7270	(45)
Energy content (annual)										Total = Sum(45)m =		1610.7108	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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													
	35.4867	31.0369	32.0273	27.9222	26.7920	23.1195	21.4236	24.5839	24.8775	28.9923	31.6474	34.3670	(65)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	143.5201	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	26.5183	23.5533	19.1548	14.5014	10.8400	9.1516	9.8886	12.8536	17.2520	21.9054	25.5669	27.2553	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	287.6793	290.6645	283.1419	267.1271	246.9112	227.9112	215.2181	212.2329	219.7555	235.7703	255.9861	274.9861	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	37.3520	(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)													
	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	(71)
Water heating gains (Table 5)													
	47.6972	46.1859	43.0474	38.7808	36.0107	32.1103	28.7951	33.0428	34.5520	38.9681	43.9547	46.1922	(72)
Total internal gains													
	427.9507	426.4596	411.4001	386.4653	359.8180	335.2292	319.9578	324.1853	337.6156	362.6999	391.5636	414.4896	(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	
East	8.7400	19.6403	0.6300	0.7000	0.7700	52.4603	(76)
South	1.8900	46.7521	0.6300	0.7000	0.7700	27.0044	(78)
West	9.8100	19.6403	0.6300	0.7000	0.7700	58.8828	(80)

Solar gains	138.3474	262.0368	415.0394	586.8193	707.4868	720.1704	687.2292	597.3168	476.0365	306.1528	170.8411	114.8974	(83)
Total gains	566.2982	688.4965	826.4395	973.2846	1067.3048	1055.3996	1007.1870	921.5021	813.6521	668.8526	562.4047	529.3870	(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, ni1,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	62.7520	62.9326	63.1106	63.9603	64.1218	64.8846	64.8846	65.0279	64.5887	64.1218	63.7959	63.4587	
alpha	5.1835	5.1955	5.2074	5.2640	5.2748	5.3256	5.3256	5.3352	5.3059	5.2748	5.2531	5.2306	
util living area													
	0.9994	0.9982	0.9933	0.9702	0.8933	0.7298	0.5574	0.6255	0.8824	0.9883	0.9986	0.9996	(86)
MIT	19.6900	19.8512	20.1260	20.4876	20.7859	20.9493	20.9900	20.9824	20.8543	20.4447	20.0005	19.6675	(87)
Th 2	19.9954	19.9980	20.0005	20.0125	20.0147	20.0252	20.0252	20.0271	20.0212	20.0147	20.0102	20.0055	(88)
util rest of house													
	0.9992	0.9976	0.9908	0.9584	0.8522	0.6421	0.4404	0.5053	0.8209	0.9821	0.9981	0.9995	(89)
MIT 2	18.7906	18.9536	19.2292	19.5930	19.8680	20.0016	20.0226	20.0220	19.9367	19.5576	19.1128	18.7762	(90)
Living area fraction									fLA = Living area / (4) =			0.1411	(91)
MIT	18.9175	19.0803	19.3557	19.7193	19.9975	20.1353	20.1591	20.1575	20.0661	19.6827	19.2380	18.9020	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.9175	19.0803	19.3557	19.7193	19.9975	20.1353	20.1591	20.1575	20.0661	19.6827	19.2380	18.9020	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9989	0.9968	0.9886	0.9540	0.8514	0.6528	0.4570	0.5222	0.8243	0.9791	0.9974	0.9992	(94)
Useful gains	565.6709	686.2844	817.0022	928.4657	908.6913	688.9726	460.2982	481.2150	670.6684	654.8949	560.9473	528.9775	(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													
	1972.0632	1907.5905	1724.5325	1432.0687	1095.5109	722.2305	464.3813	489.1841	782.0116	1199.1901	1610.7609	1961.3768	(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													
	1046.3559	820.7177	675.2026	362.5942	138.9937	0.0000	0.0000	0.0000	0.0000	404.9556	755.8658	1065.7051	(98)
Space heating												5270.3906	(98)
Space heating per m2											(98) / (4) =	43.2318	(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	1226.4869	965.5323	989.4432	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8792	0.9361	0.9093	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1078.3451	903.8180	899.7285	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1349.4138	1290.4934	1192.6056	0.0000	0.0000	0.0000	0.0000	(103)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	(103a)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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Space cooling kWh
              0.0000     0.0000     0.0000     0.0000     0.0000   195.1694   287.6864   217.9005     0.0000     0.0000     0.0000     0.0000 (104)
Space cooling                                                                                                                          700.7564 (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    48.7924    71.9216    54.4751     0.0000     0.0000     0.0000     0.0000 (107)
Space cooling                                                                                                                          175.1891 (107)
Space cooling per m2                                                                                                                     1.4370 (108)
Energy for space heating                                                                                                                43.2318 (99)
Energy for space cooling                                                                                                                 1.4370 (108)
Total                                                                                                                                   44.6689 (109)
Target Fabric Energy Efficiency (TFEE)                                                                                                    51.4 (109)


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CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	58.8300 (1b)	x	2.3600 (2b)	=	138.8388	(1b) - (3b)
First floor	63.0800 (1c)	x	2.3200 (2c)	=	146.3456	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.9100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	285.1844	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1403	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3903	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3610	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.3000	4.0000	3.9000	3.6000	3.7000	3.3000	3.3000	3.1000	3.1000	3.4000	3.4000	3.8000	(22)
Wind factor	1.0750	1.0000	0.9750	0.9000	0.9250	0.8250	0.8250	0.7750	0.7750	0.8500	0.8500	0.9500	(22a)
Adj infilt rate	0.3881	0.3610	0.3520	0.3249	0.3339	0.2978	0.2978	0.2798	0.2798	0.3068	0.3068	0.3429	(22b)
Effective ac	0.5753	0.5652	0.5619	0.5528	0.5558	0.5443	0.5443	0.5391	0.5391	0.5471	0.5471	0.5588	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Front Door			1.9100	1.4000	2.6740			(26)
Windows (Uw = 1.40)			20.4400	1.3258	27.0985			(27)
Ground Floor			58.8300	0.1200	7.0596	75.0000	4412.2500	(28a)
Exposed Floor			4.2500	0.1600	0.6800	20.0000	85.0000	(28b)
External Walls	102.1100	20.9100	81.2000	0.2400	19.4880	60.0000	4872.0000	(29a)
Dormer Walls & Cheeks	4.0200	1.4400	2.5800	0.2300	0.5934	9.0000	23.2200	(29a)
Pitched Cold Roof	43.2000		43.2000	0.1000	4.3200	9.0000	388.8000	(30)
Sloping Roof	27.5900		27.5900	0.1700	4.6903	9.0000	248.3100	(30)
Total net area of external elements Aum(A, m2)			240.0000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	66.6038			(33)
Party Wall			33.0600	0.0000	0.0000	70.0000	2314.2000	(32)
Internal Wall - Masonry			56.0700			75.0000	4205.2500	(32c)
Internal Wall - Timber			100.8300			9.0000	907.4700	(32c)
Internal Floor			58.8300			18.0000	1058.9400	(32d)
Internal Ceiling			58.8300			18.0000	1058.9400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 19574.3800	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	160.5642	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	18.8912	(36)
Total fabric heat loss	(33) + (36) = 85.4950	(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	54.1417	53.1874	52.8847	52.0223	52.3021	51.2290	51.2290	50.7385	50.7385	51.4858	51.4858	52.5895	(38)
Heat transfer coeff	139.6367	138.6824	138.3796	137.5173	137.7971	136.7240	136.7240	136.2334	136.2334	136.9808	136.9808	138.0845	(39)
Average = Sum(39)m / 12 =												137.4978	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1454	1.1376	1.1351	1.1280	1.1303	1.1215	1.1215	1.1175	1.1175	1.1236	1.1236	1.1327	(40)
HLP (average)												1.1279	(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	2.8704 (42)
Average daily hot water use (litres/day)	102.3720 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF HEAT DEMAND 09 Jan 2014

	112.6092	108.5144	104.4195	100.3246	96.2297	92.1348	92.1348	96.2297	100.3246	104.4195	108.5144	112.6092	(44)
Energy conte	166.9963	146.0560	150.7167	131.3985	126.0800	108.7974	100.8168	115.6888	117.0704	136.4343	148.9287	161.7270	(45)
Energy content (annual)										Total = Sum(45)m =		1610.7108	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.0494	21.9084	22.6075	19.7098	18.9120	16.3196	15.1225	17.3533	17.5606	20.4651	22.3393	24.2590	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1574	12.7758	14.1183	13.6282	14.0477	13.5534	13.9795	14.0237	13.5938	14.0840	13.6702	14.1447	(61)
Total heat required for water heating calculated for each month													
	181.1536	158.8318	164.8350	145.0266	140.1277	122.3508	114.7963	129.7125	130.6642	150.5183	162.5990	175.8717	(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													
	181.1536	158.8318	164.8350	145.0266	140.1277	122.3508	114.7963	129.7125	130.6642	150.5183	162.5990	175.8717	(64)
									Total per year (kWh/year) = Sum(64)m =			1776.4874	(64)
RHI water heating demand												1776	(64)
Heat gains from water heating, kWh/month													
	59.0656	51.7576	53.6429	47.0970	45.4335	39.5635	37.0165	41.9724	42.3244	48.8854	52.9364	57.3104	(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	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	66.2956	58.8832	47.8870	36.2536	27.1000	22.8789	24.7215	32.1339	43.1301	54.7636	63.9172	68.1382	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	429.3721	433.8276	422.5998	398.6971	368.5243	340.1660	321.2210	316.7655	327.9933	351.8960	382.0688	410.4270	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	(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)													
	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	(71)
Water heating gains (Table 5)													
	79.3892	77.0202	72.1006	65.4125	61.0666	54.9493	49.7533	56.4146	58.7838	65.7062	73.5227	77.0301	(72)
Total internal gains													
	690.5578	685.2318	658.0883	615.8640	572.1916	533.4951	511.1966	520.8148	545.4080	587.8666	635.0095	671.0961	(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	
East	8.7400	24.4891	0.6300	0.7000	0.7700	65.4118	(76)
South	1.8900	55.4171	0.6300	0.7000	0.7700	32.0094	(78)
West	9.8100	24.4891	0.6300	0.7000	0.7700	73.4199	(80)

Solar gains	170.8411	279.0763	435.7205	627.0531	731.2519	797.8518	747.5064	659.6017	535.6825	348.6111	206.6078	138.3474	(83)
Total gains	861.3989	964.3081	1093.8088	1242.9171	1303.4435	1331.3469	1258.7031	1180.4166	1081.0905	936.4776	841.6173	809.4436	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	38.9391	39.2071	39.2928	39.5392	39.4589	39.7686	39.7686	39.9119	39.9119	39.6941	39.6941	39.3768	
alpha	3.5959	3.6138	3.6195	3.6359	3.6306	3.6512	3.6512	3.6608	3.6608	3.6463	3.6463	3.6251	
util living area													
	0.9813	0.9710	0.9408	0.8700	0.7453	0.5479	0.3932	0.4365	0.7012	0.9023	0.9683	0.9844	(86)
MIT	19.4463	19.6329	20.0207	20.4449	20.7694	20.9461	20.9881	20.9826	20.8620	20.4473	19.8815	19.4165	(87)
Th 2	19.9639	19.9703	19.9723	19.9780	19.9762	19.9833	19.9833	19.9866	19.9866	19.9816	19.9816	19.9742	(88)
util rest of house													
	0.9772	0.9648	0.9276	0.8413	0.6900	0.4631	0.2892	0.3291	0.6241	0.8740	0.9602	0.9810	(89)
MIT 2	17.9106	18.1839	18.7398	19.3310	19.7476	19.9457	19.9787	19.9791	19.8711	19.3510	18.5536	17.8743	(90)
Living area fraction									fLA = Living area / (4) =			0.1411	(91)
MIT	18.1272	18.3883	18.9205	19.4881	19.8918	20.0868	20.1211	20.1207	20.0109	19.5056	18.7409	18.0919	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1272	18.3883	18.9205	19.4881	19.8918	20.0868	20.1211	20.1207	20.0109	19.5056	18.7409	18.0919	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9668	0.9517	0.9104	0.8252	0.6850	0.4722	0.3036	0.3438	0.6261	0.8576	0.9467	0.9719	(94)
Useful gains	832.7919	917.6999	995.8237	1025.6122	892.8856	628.6295	382.1376	405.8130	676.8902	803.1195	796.7339	786.6656	(95)
Ext temp.	4.6000	5.1000	7.0000	9.4000	12.4000	15.3000	17.3000	17.1000	14.5000	11.1000	7.5000	4.6000	(96)
Heat loss rate W													
	1888.8988	1842.8594	1649.5532	1387.2950	1032.3435	654.4722	385.7156	411.5156	750.7733	1151.4099	1539.7907	1863.0251	(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													
	785.7436	621.7072	486.3748	260.4116	103.7567	0.0000	0.0000	0.0000	0.0000	259.1281	535.0009	800.8114	(98)
Space heating												3852.9343	(98)
RHI space heating demand												3853	(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	58.8300 (1b)	x	2.3600 (2b)	=	138.8388	(1b) - (3b)
First floor	63.0800 (1c)	x	2.3200 (2c)	=	146.3456	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.9100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	285.1844	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1403	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3903	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3610	(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	0.4603	0.4512	0.4422	0.3971	0.3881	0.3429	0.3429	0.3339	0.3610	0.3881	0.4061	0.4242	(22b)
Effective ac	0.6059	0.6018	0.5978	0.5788	0.5753	0.5588	0.5588	0.5558	0.5652	0.5753	0.5825	0.5900	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Front Door			1.9100	1.4000	2.6740			(26)
Windows (Uw = 1.40)			20.4400	1.3258	27.0985			(27)
Ground Floor			58.8300	0.1200	7.0596	75.0000	4412.2500	(28a)
Exposed Floor			4.2500	0.1600	0.6800	20.0000	85.0000	(28b)
External Walls	102.1100	20.9100	81.2000	0.2400	19.4880	60.0000	4872.0000	(29a)
Dormer Walls & Cheeks	4.0200	1.4400	2.5800	0.2300	0.5934	9.0000	23.2200	(29a)
Pitched Cold Roof	43.2000		43.2000	0.1000	4.3200	9.0000	388.8000	(30)
Sloping Roof	27.5900		27.5900	0.1700	4.6903	9.0000	248.3100	(30)
Total net area of external elements Aum(A, m2)			240.0000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	66.6038			(33)
Party Wall			33.0600	0.0000	0.0000	70.0000	2314.2000	(32)
Internal Wall - Masonry			56.0700			75.0000	4205.2500	(32c)
Internal Wall - Timber			100.8300			9.0000	907.4700	(32c)
Internal Floor			58.8300			18.0000	1058.9400	(32d)
Internal Ceiling			58.8300			18.0000	1058.9400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	19574.3800 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		160.5642 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		18.8912 (36)
Total fabric heat loss	(33) + (36) =	85.4950 (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	57.0237	56.6367	56.2572	54.4751	54.1417	52.5895	52.5895	52.3021	53.1874	54.1417	54.8162	55.5214	(38)
Heat transfer coeff	142.5187	142.1316	141.7522	139.9701	139.6367	138.0845	138.0845	137.7971	138.6824	139.6367	140.3112	141.0164	(39)
Average = Sum(39)m / 12 =												139.9685	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1690	1.1659	1.1628	1.1481	1.1454	1.1327	1.1327	1.1303	1.1376	1.1454	1.1509	1.1567	(40)
HLP (average)												1.1481	(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	2.8704 (42)
Average daily hot water use (litres/day)	102.3720 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

	112.6092	108.5144	104.4195	100.3246	96.2297	92.1348	92.1348	96.2297	100.3246	104.4195	108.5144	112.6092	(44)
Energy conte	166.9963	146.0560	150.7167	131.3985	126.0800	108.7974	100.8168	115.6888	117.0704	136.4343	148.9287	161.7270	(45)
Energy content (annual)										Total = Sum(45)m =		1610.7108	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.0494	21.9084	22.6075	19.7098	18.9120	16.3196	15.1225	17.3533	17.5606	20.4651	22.3393	24.2590	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1574	12.7758	14.1183	13.6282	14.0477	13.5534	13.9795	14.0237	13.5938	14.0840	13.6702	14.1447	(61)
Total heat required for water heating calculated for each month													
	181.1536	158.8318	164.8350	145.0266	140.1277	122.3508	114.7963	129.7125	130.6642	150.5183	162.5990	175.8717	(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													
	181.1536	158.8318	164.8350	145.0266	140.1277	122.3508	114.7963	129.7125	130.6642	150.5183	162.5990	175.8717	(64)
								Total per year (kWh/year) = Sum(64)m =				1776.4874	(64)
Heat gains from water heating, kWh/month													
	59.0656	51.7576	53.6429	47.0970	45.4335	39.5635	37.0165	41.9724	42.3244	48.8854	52.9364	57.3104	(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	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	66.2956	58.8832	47.8870	36.2536	27.1000	22.8789	24.7215	32.1339	43.1301	54.7636	63.9172	68.1382	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	429.3721	433.8276	422.5998	398.6971	368.5243	340.1660	321.2210	316.7655	327.9933	351.8960	382.0688	410.4270	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	(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)													
	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	(71)
Water heating gains (Table 5)													
	79.3892	77.0202	72.1006	65.4125	61.0666	54.9493	49.7533	56.4146	58.7838	65.7062	73.5227	77.0301	(72)
Total internal gains													
	690.5578	685.2318	658.0883	615.8640	572.1916	533.4951	511.1966	520.8148	545.4080	587.8666	635.0095	671.0961	(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	
East	8.7400	19.6403	0.6300	0.7000	0.7700	52.4603	(76)
South	1.8900	46.7521	0.6300	0.7000	0.7700	27.0044	(78)
West	9.8100	19.6403	0.6300	0.7000	0.7700	58.8828	(80)

Solar gains	138.3474	262.0368	415.0394	586.8193	707.4868	720.1704	687.2292	597.3168	476.0365	306.1528	170.8411	114.8974	(83)
Total gains	828.9052	947.2686	1073.1277	1202.6834	1279.6784	1253.6655	1198.4258	1118.1316	1021.4445	894.0193	805.8506	785.9935	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	38.1517	38.2556	38.3580	38.8464	38.9391	39.3768	39.3768	39.4589	39.2071	38.9391	38.7519	38.5581	
alpha	3.5434	3.5504	3.5572	3.5898	3.5959	3.6251	3.6251	3.6306	3.6138	3.5959	3.5835	3.5705	
util living area													
	0.9844	0.9739	0.9501	0.8929	0.7881	0.6319	0.4847	0.5332	0.7570	0.9247	0.9748	0.9869	(86)
MIT	19.3280	19.5389	19.8909	20.3340	20.6881	20.9012	20.9712	20.9593	20.8021	20.3273	19.7492	19.2914	(87)
Th 2	19.9448	19.9474	19.9499	19.9617	19.9639	19.9742	19.9742	19.9762	19.9703	19.9639	19.9594	19.9548	(88)
util rest of house													
	0.9809	0.9683	0.9390	0.8687	0.7403	0.5523	0.3809	0.4278	0.6872	0.9024	0.9684	0.9840	(89)
MIT 2	17.7269	18.0334	18.5402	19.1691	19.6385	19.8958	19.9594	19.9534	19.7932	19.1751	18.3489	17.6802	(90)
Living area fraction									fLA = Living area / (4) =			0.1411	(91)
MIT	17.9528	18.2458	18.7308	19.3334	19.7866	20.0376	20.1022	20.0953	19.9356	19.3377	18.5465	17.9075	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.9528	18.2458	18.7308	19.3334	19.7866	20.0376	20.1022	20.0953	19.9356	19.3377	18.5465	17.9075	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9715	0.9556	0.9221	0.8510	0.7311	0.5576	0.3944	0.4408	0.6845	0.8851	0.9560	0.9757	(94)
Useful gains	805.2817	905.1816	989.5111	1023.4400	935.5348	699.0551	472.6817	492.8245	699.2266	791.3231	770.4325	766.9165	(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													
	1945.7819	1896.8650	1733.7425	1460.3675	1129.1806	750.8531	483.5931	509.2030	809.2915	1220.1032	1606.0707	1932.9883	(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													
	848.5321	666.4112	553.7081	314.5878	144.0725	0.0000	0.0000	0.0000	0.0000	319.0123	601.6595	867.5574	(98)
Space heating												4315.5409	(98)
Space heating per m2											(98) / (4) =	35.3994	(99)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

8c. Space cooling requirement

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4768.5535	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	848.5321	666.4112	553.7081	314.5878	144.0725	0.0000	0.0000	0.0000	0.0000	319.0123	601.6595	867.5574	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	937.6045	736.3660	611.8322	347.6108	159.1961	0.0000	0.0000	0.0000	0.0000	352.4998	664.8171	958.6270	(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													
	181.1536	158.8318	164.8350	145.0266	140.1277	122.3508	114.7963	129.7125	130.6642	150.5183	162.5990	175.8717	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9201	89.8660	89.7454	89.4652	88.8934	87.3000	87.3000	87.3000	87.3000	89.4489	89.7997	89.9443	(217)
Fuel for water heating, kWh/month													
	201.4606	176.7429	183.6697	162.1039	157.6356	140.1498	131.4963	148.5825	149.6726	168.2729	181.0685	195.5340	(219)
Water heating fuel used												1996.3893	(219)
Annual totals kWh/year													
Space heating fuel - main system												4768.5535	(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)												468.3206	(232)
Total delivered energy for all uses												7308.2634	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4768.5535	3.4800	165.9457	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1996.3893	3.4800	69.4743	(247)
Pumps and fans for heating	75.0000	13.1900	9.8925	(249)
Energy for lighting	468.3206	13.1900	61.7715	(250)
Additional standing charges			120.0000	(251)
Total energy cost			427.0840	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.0747	(257)
SAP value		85.0082	
SAP rating (Section 12)		85	(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	4768.5535	0.2160	1030.0076	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1996.3893	0.2160	431.2201	(264)
Space and water heating			1461.2276	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.3206	0.5190	243.0584	(268)
Total kg/year			1743.2110	(272)
CO2 emissions per m2			14.3000	(273)
EI value			86.0050	
EI rating			86	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency	3.48 × (1 + 0.29 × 0.00) / 0.9050 = 3.845, stars = 4
Main heating environmental impact	0.216 × (1 + 0.29 × 0.00) / 0.9050 = 0.2387, stars = 4
Water heating energy efficiency	3.48 / 0.8886 = 3.916, stars = 4
Water heating environmental impact	0.216 / 0.8886 = 0.2431, 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	58.8300 (1b)	x	2.3600 (2b)	=	138.8388	(1b) - (3b)
First floor	63.0800 (1c)	x	2.3200 (2c)	=	146.3456	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.9100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	285.1844	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1403	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3903	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3610	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.3000	4.0000	3.9000	3.6000	3.7000	3.3000	3.3000	3.1000	3.1000	3.4000	3.4000	3.8000	(22)
Wind factor	1.0750	1.0000	0.9750	0.9000	0.9250	0.8250	0.8250	0.7750	0.7750	0.8500	0.8500	0.9500	(22a)
Adj infilt rate	0.3881	0.3610	0.3520	0.3249	0.3339	0.2978	0.2978	0.2798	0.2798	0.3068	0.3068	0.3429	(22b)
Effective ac	0.5753	0.5652	0.5619	0.5528	0.5558	0.5443	0.5443	0.5391	0.5391	0.5471	0.5471	0.5588	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Front Door			1.9100	1.4000	2.6740			(26)
Windows (Uw = 1.40)			20.4400	1.3258	27.0985			(27)
Ground Floor			58.8300	0.1200	7.0596	75.0000	4412.2500	(28a)
Exposed Floor			4.2500	0.1600	0.6800	20.0000	85.0000	(28b)
External Walls	102.1100	20.9100	81.2000	0.2400	19.4880	60.0000	4872.0000	(29a)
Dormer Walls & Cheeks	4.0200	1.4400	2.5800	0.2300	0.5934	9.0000	23.2200	(29a)
Pitched Cold Roof	43.2000		43.2000	0.1000	4.3200	9.0000	388.8000	(30)
Sloping Roof	27.5900		27.5900	0.1700	4.6903	9.0000	248.3100	(30)
Total net area of external elements Aum(A, m2)			240.0000					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	66.6038			(33)
Party Wall			33.0600	0.0000	0.0000	70.0000	2314.2000	(32)
Internal Wall - Masonry			56.0700			75.0000	4205.2500	(32c)
Internal Wall - Timber			100.8300			9.0000	907.4700	(32c)
Internal Floor			58.8300			18.0000	1058.9400	(32d)
Internal Ceiling			58.8300			18.0000	1058.9400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 19574.3800	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	160.5642	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	18.8912	(36)
Total fabric heat loss	(33) + (36) = 85.4950	(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	54.1417	53.1874	52.8847	52.0223	52.3021	51.2290	51.2290	50.7385	50.7385	51.4858	51.4858	52.5895	(38)
Heat transfer coeff	139.6367	138.6824	138.3796	137.5173	137.7971	136.7240	136.7240	136.2334	136.2334	136.9808	136.9808	138.0845	(39)
Average = Sum(39)m / 12 =												137.4978	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1454	1.1376	1.1351	1.1280	1.1303	1.1215	1.1215	1.1175	1.1175	1.1236	1.1236	1.1327	(40)
HLP (average)												1.1279	(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	2.8704 (42)
Average daily hot water use (litres/day)	102.3720 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

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

	112.6092	108.5144	104.4195	100.3246	96.2297	92.1348	92.1348	96.2297	100.3246	104.4195	108.5144	112.6092	(44)
Energy conte	166.9963	146.0560	150.7167	131.3985	126.0800	108.7974	100.8168	115.6888	117.0704	136.4343	148.9287	161.7270	(45)
Energy content (annual)										Total = Sum(45)m =		1610.7108	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.0494	21.9084	22.6075	19.7098	18.9120	16.3196	15.1225	17.3533	17.5606	20.4651	22.3393	24.2590	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1574	12.7758	14.1183	13.6282	14.0477	13.5534	13.9795	14.0237	13.5938	14.0840	13.6702	14.1447	(61)
Total heat required for water heating calculated for each month													
	181.1536	158.8318	164.8350	145.0266	140.1277	122.3508	114.7963	129.7125	130.6642	150.5183	162.5990	175.8717	(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													
	181.1536	158.8318	164.8350	145.0266	140.1277	122.3508	114.7963	129.7125	130.6642	150.5183	162.5990	175.8717	(64)
								Total per year (kWh/year) = Sum(64)m =				1776.4874	(64)
Heat gains from water heating, kWh/month													
	59.0656	51.7576	53.6429	47.0970	45.4335	39.5635	37.0165	41.9724	42.3244	48.8854	52.9364	57.3104	(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	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	66.2956	58.8832	47.8870	36.2536	27.1000	22.8789	24.7215	32.1339	43.1301	54.7636	63.9172	68.1382	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	429.3721	433.8276	422.5998	398.6971	368.5243	340.1660	321.2210	316.7655	327.9933	351.8960	382.0688	410.4270	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	(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)													
	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	(71)
Water heating gains (Table 5)													
	79.3892	77.0202	72.1006	65.4125	61.0666	54.9493	49.7533	56.4146	58.7838	65.7062	73.5227	77.0301	(72)
Total internal gains													
	690.5578	685.2318	658.0883	615.8640	572.1916	533.4951	511.1966	520.8148	545.4080	587.8666	635.0095	671.0961	(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	
East	8.7400	24.4891	0.6300	0.7000	0.7700	65.4118	(76)
South	1.8900	55.4171	0.6300	0.7000	0.7700	32.0094	(78)
West	9.8100	24.4891	0.6300	0.7000	0.7700	73.4199	(80)

Solar gains	170.8411	279.0763	435.7205	627.0531	731.2519	797.8518	747.5064	659.6017	535.6825	348.6111	206.6078	138.3474	(83)
Total gains	861.3989	964.3081	1093.8088	1242.9171	1303.4435	1331.3469	1258.7031	1180.4166	1081.0905	936.4776	841.6173	809.4436	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	38.9391	39.2071	39.2928	39.5392	39.4589	39.7686	39.7686	39.9119	39.9119	39.6941	39.6941	39.3768	
alpha	3.5959	3.6138	3.6195	3.6359	3.6306	3.6512	3.6512	3.6608	3.6608	3.6463	3.6463	3.6251	
util living area													
	0.9813	0.9710	0.9408	0.8700	0.7453	0.5479	0.3932	0.4365	0.7012	0.9023	0.9683	0.9844	(86)
MIT	19.4463	19.6329	20.0207	20.4449	20.7694	20.9461	20.9881	20.9826	20.8620	20.4473	19.8815	19.4165	(87)
Th 2	19.9639	19.9703	19.9723	19.9780	19.9762	19.9833	19.9833	19.9866	19.9866	19.9816	19.9816	19.9742	(88)
util rest of house													
	0.9772	0.9648	0.9276	0.8413	0.6900	0.4631	0.2892	0.3291	0.6241	0.8740	0.9602	0.9810	(89)
MIT 2	17.9106	18.1839	18.7398	19.3310	19.7476	19.9457	19.9787	19.9791	19.8711	19.3510	18.5536	17.8743	(90)
Living area fraction										fLA = Living area / (4) =		0.1411	(91)
MIT	18.1272	18.3883	18.9205	19.4881	19.8918	20.0868	20.1211	20.1207	20.0109	19.5056	18.7409	18.0919	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1272	18.3883	18.9205	19.4881	19.8918	20.0868	20.1211	20.1207	20.0109	19.5056	18.7409	18.0919	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9668	0.9517	0.9104	0.8252	0.6850	0.4722	0.3036	0.3438	0.6261	0.8576	0.9467	0.9719	(94)
Useful gains	832.7919	917.6999	995.8237	1025.6122	892.8856	628.6295	382.1376	405.8130	676.8902	803.1195	796.7339	786.6656	(95)
Ext temp.	4.6000	5.1000	7.0000	9.4000	12.4000	15.3000	17.3000	17.1000	14.5000	11.1000	7.5000	4.6000	(96)
Heat loss rate W													
	1888.8988	1842.8594	1649.5532	1387.2950	1032.3435	654.4722	385.7156	411.5156	750.7733	1151.4099	1539.7907	1863.0251	(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													
	785.7436	621.7072	486.3748	260.4116	103.7567	0.0000	0.0000	0.0000	0.0000	259.1281	535.0009	800.8114	(98)
Space heating												3852.9343	(98)
Space heating per m2											(98) / (4) =	31.6047	(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 %)												90.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												4257.3860	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	785.7436	621.7072	486.3748	260.4116	103.7567	0.0000	0.0000	0.0000	0.0000	259.1281	535.0009	800.8114	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	868.2249	686.9693	537.4307	287.7476	114.6483	0.0000	0.0000	0.0000	0.0000	286.3293	591.1612	884.8745	(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													
	181.1536	158.8318	164.8350	145.0266	140.1277	122.3508	114.7963	129.7125	130.6642	150.5183	162.5990	175.8717	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.8827	89.8300	89.6680	89.3287	88.6333	87.3000	87.3000	87.3000	87.3000	89.2973	89.7333	89.9066	(217)
Fuel for water heating, kWh/month													
	201.5444	176.8138	183.8280	162.3516	158.0982	140.1498	131.4963	148.5825	149.6726	168.5586	181.2024	195.6160	(219)
Water heating fuel used												1997.9143	(219)
Annual totals kWh/year													
Space heating fuel - main system												4257.3860	(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)												468.3206	(232)
Total delivered energy for all uses												6798.6209	(238)

10a. Fuel costs - using BEDF prices (476)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4257.3860	3.8700	164.7608	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1997.9143	3.8700	77.3193	(247)
Pumps and fans for heating	75.0000	18.9000	14.1750	(249)
Energy for lighting	468.3206	18.9000	88.5126	(250)
Additional standing charges			93.0000	(251)
Total energy cost			437.7677	(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	4257.3860	0.2160	919.5954	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1997.9143	0.2160	431.5495	(264)
Space and water heating			1351.1449	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	468.3206	0.5190	243.0584	(268)
Total kg/year			1633.1283	(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	4257.3860	1.2200	5194.0109	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1997.9143	1.2200	2437.4555	(264)
Space and water heating			7631.4664	(265)
Pumps and fans	75.0000	3.0700	230.2500	(267)
Energy for lighting	468.3206	3.0700	1437.7443	(268)
Primary energy kWh/year			9299.4606	(272)
Primary energy kWh/m2/year			76.2814	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: B 85

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

Current environmental impact rating: B 86

(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	Recommended
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	+ 1.0	-£ 30	-195 kg (12.0%)
U Solar photovoltaic panels	+ 8.0	-£ 357	-980 kg (68.1%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£30	1.60 kg/m²	B 86	B 88
Solar photovoltaic panels	£357	8.04 kg/m²	A 94	A 95
Total Savings	£387	9.64 kg/m²		

Potential energy efficiency rating: A 94
Potential environmental impact rating: A 95

Fuel prices for cost data on this page from database revision number 476 TEST (01 Apr 2021)
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	£103	£112	-£9
Mains gas	£335	£295	£40
Space heating	£272	£272	£0
Water heating	£77	£47	£30
Lighting	£89	£89	£0
Generated (PV)	-£0	-£357	£357
Total cost of fuels	£438	£50	£388
Total cost of uses	£438	£51	£387
Delivered energy	56 kWh/m²	32 kWh/m²	23 kWh/m²
Carbon dioxide emissions	1.6 tonnes	0.5 tonnes	1.2 tonnes
CO2 emissions per m²	13 kg/m²	4 kg/m²	10 kg/m²
Primary energy	76 kWh/m²	20 kWh/m²	57 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	58.8300 (1b)	x	2.3600 (2b)	=	138.8388	(1b) - (3b)
First floor	63.0800 (1c)	x	2.3200 (2c)	=	146.3456	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.9100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	285.1844	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1403	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3903	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3610	(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	0.4603	0.4512	0.4422	0.3971	0.3881	0.3429	0.3429	0.3339	0.3610	0.3881	0.4061	0.4242	(22b)
Effective ac	0.6059	0.6018	0.5978	0.5788	0.5753	0.5588	0.5588	0.5558	0.5652	0.5753	0.5825	0.5900	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Front Door			1.9100	1.4000	2.6740			(26)
Windows (Uw = 1.40)			20.4400	1.3258	27.0985			(27)
Ground Floor			58.8300	0.1200	7.0596	75.0000	4412.2500	(28a)
Exposed Floor			4.2500	0.1600	0.6800	20.0000	85.0000	(28b)
External Walls	102.1100	20.9100	81.2000	0.2400	19.4880	60.0000	4872.0000	(29a)
Dormer Walls & Cheeks	4.0200	1.4400	2.5800	0.2300	0.5934	9.0000	23.2200	(29a)
Pitched Cold Roof	43.2000		43.2000	0.1000	4.3200	9.0000	388.8000	(30)
Sloping Roof	27.5900		27.5900	0.1700	4.6903	9.0000	248.3100	(30)
Total net area of external elements Aum(A, m2)			240.0000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		66.6038			(33)
Party Wall			33.0600	0.0000	0.0000	70.0000	2314.2000	(32)
Internal Wall - Masonry			56.0700			75.0000	4205.2500	(32c)
Internal Wall - Timber			100.8300			9.0000	907.4700	(32c)
Internal Floor			58.8300			18.0000	1058.9400	(32d)
Internal Ceiling			58.8300			18.0000	1058.9400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	19574.3800 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		160.5642 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)		18.8912 (36)
Total fabric heat loss	(33) + (36) =	85.4950 (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	57.0237	56.6367	56.2572	54.4751	54.1417	52.5895	52.5895	52.3021	53.1874	54.1417	54.8162	55.5214	(38)
Heat transfer coeff	142.5187	142.1316	141.7522	139.9701	139.6367	138.0845	138.0845	137.7971	138.6824	139.6367	140.3112	141.0164	(39)
Average = Sum(39)m / 12 =												139.9685	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1690	1.1659	1.1628	1.1481	1.1454	1.1327	1.1327	1.1303	1.1376	1.1454	1.1509	1.1567	(40)
HLP (average)												1.1481	(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	2.8704 (42)
Average daily hot water use (litres/day)	102.3720 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	112.6092	108.5144	104.4195	100.3246	96.2297	92.1348	92.1348	96.2297	100.3246	104.4195	108.5144	112.6092	(44)
Energy conte	166.9963	146.0560	150.7167	131.3985	126.0800	108.7974	100.8168	115.6888	117.0704	136.4343	148.9287	161.7270	(45)
Energy content (annual)										Total = Sum(45)m =		1610.7108	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.0494	21.9084	22.6075	19.7098	18.9120	16.3196	15.1225	17.3533	17.5606	20.4651	22.3393	24.2590	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1574	12.7758	14.1183	13.6282	14.0477	13.5534	13.9795	14.0237	13.5938	14.0840	13.6702	14.1447	(61)
Total heat required for water heating calculated for each month													
	181.1536	158.8318	164.8350	145.0266	140.1277	122.3508	114.7963	129.7125	130.6642	150.5183	162.5990	175.8717	(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												1.1260	(H8)
Utilisation factor												0.5886	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												102.3720	(H14)
Volume ratio Veff/V												0.7326	(H15)
Solar storage volume factor												0.9378	(H16)
Solar input												-880.1892	(H17)
Solar input	-25.5237	-42.5918	-72.5387	-97.2161	-120.1023	-118.0797	-116.5192	-101.8034	-79.7325	-54.4479	-30.2748	-21.3590	(63)
									Solar input (sum of months) = Sum(63)m =			-880.1892	(63)
Output from w/h													
	155.6299	116.2400	92.2963	47.8105	20.0254	4.2711	0.0000	27.9091	50.9317	96.0704	132.3241	154.5127	(64)
									Total per year (kWh/year) = Sum(64)m =			898.0212	(64)
Heat gains from water heating, kWh/month													
	59.0656	51.7576	53.6429	47.0970	45.4335	39.5635	37.0165	41.9724	42.3244	48.8854	52.9364	57.3104	(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	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	66.2956	58.8832	47.8870	36.2536	27.1000	22.8789	24.7215	32.1339	43.1301	54.7636	63.9172	68.1382	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	429.3721	433.8276	422.5998	398.6971	368.5243	340.1660	321.2210	316.7655	327.9933	351.8960	382.0688	410.4270	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	(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)													
	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	(71)
Water heating gains (Table 5)													
	79.3892	77.0202	72.1006	65.4125	61.0666	54.9493	49.7533	56.4146	58.7838	65.7062	73.5227	77.0301	(72)
Total internal gains													
	690.5578	685.2318	658.0883	615.8640	572.1916	533.4951	511.1966	520.8148	545.4080	587.8666	635.0095	671.0961	(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	
East	8.7400	19.6403	0.6300	0.7000	0.7700	52.4603	(76)
South	1.8900	46.7521	0.6300	0.7000	0.7700	27.0044	(78)
West	9.8100	19.6403	0.6300	0.7000	0.7700	58.8828	(80)

Solar gains	138.3474	262.0368	415.0394	586.8193	707.4868	720.1704	687.2292	597.3168	476.0365	306.1528	170.8411	114.8974	(83)
Total gains	828.9052	947.2686	1073.1277	1202.6834	1279.6784	1253.6655	1198.4258	1118.1316	1021.4445	894.0193	805.8506	785.9935	(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	38.1517	38.2556	38.3580	38.8464	38.9391	39.3768	39.3768	39.4589	39.2071	38.9391	38.7519	38.5581	
alpha	3.5434	3.5504	3.5572	3.5898	3.5959	3.6251	3.6251	3.6306	3.6138	3.5959	3.5835	3.5705	
util living area													
	0.9844	0.9739	0.9501	0.8929	0.7881	0.6319	0.4847	0.5332	0.7570	0.9247	0.9748	0.9869	(86)
MIT	19.3280	19.5389	19.8909	20.3340	20.6881	20.9012	20.9712	20.9593	20.8021	20.3273	19.7492	19.2914	(87)
Th 2	19.9448	19.9474	19.9499	19.9617	19.9639	19.9742	19.9742	19.9762	19.9703	19.9639	19.9594	19.9548	(88)
util rest of house													
	0.9809	0.9683	0.9390	0.8687	0.7403	0.5523	0.3809	0.4278	0.6872	0.9024	0.9684	0.9840	(89)
MIT 2	17.7269	18.0334	18.5402	19.1691	19.6385	19.8958	19.9594	19.9534	19.7932	19.1751	18.3489	17.6802	(90)
Living area fraction									fLA = Living area / (4) =			0.1411	(91)
MIT	17.9528	18.2458	18.7308	19.3334	19.7866	20.0376	20.1022	20.0953	19.9356	19.3377	18.5465	17.9075	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.9528	18.2458	18.7308	19.3334	19.7866	20.0376	20.1022	20.0953	19.9356	19.3377	18.5465	17.9075	(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	0.9715	0.9556	0.9221	0.8510	0.7311	0.5576	0.3944	0.4408	0.6845	0.8851	0.9560	0.9757	(94)
Useful gains	805.2817	905.1816	989.5111	1023.4400	935.5348	699.0551	472.6817	492.8245	699.2266	791.3231	770.4325	766.9165	(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													
	1945.7819	1896.8650	1733.7425	1460.3675	1129.1806	750.8531	483.5931	509.2030	809.2915	1220.1032	1606.0707	1932.9883	(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													
	848.5321	666.4112	553.7081	314.5878	144.0725	0.0000	0.0000	0.0000	0.0000	319.0123	601.6595	867.5574	(98)
Space heating												4315.5409	(98)
Space heating per m2											(98) / (4) =	35.3994	(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 %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4768.5535	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	848.5321	666.4112	553.7081	314.5878	144.0725	0.0000	0.0000	0.0000	0.0000	319.0123	601.6595	867.5574	(98)
Space heating efficiency (main heating system 1)													
	90.5000	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)													
	937.6045	736.3660	611.8322	347.6108	159.1961	0.0000	0.0000	0.0000	0.0000	352.4998	664.8171	958.6270	(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													
	155.6299	116.2400	92.2963	47.8105	20.0254	4.2711	0.0000	27.9091	50.9317	96.0704	132.3241	154.5127	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9888	90.0100	90.0285	90.0645	90.0970	87.3000	87.3000	87.3000	87.3000	89.7387	89.9059	90.0013	(217)
Fuel for water heating, kWh/month													
	172.9436	129.1413	102.5190	53.0848	22.2265	4.8924	0.0000	31.9691	58.3410	107.0557	147.1807	171.6783	(219)
Water heating fuel used												1001.0325	(219)
Annual totals kWh/year													
Space heating fuel - main system												4768.5535	(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)												468.3206	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												4635.6672	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4768.5535	3.4800	165.9457	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	1001.0325	3.4800	34.8359	(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	468.3206	13.1900	61.7715	(250)
Additional standing charges			120.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			171.2177	(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] =	0.4308	(257)
SAP value	93.9898	
SAP rating (Section 12)	94	(258)
SAP band	A	

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	4768.5535	0.2160	1030.0076	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1001.0325	0.2160	216.2230	(264)
Space and water heating			1246.2306	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	468.3206	0.5190	243.0584	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			657.7267	(272)
CO2 emissions per m2			5.4000	(273)
EI value			94.7196	
EI rating			95	(274)
EI band			A	

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

SAP 2012 WORKSHEET FOR New Build (As 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	58.8300 (1b)	x	2.3600 (2b)	=	138.8388	(1b) - (3b)
First floor	63.0800 (1c)	x	2.3200 (2c)	=	146.3456	(1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	121.9100					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	285.1844	(5)

2. Ventilation rate

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

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	40.0000 / (5) =	0.1403	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3903	(18)
Number of sides sheltered		1	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.9250	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3610	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	4.3000	4.0000	3.9000	3.6000	3.7000	3.3000	3.3000	3.1000	3.1000	3.4000	3.4000	3.8000	(22)
Wind factor	1.0750	1.0000	0.9750	0.9000	0.9250	0.8250	0.8250	0.7750	0.7750	0.8500	0.8500	0.9500	(22a)
Adj infilt rate	0.3881	0.3610	0.3520	0.3249	0.3339	0.2978	0.2978	0.2798	0.2798	0.3068	0.3068	0.3429	(22b)
Effective ac	0.5753	0.5652	0.5619	0.5528	0.5558	0.5443	0.5443	0.5391	0.5391	0.5471	0.5471	0.5588	(25)

3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K	
Front Door			1.9100	1.4000	2.6740			(26)
Windows (Uw = 1.40)			20.4400	1.3258	27.0985			(27)
Ground Floor			58.8300	0.1200	7.0596	75.0000	4412.2500	(28a)
Exposed Floor			4.2500	0.1600	0.6800	20.0000	85.0000	(28b)
External Walls	102.1100	20.9100	81.2000	0.2400	19.4880	60.0000	4872.0000	(29a)
Dormer Walls & Cheeks	4.0200	1.4400	2.5800	0.2300	0.5934	9.0000	23.2200	(29a)
Pitched Cold Roof	43.2000		43.2000	0.1000	4.3200	9.0000	388.8000	(30)
Sloping Roof	27.5900		27.5900	0.1700	4.6903	9.0000	248.3100	(30)
Total net area of external elements Aum(A, m2)			240.0000					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		66.6038			(33)
Party Wall			33.0600	0.0000	0.0000	70.0000	2314.2000	(32)
Internal Wall - Masonry			56.0700			75.0000	4205.2500	(32c)
Internal Wall - Timber			100.8300			9.0000	907.4700	(32c)
Internal Floor			58.8300			18.0000	1058.9400	(32d)
Internal Ceiling			58.8300			18.0000	1058.9400	(32e)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) = 19574.3800	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K	160.5642	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)	18.8912	(36)
Total fabric heat loss	(33) + (36) = 85.4950	(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	54.1417	53.1874	52.8847	52.0223	52.3021	51.2290	51.2290	50.7385	50.7385	51.4858	51.4858	52.5895	(38)
Heat transfer coeff	139.6367	138.6824	138.3796	137.5173	137.7971	136.7240	136.7240	136.2334	136.2334	136.9808	136.9808	138.0845	(39)
Average = Sum(39)m / 12 =												137.4978	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.1454	1.1376	1.1351	1.1280	1.1303	1.1215	1.1215	1.1175	1.1175	1.1236	1.1236	1.1327	(40)
HLP (average)												1.1279	(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	2.8704 (42)
Average daily hot water use (litres/day)	102.3720 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use												

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

	112.6092	108.5144	104.4195	100.3246	96.2297	92.1348	92.1348	96.2297	100.3246	104.4195	108.5144	112.6092	(44)
Energy conte	166.9963	146.0560	150.7167	131.3985	126.0800	108.7974	100.8168	115.6888	117.0704	136.4343	148.9287	161.7270	(45)
Energy content (annual)										Total = Sum(45)m =		1610.7108	(45)
Distribution loss (46)m = 0.15 x (45)m													
	25.0494	21.9084	22.6075	19.7098	18.9120	16.3196	15.1225	17.3533	17.5606	20.4651	22.3393	24.2590	(46)
Water storage loss:													
Total storage loss													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)
If cylinder contains dedicated solar storage													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(57)
Combi loss	14.1574	12.7758	14.1183	13.6282	14.0477	13.5534	13.9795	14.0237	13.5938	14.0840	13.6702	14.1447	(61)
Total heat required for water heating calculated for each month													
	181.1536	158.8318	164.8350	145.0266	140.1277	122.3508	114.7963	129.7125	130.6642	150.5183	162.5990	175.8717	(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												1179.9840	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1982.3731	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.2307	(H8)
Utilisation factor												0.5563	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												102.3720	(H14)
Volume ratio Veff/V												0.7326	(H15)
Solar storage volume factor												0.9378	(H16)
Solar input												-909.2759	(H17)
Solar input	-29.5664	-42.5831	-71.6125	-97.9080	-117.1813	-123.5582	-119.6786	-106.0312	-84.4490	-58.2342	-34.3511	-24.1224	(63)
									Solar input (sum of months) = Sum(63)m =			-909.2759	(63)
Output from w/h													
	151.5872	116.2487	93.2225	47.1186	22.9464	0.0000	0.0000	23.6813	46.2152	92.2841	128.2479	151.7493	(64)
									Total per year (kWh/year) = Sum(64)m =			873.3012	(64)
Heat gains from water heating, kWh/month													
	59.0656	51.7576	53.6429	47.0970	45.4335	39.5635	37.0165	41.9724	42.3244	48.8854	52.9364	57.3104	(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	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	172.2241	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	66.2956	58.8832	47.8870	36.2536	27.1000	22.8789	24.7215	32.1339	43.1301	54.7636	63.9172	68.1382	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	429.3721	433.8276	422.5998	398.6971	368.5243	340.1660	321.2210	316.7655	327.9933	351.8960	382.0688	410.4270	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	55.0928	(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)													
	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	-114.8161	(71)
Water heating gains (Table 5)													
	79.3892	77.0202	72.1006	65.4125	61.0666	54.9493	49.7533	56.4146	58.7838	65.7062	73.5227	77.0301	(72)
Total internal gains													
	690.5578	685.2318	658.0883	615.8640	572.1916	533.4951	511.1966	520.8148	545.4080	587.8666	635.0095	671.0961	(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	
East	8.7400	24.4891	0.6300	0.7000	0.7700	65.4118	(76)
South	1.8900	55.4171	0.6300	0.7000	0.7700	32.0094	(78)
West	9.8100	24.4891	0.6300	0.7000	0.7700	73.4199	(80)

Solar gains	170.8411	279.0763	435.7205	627.0531	731.2519	797.8518	747.5064	659.6017	535.6825	348.6111	206.6078	138.3474	(83)
Total gains	861.3989	964.3081	1093.8088	1242.9171	1303.4435	1331.3469	1258.7031	1180.4166	1081.0905	936.4776	841.6173	809.4436	(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	38.9391	39.2071	39.2928	39.5392	39.4589	39.7686	39.7686	39.9119	39.9119	39.6941	39.6941	39.3768	
alpha	3.5959	3.6138	3.6195	3.6359	3.6306	3.6512	3.6512	3.6608	3.6608	3.6463	3.6463	3.6251	
util living area													
	0.9813	0.9710	0.9408	0.8700	0.7453	0.5479	0.3932	0.4365	0.7012	0.9023	0.9683	0.9844	(86)
MIT	19.4463	19.6329	20.0207	20.4449	20.7694	20.9461	20.9881	20.9826	20.8620	20.4473	19.8815	19.4165	(87)
Th 2	19.9639	19.9703	19.9723	19.9780	19.9762	19.9833	19.9833	19.9866	19.9866	19.9816	19.9816	19.9742	(88)
util rest of house													
	0.9772	0.9648	0.9276	0.8413	0.6900	0.4631	0.2892	0.3291	0.6241	0.8740	0.9602	0.9810	(89)
MIT 2	17.9106	18.1839	18.7398	19.3310	19.7476	19.9457	19.9787	19.9791	19.8711	19.3510	18.5536	17.8743	(90)
Living area fraction									fLA = Living area / (4) =			0.1411	(91)
MIT	18.1272	18.3883	18.9205	19.4881	19.8918	20.0868	20.1211	20.1207	20.0109	19.5056	18.7409	18.0919	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1272	18.3883	18.9205	19.4881	19.8918	20.0868	20.1211	20.1207	20.0109	19.5056	18.7409	18.0919	(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	0.9668	0.9517	0.9104	0.8252	0.6850	0.4722	0.3036	0.3438	0.6261	0.8576	0.9467	0.9719	(94)
Useful gains	832.7919	917.6999	995.8237	1025.6122	892.8856	628.6295	382.1376	405.8130	676.8902	803.1195	796.7339	786.6656	(95)
Ext temp.	4.6000	5.1000	7.0000	9.4000	12.4000	15.3000	17.3000	17.1000	14.5000	11.1000	7.5000	4.6000	(96)
Heat loss rate W	1888.8988	1842.8594	1649.5532	1387.2950	1032.3435	654.4722	385.7156	411.5156	750.7733	1151.4099	1539.7907	1863.0251	(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	785.7436	621.7072	486.3748	260.4116	103.7567	0.0000	0.0000	0.0000	0.0000	259.1281	535.0009	800.8114	(98)
Space heating												3852.9343	(98)
Space heating per m2											(98) / (4) =	31.6047	(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 %)	90.5000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	4257.3860	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	785.7436	621.7072	486.3748	260.4116	103.7567	0.0000	0.0000	0.0000	0.0000	259.1281	535.0009	800.8114	(98)
Space heating efficiency (main heating system 1)	90.5000	90.5000	90.5000	90.5000	0.0000	0.0000	0.0000	0.0000	0.0000	90.5000	90.5000	90.5000	(210)
Space heating fuel (main heating system)	868.2249	686.9693	537.4307	287.7476	114.6483	0.0000	0.0000	0.0000	0.0000	286.3293	591.1612	884.8745	(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	151.5872	116.2487	93.2225	47.1186	22.9464	0.0000	0.0000	23.6813	46.2152	92.2841	128.2479	151.7493	(64)
Efficiency of water heater												87.3000	(216)
(217)m	89.9667	89.9804	89.9696	89.9946	89.9032	87.3000	87.3000	87.3000	87.3000	89.6372	89.8631	89.9746	(217)
Fuel for water heating, kWh/month	168.4926	129.1933	103.6156	52.3572	25.5235	0.0000	0.0000	27.1264	52.9384	102.9529	142.7148	168.6579	(219)
Water heating fuel used												973.5725	(219)
Annual totals kWh/year													
Space heating fuel - main system												4257.3860	(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)												468.3206	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1180 * 0.80) =										-1887.9744		-1887.9744	(233)
Total delivered energy for all uses												3936.3047	(238)

10a. Fuel costs - using BEDF prices (476)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	4257.3860	3.8700	164.7608	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	973.5725	3.8700	37.6773	(247)
Pumps and fans for heating	75.0000	18.9000	14.1750	(249)
Pump for solar water heating	50.0000	18.9000	9.4500	(249)
Energy for lighting	468.3206	18.9000	88.5126	(250)
Additional standing charges			93.0000	(251)
Energy saving/generation technologies				
PV Unit	-1887.9744	18.9000	-356.8272	(252)
Total energy cost			50.7485	(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	4257.3860	0.2160	919.5954	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	973.5725	0.2160	210.2917	(264)
Space and water heating			1129.8870	(265)
Pumps and fans	125.0000	0.5190	64.8750	(267)
Energy for lighting	468.3206	0.5190	243.0584	(268)

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

Energy saving/generation technologies				
PV Unit	-1887.9744	0.5190	-979.8587	(269)
Total kg/year			457.9617	(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	4257.3860	1.2200	5194.0109	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	973.5725	1.2200	1187.7585	(264)
Space and water heating			6381.7694	(265)
Pumps and fans	125.0000	3.0700	383.7500	(267)
Energy for lighting	468.3206	3.0700	1437.7443	(268)
Energy saving/generation technologies				
PV Unit	-1887.9744	3.0700	-5796.0815	(269)
Primary energy kWh/year			2407.1821	(272)
Primary energy kWh/m2/year			19.7456	(273)

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

Overheating Calculation Input Data

Dwelling type	SemiDetached House
Number of storeys	2
Cross ventilation possible	No
SAP Region	Thames Valley
Front of dwelling faces	East
Overshading	Average or unknown
Thermal mass parameter	160.6 (calculated from construction elements)
Night ventilation	Yes
Ventilation rate during hot weather (ach)	5.00 (Windows fully open)

Overheating Calculation

Summer ventilation heat loss coefficient		470.55 (P1)
Transmission heat loss coefficient		85.49 (37)
Summer heat loss coefficient		556.05 (P2)

Overhangs

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

Solar shading

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

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
East	8.7400	117.5071	0.6300	0.7000	0.9000	366.8589
South	1.8900	112.2060	0.6300	0.7000	0.9000	75.7533
West	9.8100	117.5071	0.6300	0.7000	0.9000	411.7718
total:						854.3840

	Jun	Jul	Aug	
Solar gains	905	854	760	(P3)
Internal gains	530	508	518	
Total summer gains	1436	1363	1278	(P5)
Summer gain/loss ratio	2.58	2.45	2.30	(P6)
Summer external temperature	16.00	17.90	17.80	
Thermal mass temperature increment (TMP = 160.6)	0.88	0.88	0.88	
Threshold temperature	19.46	21.23	20.97	(P7)
Likelihood of high internal temperature	Not significant	Slight	Slight	

Assessment of likelihood of high internal temperature: Slight

PREDICTED ENERGY ASSESSMENT

Design SAP
elmhurst energy

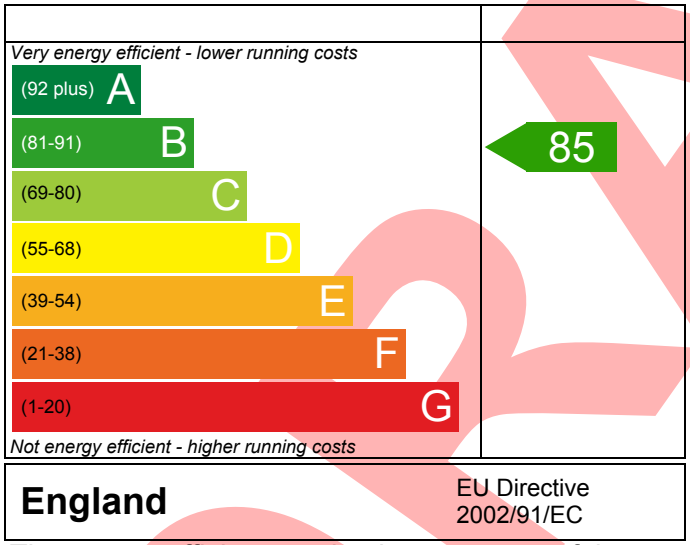
Plot 1, 2 Kiln Lane,
Farnham,
Surrey,
GU10 3LR

Dwelling type:	House, Semi-Detached
Date of assessment:	04/05/2021
Produced by:	Scott Spearing
Total floor area:	121.91 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.

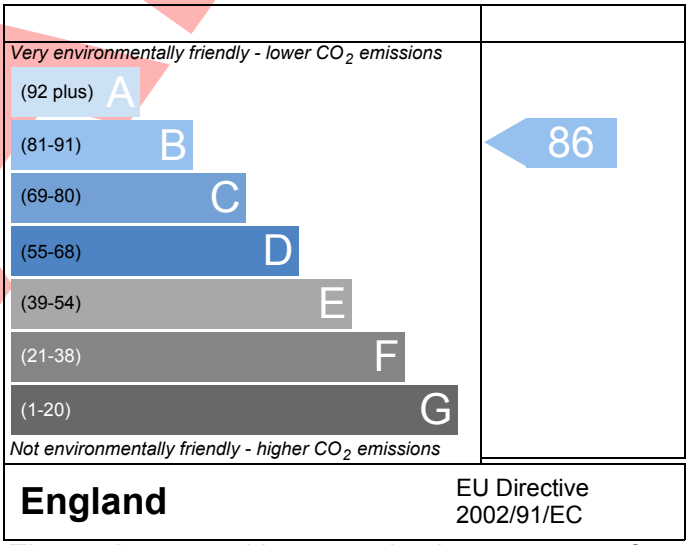
The energy performance has been assessed using the Government approved SAP2012 methodology and is rated in terms of the energy use per square meter of floor area; the energy efficiency is based on fuel costs and the environmental impact is based on carbon dioxide (CO_2) emissions.

Energy Efficiency Rating



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



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.

DRAFT

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