



elmhurst  
energy



## SAP Report Submission for Building Regulations Compliance

Client: Shorewood Homes Ltd

Project: Tree House, Larg Drive  
Winchester, Hampshire, SO22 6NU

Contact: Scott Spearing  
Scott Spearing  
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Report Issue Date: 01/03/2023

EXCELLENCE  
IN ENERGY  
ASSESSMENT

# BASIC COMPLIANCE REPORT

## Calculation Type: New Build (As Designed)

<b>Property Reference</b>	SAP-1425 - Plot 3	<b>Issued on Date</b>	01/03/2023	
<b>Assessment Reference</b>	REV-	<b>Prop Type Ref</b>		
<b>Property</b>	Tree House, Larg Drive, Winchester, Hampshire, SO22 6NU			
<b>SAP Rating</b>	92 A	<b>DER</b>	9.13	
<b>Environmental</b>	91 B	<b>TER</b>	16.55	
<b>CO<sub>2</sub> Emissions (t/year)</b>	1.02	<b>% DER&lt;TER</b>	44.83	
<b>General Requirements Compliance</b>	Pass	<b>DFEE</b>	54.23	
		<b>TFEE</b>	63.16	
		<b>% DFEE&lt;TFEE</b>	14.13	
<b>Assessor Details</b>	Mr. Scott Spearing, Scott Spearing, Tel: 01489 565920, scott@beatsolutions.co.uk		<b>Assessor ID</b>	p775-0001
<b>Client</b>	Shorewood Homes Ltd, SHOREWOOD HOMES			

### SUMMARY 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)	16.55	kgCO <sub>2</sub> /m <sup>2</sup>	
Dwelling Carbon Dioxide Emission Rate (DER)	9.13	kgCO <sub>2</sub> /m <sup>2</sup>	Pass
	-7.42 (-44.8%)	kgCO <sub>2</sub> /m <sup>2</sup>	

##### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	63.16	kWh/m <sup>2</sup> /yr	
Dwelling Fabric Energy Efficiency (DFEE)	54.23	kWh/m <sup>2</sup> /yr	
	-9.0 (-14.2%)	kWh/m <sup>2</sup> /yr	Pass

#### Criterion 2 – Limits on design flexibility

##### Limiting Fabric Standards

##### 2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	Pass
Party wall	0.00 (max. 0.20)	-	Pass
Floor	0.13 (max. 0.25)	0.15 (max. 0.70)	Pass
Roof	0.11 (max. 0.20)	0.15 (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

# BASIC COMPLIANCE REPORT

## Calculation Type: New Build (As Designed)

Main heating system	Boiler system with radiators or underfloor - Mains gas Data from database Worcester Greenstar 18i System ErP  Efficiency: 89.7% SEDBUK2009 Minimum: 88.0%	Pass
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Secondary heating system	Room heaters - Wood Logs Closed room heater Efficiency: 65% Minimum: 65%	Pass
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### 5 Cylinder insulation

Hot water storage	Measured cylinder loss: 1.95 kWh/day Permitted by DBSCG 2.30	Pass
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Primary pipework insulated	Yes	Pass
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### 6 Controls

Space heating controls	Time and temperature zone control	Pass
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Hot water controls	Cylinderstat	Pass
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Independent timer for DHW	Yes	Pass
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Boiler interlock	Yes	Pass
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### 7 Low energy lights

Percentage of fixed lights with low-energy fittings	100	%	
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Minimum	75	%	Pass
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### 8 Mechanical ventilation

Not applicable

## Criterion 3 – Limiting the effects of heat gains in summer

### 9 Summertime temperature

Overheating risk (Southern England)	Not significant	Pass
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Based on:

Overshading	Average
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Windows facing North East	3.78 m <sup>2</sup> , No overhang
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Windows facing South East	10.72 m <sup>2</sup> , No overhang
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Windows facing South West	1.34 m <sup>2</sup> , No overhang
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Windows facing North West	11.61 m <sup>2</sup> , No overhang
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Air change rate	8.00 ach
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Blinds/curtains	None
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## Criterion 4 – Building performance consistent with DER and DFEE rate

### Party Walls

Type	U-value	W/m <sup>2</sup> K	
Filled Cavity with Edge Sealing	0.00		Pass

### Air permeability and pressure testing

#### 3 Air permeability

Air permeability at 50 pascals	5.00 (design value)
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Maximum	10.0	Pass
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# BASIC COMPLIANCE REPORT

## Calculation Type: New Build (As Designed)

### 10 Key features

Party wall U-value	0.00	W/m <sup>2</sup> K
Roof U-value	0.10	W/m <sup>2</sup> K
Floor U-value	0.12	W/m <sup>2</sup> K
Secondary heating (wood logs)	N/A	
Secondary heating fuel:	wood logs	
Photovoltaic array	2.80	kW

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

# SUMMARY FOR INPUT DATA

## Calculation Type: New Build (As Designed)

Property Reference	SAP-1425 - Plot 3		Issued on Date	01/03/2023	
Assessment Reference	REV-	Prop Type Ref			
Property	Tree House, Larg Drive, Winchester, Hampshire, SO22 6NU				
SAP Rating	92 A	DER	9.13	TER	16.55
Environmental	91 B	% DER<TER	44.83		
CO <sub>2</sub> Emissions (t/year)	1.02	DFEE	54.23	TFEE	63.16
General Requirements Compliance	Pass	% DFEE<TFEE	14.13		
Assessor Details	Mr. Scott Spearing, Scott Spearing, Tel: 01489 565920, scott@beatsolutions.co.uk			Assessor ID	p775-0001
Client	Shorewood Homes Ltd, SHOREWOOD HOMES				

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

Orientation	North West
Property Tenure	Unknown
Transaction Type	New dwelling
Terrain Type	Suburban
1.0 Property Type	House, Semi-Detached
2.0 Number of Storeys	2
3.0 Date Built	2023
4.0 Sheltered Sides	0
5.0 Sunlight/Shade	Average or unknown

#### 6.0 Measurements

	Heat Loss Perimeter	Internal Floor Area	Average Storey Height
Ground Floor:	42.63 m	79.94 m <sup>2</sup>	2.52 m
1st Storey:	42.45 m	92.59 m <sup>2</sup>	2.64 m

7.0 Living Area  m<sup>2</sup>

8.0 Thermal Mass Parameter  
 Thermal Mass   
 kJ/m<sup>2</sup>K

#### 9.0 External Walls

Description	Type	Construction	U-Value (W/m <sup>2</sup> K)	Kappa (kJ/m <sup>2</sup> K)	Gross Area (m <sup>2</sup> )	Nett Area (m <sup>2</sup> )
External Walls	Cavity Wall	Cavity wall : plasterboard on dabs, AAC block, filled cavity, any outside structure	0.18	60.00	187.17	157.75
Dormer Walls	Timber Frame	Timber framed wall (one layer of plasterboard)	0.17	9.00	9.24	6.78

#### 9.1 Party Walls

Description	Type	Construction	U-Value (W/m <sup>2</sup> K)	Kappa (kJ/m <sup>2</sup> K)	Area (m <sup>2</sup> )
Party Wall	Filled Cavity with Edge Sealing	Single plasterboard on dabs on both sides, dense blocks, cavity or cavity fill	0.00	70.00	10.56

#### 9.2 Internal Walls

Description	Construction	Kappa (kJ/m <sup>2</sup> K)	Area (m <sup>2</sup> )
Internal Wall Masonry	Dense block, plasterboard on dabs	75.00	40.05
Internal Wall Timber	Plasterboard on timber frame	9.00	163.94

#### 10.0 External Roofs

Description	Construction	U-Value (W/m <sup>2</sup> K)	Kappa (kJ/m <sup>2</sup> K)	Area (m <sup>2</sup> )
External Wall	Plasterboard on timber frame	0.17	9.00	6.78

# SUMMARY FOR INPUT DATA

## Calculation Type: New Build (As Designed)

Description	Type	Construction	U-Value (W/m <sup>2</sup> K)	Kappa (kJ/m <sup>2</sup> K)	Gross Area (m <sup>2</sup> )	Nett Area (m <sup>2</sup> )
Bay Roof	External Flat Roof	Plasterboard, insulated flat roof	0.15	9.00	2.31	2.31
Flat Roof	External Flat Roof	Plasterboard, insulated flat roof	0.14	9.00	9.64	7.84
Pitched Cold Roof	External Plane Roof	Plasterboard, insulated at ceiling level	0.10	9.00	67.99	67.99
Pitched Sloping Roof	External Slope Roof	Plasterboard, insulated slope	0.13	9.00	18.46	18.46
Dormer Flat Roof	External Flat Roof	Plasterboard, insulated flat roof	0.13	9.00	3.07	3.07
Over Garage Flat Roof	External Flat Roof	Plasterboard, insulated flat roof	0.14	9.00	7.51	7.51

### 10.2 Internal Ceilings

Description	Construction	Kappa (kJ/m <sup>2</sup> K)	Area (m <sup>2</sup> )
Internal Ceiling	Plasterboard ceiling, carpeted chipboard floor	9.00	67.99

### 11.0 Heat Loss Floors

Description	Type	Construction	U-Value (W/m <sup>2</sup> K)	Kappa (kJ/m <sup>2</sup> K)	Area (m <sup>2</sup> )
Heat Loss Floor	Ground Floor - Solid	Suspended concrete floor, carpeted	0.12	75.00	55.35
Exposed Floor	Exposed Floor - Timber	Timber exposed floor, insulation between joists	0.15	20.00	24.59

### 11.2 Internal Floors

Description	Construction	Kappa (kJ/m <sup>2</sup> K)	Area (m <sup>2</sup> )
Internal Floor	Plasterboard ceiling, carpeted chipboard floor	18.00	67.99

### 12.0 Opening Types

Description	Data Source	Type	Glazing	Glazing Gap	Argon Filled	G-value	Frame Type	Frame Factor	U Value (W/m <sup>2</sup> K)
Front Door	Manufacturer	Solid Door							1.40
Window	Manufacturer	Window	Double Low-E Soft 0.05			0.63		0.70	1.40
Lantern Rooflight	Manufacturer	Roof Window	Double Low-E Soft 0.05			0.63		0.70	1.40
Garage Door	Manufacturer	Solid Door							1.40

### 13.0 Openings

Name	Opening Type	Location	Orientation	Curtain Type	Overhang Ratio	Wide Overhang	Width (m)	Height (m)	Count	Area (m <sup>2</sup> )	Curtain Closed
Front Door	Solid Door	[1] External Walls	North West							2.33	
Front Elevation	Window	[1] External Walls	North West	None	0.00					10.38	
Side Elevation	Window	[1] External Walls	North East	None	0.00					3.78	
Rear Elevation	Window	[1] External Walls	South East	None	0.00					9.49	
Side Elevation	Window	[1] External Walls	South West	None	0.00					1.34	
Lantern Rooflight	Roof Window	[2] Flat Roof	North	None						1.80	
Front Dormer	Window	[2] Dormer Walls	North West	None	0.00					1.23	
Rear Dormer	Window	[2] Dormer Walls	South East	None	0.00					1.23	
Garage Door	Solid Door	[1] External Walls	North East							2.10	

### 14.0 Conservatory

### 15.0 Draught Proofing

 %

### 16.0 Draught Lobby

### 17.0 Thermal Bridging

### 17.1 List of Bridges

# SUMMARY FOR INPUT DATA

## Calculation Type: New Build (As Designed)

Source Type	Bridge Type	Length	Psi	Imported
Table K1 - Approved	E2 Other lintels (including other steel lintels)	19.00	0.300	No
Table K1 - Approved	E3 Sill	17.00	0.040	No
Table K1 - Approved	E4 Jamb	49.35	0.050	No
Table K1 - Approved	E5 Ground floor (normal)	42.63	0.160	Yes
Table K1 - Default	E20 Exposed floor (normal)	8.15	0.320	No
Table K1 - Default	E21 Exposed floor (inverted)	6.14	0.320	No
Table K1 - Approved	E6 Intermediate floor within a dwelling	34.30	0.070	No
Table K1 - Approved	E10 Eaves (insulation at ceiling level)	28.28	0.060	No
Table K1 - Default	E24 Eaves (insulation at ceiling level - inverted)	11.26	0.240	No
Table K1 - Approved	E11 Eaves (insulation at rafter level)	6.10	0.040	No
Table K1 - Default	E14 Flat roof	4.30	0.080	No
Table K1 - Default	E15 Flat roof with parapet	9.25	0.560	No
Table K1 - Approved	E16 Corner (normal)	41.91	0.090	No
Table K1 - Approved	E17 Corner (inverted – internal area greater than external area)	12.50	-0.090	No
Table K1 - Default	E25 Staggered party wall between dwellings	0.90	0.120	No
Table K1 - Default	P7 Party Wall - Exposed floor (normal)	6.04	0.160	No
Table K1 - Default	P4 Party wall - Roof (insulation at ceiling level)	1.96	0.240	No
Table K1 - Default	P5 Party wall - Roof (insulation at rafter level)	5.66	0.080	No
Table K1 - Default	R6 Flat ceiling	7.30	0.060	No

Y-value  W/m<sup>2</sup>K

### 18.0 Pressure Testing

Designed AP<sub>50</sub>  m<sup>3</sup>/(h.m<sup>2</sup>) @ 50 Pa  
 Property Tested ?   
 As Built AP<sub>50</sub>  m<sup>3</sup>/(h.m<sup>2</sup>) @ 50 Pa

### 19.0 Mechanical Ventilation

#### Summer Overheating

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

#### Mechanical Ventilation

Mechanical Ventilation System Present

### 20.0 Fans, Open Fireplaces, Flues

	MHS	SHS	Other	Total
Number of Chimneys	0	0	0	0
Number of open flues	0	0	0	0
Number of intermittent fans				4
Number of passive vents				0
Number of flueless gas fires				0

### 21.0 Fixed Cooling System

### 22.0 Lighting

#### Internal

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

#### External

External lights fitted

### 23.0 Electricity Tariff

# SUMMARY FOR INPUT DATA

## Calculation Type: New Build (As Designed)

<b>24.0 Main Heating 1</b>	Database	
Percentage of Heat	100	%
Database Ref. No.	17485	
Fuel Type	Mains gas	
Main Heating	BGB	
SAP Code	102	
In Winter	90.7	
In Summer	80.0	
Controls	CBI Time and temperature zone control	
PCDF Controls	0	
Delayed Start Stat	No	
Sap Code	2110	
Flue Type	Balanced	
Fan Assisted Flue	Yes	
Is MHS Pumped	in unheated space	
Heat Emitter	Radiators and Underfloor	
Underfloor Heating	Yes - Pipes in thin screed	
Flow Temperature	Normal (> 45°C)	
<b>25.0 Main Heating 2</b>	None	
Community Heating	None	
<b>27.0 Secondary Heating</b>	RWM	
Secondary Heating	SAP table	
Description	Wood Logs RWM Closed room heater	
SHS efficiency	65.00	%
SAP Code	633	
HETAS Approved System	Yes	
Smoke Control Area	Unknown	
<b>28.0 Water Heating</b>	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	
<b>29.0 Hot Water Cylinder</b>	Hot Water Cylinder	
Cylinder Stat	Yes	
Cylinder In Heated Space	Yes	
Independent Time Control	Yes	
Insulation Type	Measured Loss	
Cylinder Volume	210.00	L



# SUMMARY FOR INPUT DATA

## Calculation Type: New Build (As Designed)

Loss	<input type="text" value="1.95"/>	kWh/day			
Pipes insulation	<input type="text" value="Fully insulated primary pipework"/>				
<b>31.0 Thermal Store</b>	<input type="text" value="None"/>				
<b>32.0 Photovoltaic Unit</b>	<input type="text" value="One Dwelling"/>				
<b>PV Cells kWp</b>	<b>Orientation</b>	<b>Elevation</b>	<b>Overshading</b>	<b>Connected to Dwelling</b>	
2.80	South West	30°	None Or Little	Yes	

### Recommendations

#### Lower cost measures

None

#### Further measures to achieve even higher standards

	Typical Cost	Typical savings per year	Ratings after improvement	
			SAP rating	Environmental Impact
Solar water heating	£4,000 - £6,000	£116	A 93	

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

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<b>Assessment Reference</b>	REV-	<b>Prop Type Ref</b>			
<b>Property</b>	Tree House, Larg Drive, Winchester, Hampshire, SO22 6NU				
<b>SAP Rating</b>	92 A	<b>DER</b>	9.13	<b>TER</b>	16.55
<b>Environmental</b>	91 B	<b>% DER&lt;TER</b>	44.83		
<b>CO<sub>2</sub> Emissions (t/year)</b>	1.02	<b>DFEE</b>	54.23	<b>TFEE</b>	63.16
<b>General Requirements Compliance</b>	Pass	<b>% DFEE&lt;TFEE</b>	14.13		
<b>Assessor Details</b>	Mr. Scott Spearing, Scott Spearing, Tel: 01489 565920, scott@beatsolutions.co.uk			<b>Assessor ID</b>	p775-0001
<b>Client</b>	Shorewood Homes Ltd, SHOREWOOD HOMES				

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

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

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

DWELLING AS DESIGNED

Semi-Detached House, total floor area 173 m<sup>2</sup>

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) 16.55 kgCO<sub>2</sub>/m<sup>2</sup>  
Dwelling Carbon Dioxide Emission Rate (DER) 9.13 kgCO<sub>2</sub>/m<sup>2</sup>OK

#### 1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE) 63.2 kWh/m<sup>2</sup>/yr  
Dwelling Fabric Energy Efficiency (DFEE) 54.2 kWh/m<sup>2</sup>/yrOK

#### 2 Fabric U-values

Element	Average	Highest	
External wall	0.18 (max. 0.30)	0.18 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.13 (max. 0.25)	0.15 (max. 0.70)	OK
Roof	0.11 (max. 0.20)	0.15 (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: Worcester Greenstar 18i System ErP  
Boiler system with radiators or underfloor - Mains gas  
Data from database

Efficiency: 89.7% SEDBUK2009

Minimum: 88.0% OK

Secondary heating system: Room heaters - Wood Logs

Closed room heater

Efficiency: 65%  
Minimum: 65% OK

#### 5 Cylinder insulation

Hot water storage Measured cylinder loss: 1.95 kWh/day  
Permitted by DBSCG 2.30 OK  
Primary pipework insulated: Yes OK

#### 6 Controls

Space heating controls: Time and temperature zone control OK

Hot water controls: Cylinderstat OK  
Independent timer for DHW OK

Boiler interlock: Yes OK

#### 7 Low energy lights

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

#### 8 Mechanical ventilation

Not applicable

#### 9 Summertime temperature

Overheating risk (Southern England): Not significant OK

Based on:

Overshading: Average  
Windows facing North East: 3.78 m<sup>2</sup>, No overhang  
Windows facing South East: 10.72 m<sup>2</sup>, No overhang  
Windows facing South West: 1.34 m<sup>2</sup>, No overhang  
Windows facing North West: 11.61 m<sup>2</sup>, No overhang  
Air change rate: 8.00 ach  
Blinds/curtains: None

#### 10 Key features

Party wall U-value 0.00 W/m<sup>2</sup>K  
Roof U-value 0.10 W/m<sup>2</sup>K  
Floor U-value 0.12 W/m<sup>2</sup>K  
Secondary heating (wood logs)  
Secondary heating fuel: wood logs  
Photovoltaic array 2.80 kW

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### 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 (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	79.9400 (1b)	x 2.5200 (2b)	= 201.4488 (1b) - (3b)
First floor	92.5900 (1c)	x 2.6400 (2c)	= 244.4376 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	172.5300		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 445.8864 (5)

#### 2. Ventilation rate

	main heating	secondary heating	other	total	m <sup>3</sup> 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)							
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =				40.0000 / (5) =	0.0897 (8)							
Pressure test				Yes								
Measured/design AP50				5.0000								
Infiltration rate				0.3397 (18)								
Number of sides sheltered				0 (19)								
Shelter factor			(20) = 1 - [0.075 x (19)] =		1.0000 (20)							
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.3397 (21)							
Wind speed	Jan 5.1000	Feb 5.0000	Mar 4.9000	Apr 4.4000	May 4.3000	Jun 3.8000	Jul 3.8000	Aug 3.7000	Sep 4.0000	Oct 4.3000	Nov 4.5000	Dec 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												
Effective ac	0.4331	0.4246	0.4161	0.3737	0.3652	0.3227	0.3227	0.3142	0.3397	0.3652	0.3822	0.3992 (22b)
	0.5938	0.5902	0.5866	0.5698	0.5667	0.5521	0.5521	0.5494	0.5577	0.5667	0.5730	0.5797 (25)

#### 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K					
Front Door			2.3300	1.4000	3.2620		(26)					
Window (Uw = 1.40)			27.4500	1.3258	36.3920		(27)					
Garage Door			2.1000	1.4000	2.9400		(26)					
Lantern Rooflight (Uw = 1.40)			1.8000	1.3258	2.3864		(27a)					
Heat Loss Floor			55.3500	0.1200	6.6420	75.0000	4151.2500 (28a)					
Exposed Floor			24.5900	0.1500	3.6885	20.0000	491.8000 (28b)					
External Walls	187.1700	29.4200	157.7500	0.1800	28.3950	60.0000	9465.0000 (29a)					
Dormer Walls	9.2400	2.4600	6.7800	0.1700	1.1526	9.0000	61.0200 (29a)					
Bay Roof	2.3100		2.3100	0.1500	0.3465	9.0000	20.7900 (30)					
Flat Roof	9.6400	1.8000	7.8400	0.1400	1.0976	9.0000	70.5600 (30)					
Pitched Cold Roof	67.9900		67.9900	0.1000	6.7990	9.0000	611.9100 (30)					
Pitched Sloping Roof	18.4600		18.4600	0.1300	2.3998	9.0000	166.1400 (30)					
Dormer Flat Roof	3.0700		3.0700	0.1300	0.3991	9.0000	27.6300 (30)					
Over Garage Flat Roof	7.5100		7.5100	0.1400	1.0514	9.0000	67.5900 (30)					
Total net area of external elements Aum(A, m <sup>2</sup> )			385.3300				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	96.9519		(33)					
Party Wall			10.5600	0.0000	0.0000	70.0000	739.2000 (32)					
Internal Wall Masonry			40.0500			75.0000	3003.7500 (32c)					
Internal Wall Timber			163.9400			9.0000	1475.4600 (32c)					
Internal Floor			67.9900			18.0000	1223.8200 (32d)					
Internal Ceiling			67.9900			18.0000	1223.8200 (32e)					
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	22799.7400 (34)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							132.1494 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							37.8918 (36)					
Total fabric heat loss						(33) + (36) =	134.8437 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 87.3733	Feb 86.8373	Mar 86.3120	Apr 83.8445	May 83.3828	Jun 81.2337	Jul 81.2337	Aug 80.8358	Sep 82.0615	Oct 83.3828	Nov 84.3168	Dec 85.2932 (38)
Heat transfer coeff	222.2170	221.6810	221.1557	218.6882	218.2265	216.0774	216.0774	215.6795	216.9052	218.2265	219.1605	220.1369 (39)
Average = Sum(39)m / 12 =												218.6860 (39)
HLP	Jan 1.2880	Feb 1.2849	Mar 1.2818	Apr 1.2675	May 1.2649	Jun 1.2524	Jul 1.2524	Aug 1.2501	Sep 1.2572	Oct 1.2649	Nov 1.2703	Dec 1.2759 (40)
HLP (average)												1.2675 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

#### 4. Water heating energy requirements (kWh/year)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Assumed occupancy												2.9659 (42)
Average daily hot water use (litres/day)												104.6413 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	115.1054	110.9198	106.7341	102.5485	98.3628	94.1772	94.1772	98.3628	102.5485	106.7341	110.9198	115.1054 (44)
Energy content (annual)	170.6980	149.2936	154.0576	134.3111	128.8747	111.2091	103.0516	118.2532	119.6655	139.4586	152.2300	165.3119 (45)
Distribution loss (46)m = 0.15 x (45)m												Total = Sum(45)m = 1646.4149 (45)
Water storage loss:	25.6047	22.3940	23.1086	20.1467	19.3312	16.6814	15.4577	17.7380	17.9498	20.9188	22.8345	24.7968 (46)
Store volume												210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.9500 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												1.0530 (55)
Total storage loss	32.6430	29.4840	32.6430	31.5900	32.6430	31.5900	32.6430	32.6430	31.5900	32.6430	31.5900	32.6430 (56)
If cylinder contains dedicated solar storage	32.6430	29.4840	32.6430	31.5900	32.6430	31.5900	32.6430	32.6430	31.5900	32.6430	31.5900	32.6430 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Total heat required for water heating calculated for each month	226.6034	199.7888	209.9630	188.4131	184.7801	165.3111	158.9570	174.1586	173.7675	195.3640	206.3320	221.2173 (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)
Output from w/h	226.6034	199.7888	209.9630	188.4131	184.7801	165.3111	158.9570	174.1586	173.7675	195.3640	206.3320	221.2173 (64)
Heat gains from water heating, kWh/month	101.4814	90.0363	95.9485	87.9401	87.5752	80.2586	78.9890	84.0435	83.0704	91.0943	93.8981	99.6905 (65)
Total per year (kWh/year) = Sum(64)m =												2304.6559 (64)

5. Internal gains (see Table 5 and 5a)												
Metabolic gains (Table 5), Watts												
(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	148.2974	148.2974	148.2974	148.2974	148.2974	148.2974	148.2974	148.2974	148.2974	148.2974	148.2974	148.2974 (66)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	31.5855	28.0540	22.8150	17.2724	12.9113	10.9003	11.7782	15.3097	20.5486	26.0912	30.4523	32.4634 (67)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	344.1212	347.6921	338.6935	319.5367	295.3546	272.6268	257.4433	253.8724	262.8709	282.0278	306.2099	328.9376 (68)
Pumps, fans	37.8297	37.8297	37.8297	37.8297	37.8297	37.8297	37.8297	37.8297	37.8297	37.8297	37.8297	37.8297 (69)
Losses e.g. evaporation (negative values) (Table 5)	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)
Water heating gains (Table 5)	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380 (71)
Total internal gains	136.3997	133.9825	128.9630	122.1390	117.7086	111.4703	106.1680	112.9617	115.3755	122.4386	130.4140	133.9926 (72)
579.5957	577.2178	557.9608	526.4373	493.4637	462.4867	442.8786	449.6330	466.2843	498.0468	534.5654	562.8829 (73)	

6. Solar gains												
[Jan]	Area	Solar flux	g	FF	Access	Gains						
	m2	Table 6a	Specific data	Specific data	factor	W						
		W/m2	or Table 6b	or Table 6c	Table 6d							
Northeast	3.7800	11.2829	0.6300	0.7000	0.7700	13.0342 (75)						
Southeast	10.7200	36.7938	0.6300	0.7000	0.7700	120.5429 (77)						
Southwest	1.3400	36.7938	0.6300	0.7000	0.7700	15.0679 (79)						
Northwest	11.6100	11.2829	0.6300	0.7000	0.7700	40.0338 (81)						
North	1.8000	26.0000	0.6300	0.7000	1.0000	18.5749 (82)						
Solar gains	207.2537	377.5954	579.2625	818.3965	1005.4409	1036.3857	983.3440	838.5075	661.5300	434.4615	252.7796	174.3954 (83)
Total gains	786.8493	954.8133	1137.2233	1344.8338	1498.9046	1498.8723	1426.2227	1288.1405	1127.8143	932.5084	787.3450	737.2783 (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	28.5003	28.5693	28.6371	28.9602	29.0215	29.3101	29.3101	29.3642	29.1983	29.0215	28.8978	28.7697
alpha	2.9000	2.9046	2.9091	2.9307	2.9348	2.9540	2.9540	2.9576	2.9466	2.9348	2.9265	2.9180
util living area	0.9912	0.9840	0.9678	0.9273	0.8458	0.7163	0.5826	0.6433	0.8408	0.9553	0.9858	0.9927 (86)
MIT	19.0733	19.2607	19.5875	20.0278	20.4286	20.7135	20.8333	20.8057	20.5627	20.0401	19.4806	19.0455 (87)
Th 2	19.8503	19.8527	19.8551	19.8664	19.8685	19.8783	19.8783	19.8801	19.8745	19.8685	19.8642	19.8597 (88)
util rest of house	0.9894	0.9807	0.9608	0.9101	0.8065	0.6380	0.4629	0.5269	0.7843	0.9417	0.9823	0.9913 (89)
MIT 2	17.2611	17.5356	18.0114	18.6497	19.2050	19.5745	19.7004	19.6804	19.4007	18.6786	17.8655	17.2269 (90)
Living area fraction	fLA = Living area / (4) =											0.1137 (91)
MIT	17.4672	17.7318	18.1906	18.8064	19.3442	19.7040	19.8292	19.8083	19.5329	18.8334	18.0492	17.4337 (92)
Temperature adjustment												0.0000
adjusted MIT	17.4672	17.7318	18.1906	18.8064	19.3442	19.7040	19.8292	19.8083	19.5329	18.8334	18.0492	17.4337 (93)

8. Space heating requirement												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Utilisation	0.9837	0.9717	0.9465	0.8892	0.7843	0.6240	0.4571	0.5184	0.7628	0.9241	0.9739	0.9864 (94)
Useful gains	774.0159	927.8111	1076.3585	1195.8705	1175.5489	935.3390	651.9216	667.7234	860.2487	861.7013	766.8057	727.2408 (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	2925.9778	2844.5634	2585.4405	2166.4087	1668.1587	1102.8613	697.7649	735.1081	1178.4148	1796.7478	2399.6279	2913.2251 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh	1601.0596	1288.0575	1122.7570	698.7875	366.5017	0.0000	0.0000	0.0000	0.0000	695.6745	1175.6320	1626.3723 (98)
Space heating												8574.8422 (98)
Space heating per m2												(98) / (4) = 49.7006 (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)												0.1000 (201)
Fraction of space heat from main system(s)												0.9000 (202)
Efficiency of main space heating system 1 (in %)												90.7000 (206)
Efficiency of secondary/supplementary heating system, %												65.0000 (208)
Space heating requirement												8508.6637 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	1601.0596	1288.0575	1122.7570	698.7875	366.5017	0.0000	0.0000	0.0000	0.0000	695.6745	1175.6320	1626.3723 (98)
Space heating efficiency (main heating system 1)	90.7000	90.7000	90.7000	90.7000	90.7000	0.0000	0.0000	0.0000	0.0000	90.7000	90.7000	90.7000 (210)
Space heating fuel (main heating system)	1588.7030	1278.1166	1114.0918	693.3945	363.6731	0.0000	0.0000	0.0000	0.0000	690.3055	1166.5588	1613.8203 (211)
Water heating requirement	246.3169	198.1627	172.7318	107.5058	56.3849	0.0000	0.0000	0.0000	0.0000	107.0269	180.8665	250.2111 (215)
Water heating requirement	226.6034	199.7888	209.9630	188.4131	184.7801	165.3111	158.9570	174.1586	173.7675	195.3640	206.3320	221.2173 (64)
Efficiency of water heater	89.0809	88.9510	88.6599	87.9871	86.5439	80.0000	80.0000	80.0000	80.0000	87.9039	88.7627	89.1348 (217)
Fuel for water heating, kWh/month	254.3792	224.6054	236.8184	214.1372	213.5104	206.6389	198.6962	217.6982	217.2094	222.2473	232.4536	248.1829 (219)
Water heating fuel used												2686.5770 (211)
Annual totals kWh/year												
Space heating fuel - main system												8508.6637 (211)
Space heating fuel - secondary												1319.2065 (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)												557.8098 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 2.80 * 1029 * 1.00) =										-2305.3782		-2305.3782 (233)
Total delivered energy for all uses												10841.8787 (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	8508.6637	0.2160	1837.8714 (261)
Space heating - secondary	1319.2065	0.0190	25.0649 (263)
Water heating (other fuel)	2686.5770	0.2160	580.3006 (264)
Space and water heating			2443.2369 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	557.8098	0.5190	289.5033 (268)
Energy saving/generation technologies			
PV Unit	-2305.3782	0.5190	-1196.4913 (269)
Total CO2, kg/year			1575.1739 (272)
Dwelling Carbon Dioxide Emission Rate (DER)			9.1300 (273)

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

DER		9.1300 ZC1
Total Floor Area		TFA 172.5300
Assumed number of occupants		N 2.9659
CO2 emission factor in Table 12 for electricity displaced from grid		EF 0.5190
CO2 emissions from appliances, equation (L14)		11.8193 ZC2
CO2 emissions from cooking, equation (L16)		1.1023 ZC3
Total CO2 emissions		22.0517 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		22.0517 ZC8

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### 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	79.9400 (1b)	2.5200 (2b)	201.4488 (1b) - (3b)
First floor	92.5900 (1c)	2.6400 (2c)	244.4376 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	172.5300		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 445.8864 (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)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =				40.0000 / (5) =	0.0897 (8)
Pressure test				Yes	
Measured/design AP50				5.0000	
Infiltration rate				0.3397 (18)	
Number of sides sheltered				0 (19)	
Shelter factor			(20) = 1 - [0.075 x (19)] =		1.0000 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.3397 (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 infiltr rate	0.4331	0.4246	0.4161	0.3737	0.3652	0.3227	0.3227	0.3142	0.3397	0.3652	0.3822	0.3992 (22b)
Effective ac	0.5938	0.5902	0.5866	0.5698	0.5667	0.5521	0.5521	0.5494	0.5577	0.5667	0.5730	0.5797 (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			4.4300	1.0000	4.4300		(26)
TER Opening Type (Uw = 1.40)			27.4500	1.3258	36.3920		(27)
TER Room Window (Uw = 1.70)			1.8000	1.5918	2.8652		(27a)
Heat Loss Floor			55.3500	0.1300	7.1955		(28a)
Exposed Floor			24.5900	0.1300	3.1967		(28b)
External Walls	187.1700	29.4200	157.7500	0.1800	28.3950		(29a)
Dormer Walls	9.2400	2.4600	6.7800	0.1800	1.2204		(29a)
Bay Roof	2.3100		2.3100	0.1300	0.3003		(30)
Flat Roof	9.6400	1.8000	7.8400	0.1300	1.0192		(30)
Pitched Cold Roof	67.9900		67.9900	0.1300	8.8387		(30)
Pitched Sloping Roof	18.4600		18.4600	0.1300	2.3998		(30)
Dormer Flat Roof	3.0700		3.0700	0.1300	0.3991		(30)
Over Garage Flat Roof	7.5100		7.5100	0.1300	0.9763		(30)
Total net area of external elements Aum(A, m2)			385.3300				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	97.6282		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							30.6216 (36)
Total fabric heat loss						(33) + (36) =	128.2498 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	87.3733	86.8373	86.3120	83.8445	83.3828	81.2337	81.2337	80.8358	82.0615	83.3828	84.3168	85.2932 (38)
Heat transfer coeff	215.6231	215.0871	214.5618	212.0943	211.6327	209.4836	209.4836	209.0856	210.3114	211.6327	212.5666	213.5430 (39)
Average = Sum(39)m / 12 =												212.0921 (39)
HLP	1.2498	1.2467	1.2436	1.2293	1.2266	1.2142	1.2142	1.2119	1.2190	1.2266	1.2321	1.2377 (40)
HLP (average)												1.2293 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

#### 4. Water heating energy requirements (kWh/year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Assumed occupancy												2.9659 (42)
Average daily hot water use (litres/day)												104.6413 (43)
Daily hot water use	115.1054	110.9198	106.7341	102.5485	98.3628	94.1772	94.1772	98.3628	102.5485	106.7341	110.9198	115.1054 (44)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Energy content (annual)	170.6980	149.2936	154.0576	134.3111	128.8747	111.2091	103.0516	118.2532	119.6655	139.4586	152.2300	165.3119 (45)
Distribution loss (46)m = 0.15 x (45)m	25.6047	22.3940	23.1086	20.1467	19.3312	16.6814	15.4577	17.7380	17.9498	20.9188	22.8345	24.7968 (46)
Water storage loss:												
Store volume												210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.7016 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												0.9188 (55)
Total storage loss	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842 (56)
If cylinder contains dedicated solar storage	28.4842	25.7277	28.4842	27.5653	28.4842	27.5653	28.4842	28.4842	27.5653	28.4842	27.5653	28.4842 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Total heat required for water heating calculated for each month	222.4446	196.0324	205.8042	184.3885	180.6213	161.2864	154.7982	169.9998	169.7429	191.2052	202.3073	217.0585 (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)
Output from w/h	222.4446	196.0324	205.8042	184.3885	180.6213	161.2864	154.7982	169.9998	169.7429	191.2052	202.3073	217.0585 (64)
Heat gains from water heating, kWh/month	98.1544	87.0312	92.6214	84.7203	84.2481	77.0389	75.6619	80.7165	79.8507	87.7673	90.6783	96.3635 (65)
												2255.6893 (64)

#### 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	148.2974	148.2974	148.2974	148.2974	148.2974	148.2974	148.2974	148.2974	148.2974	148.2974	148.2974	148.2974 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	31.5855	28.0540	22.8150	17.2724	12.9113	10.9003	11.7782	15.3097	20.5486	26.0912	30.4523	32.4634 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	344.1212	347.6921	338.6935	319.5367	295.3546	272.6268	257.4433	253.8724	262.8709	282.0278	306.2099	328.9376 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.8297	37.8297	37.8297	37.8297	37.8297	37.8297	37.8297	37.8297	37.8297	37.8297	37.8297	37.8297 (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)	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380 (71)
Water heating gains (Table 5)	131.9279	129.5107	124.4912	117.6671	113.2367	106.9985	101.6961	108.4899	110.9037	117.9667	125.9421	129.5208 (72)
Total internal gains	578.1238	575.7460	556.4889	524.9655	491.9919	461.0148	441.4068	448.1612	464.8125	496.5750	533.0936	561.4110 (73)

#### 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W						
Northeast	3.7800	11.2829	0.6300	0.7000	0.7700	13.0342 (75)						
Southeast	10.7200	36.7938	0.6300	0.7000	0.7700	120.5429 (77)						
Southwest	1.3400	36.7938	0.6300	0.7000	0.7700	15.0679 (79)						
Northwest	11.6100	11.2829	0.6300	0.7000	0.7700	40.0338 (81)						
North	1.8000	26.0000	0.6300	0.7000	1.0000	18.5749 (82)						
Solar gains	207.2537	377.5954	579.2625	818.3965	1005.4409	1036.3857	983.3440	838.5075	661.5300	434.4615	252.7796	174.3954 (83)
Total gains	785.3775	953.3414	1135.7514	1343.3619	1497.4328	1497.4005	1424.7508	1286.6687	1126.3425	931.0365	785.8732	735.8064 (84)

#### 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation factor for gains for living area, nil,m (see Table 9a)												
tau	55.5657	55.7042	55.8406	56.4902	56.6134	57.1942	57.1942	57.3031	56.9691	56.6134	56.3647	56.1070
alpha	4.7044	4.7136	4.7227	4.7660	4.7742	4.8129	4.8129	4.8202	4.7979	4.7742	4.7576	4.7405
util living area	0.9994	0.9983	0.9945	0.9777	0.9183	0.7792	0.6164	0.6906	0.9138	0.9904	0.9987	0.9996 (86)
MIT	19.4945	19.6567	19.9394	20.3277	20.6816	20.9065	20.9766	20.9606	20.7732	20.3135	19.8362	19.4719 (87)
Th 2	19.8804	19.8828	19.8853	19.8966	19.8987	19.9087	19.9087	19.9105	19.9048	19.8987	19.8944	19.8899 (88)
util rest of house	0.9992	0.9977	0.9924	0.9681	0.8817	0.6872	0.4786	0.5534	0.8591	0.9850	0.9981	0.9994 (89)
MIT 2	17.8642	18.1032	18.5175	19.0857	19.5725	19.8432	19.8998	19.8932	19.7055	19.0725	18.3742	17.8378 (90)
Living area fraction										fLA = Living area / (4) =		0.1137 (91)
MIT	18.0496	18.2799	18.6792	19.2269	19.6986	19.9641	20.0222	20.0146	19.8269	19.2136	18.5404	18.0236 (92)
Temperature adjustment												0.0000
adjusted MIT	18.0496	18.2799	18.6792	19.2269	19.6986	19.9641	20.0222	20.0146	19.8269	19.2136	18.5404	18.0236 (93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	784.2615	949.8451	1123.0970	1289.6090	1307.7728	1036.9160	703.5945	730.6363	961.9388	912.2239	783.4045	735.0439 (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	2964.7371	2877.8418	2613.1841	2190.2818	1692.7718	1123.6901	716.9038	755.7648	1204.4302	1822.9188	2431.8564	2951.9346 (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												



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET EMISSIONS 09 Jan 2014

Space heating	1622.2738	1295.6138	1108.6248	648.4844	286.4393	0.0000	0.0000	0.0000	0.0000	677.5570	1186.8854	1649.3667 (98)
Space heating per m2												8475.2451 (98)
												(98) / (4) = 49.1233 (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 %)												93.5000 (206)
Efficiency of secondary/supplementary heating system, %												0.0000 (208)
Space heating requirement												9064.4332 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	1622.2738	1295.6138	1108.6248	648.4844	286.4393	0.0000	0.0000	0.0000	0.0000	677.5570	1186.8854	1649.3667 (98)
Space heating efficiency (main heating system 1)	93.5000	93.5000	93.5000	93.5000	93.5000	0.0000	0.0000	0.0000	0.0000	93.5000	93.5000	93.5000 (210)
Space heating fuel (main heating system)	1735.0522	1385.6832	1185.6950	693.5662	306.3521	0.0000	0.0000	0.0000	0.0000	724.6599	1269.3961	1764.0285 (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 requirement	222.4446	196.0324	205.8042	184.3885	180.6213	161.2864	154.7982	169.9998	169.7429	191.2052	202.3073	217.0585 (64)
Efficiency of water heater (217)m	89.0600	88.9329	88.6391	87.8910	86.0386	79.8000	79.8000	79.8000	79.8000	87.9058	88.7667	79.8000 (216)
Fuel for water heating, kWh/month	249.7693	220.4274	232.1822	209.7923	209.9305	202.1133	193.9827	213.0323	212.7103	217.5114	227.9091	243.5837 (219)
Water heating fuel used												2632.9445 (219)
Annual totals kWh/year												9064.4332 (211)
Space heating fuel - main system												0.0000 (215)
Space heating fuel - secondary												
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)												557.8098 (232)
Total delivered energy for all uses												12330.1875 (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	9064.4332	0.2160	1957.9176 (261)
Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	2632.9445	0.2160	568.7160 (264)
Space and water heating			2526.6336 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	557.8098	0.5190	289.5033 (268)
Total CO2, kg/m2/year			2855.0619 (272)
Emissions per m2 for space and water heating			14.6446 (272a)
Fuel factor (mains gas)			1.0000
Emissions per m2 for lighting			1.6780 (272b)
Emissions per m2 for pumps and fans			0.2256 (272c)
Target Carbon Dioxide Emission Rate (TER) = (14.6446 * 1.00) + 1.6780 + 0.2256, rounded to 2 d.p.			16.5500 (273)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### 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	79.9400 (1b)	x 2.5200 (2b)	= 201.4488 (1b) - (3b)
First floor	92.5900 (1c)	x 2.6400 (2c)	= 244.4376 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	172.5300		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 445.8864 (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)							
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =				40.0000 / (5) =	0.0897 (8)							
Pressure test				Yes								
Measured/design AP50				5.0000								
Infiltration rate				0.3397 (18)								
Number of sides sheltered				0 (19)								
Shelter factor			(20) = 1 - [0.075 x (19)] =		1.0000 (20)							
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.3397 (21)							
Wind speed	Jan 5.1000	Feb 5.0000	Mar 4.9000	Apr 4.4000	May 4.3000	Jun 3.8000	Jul 3.8000	Aug 3.7000	Sep 4.0000	Oct 4.3000	Nov 4.5000	Dec 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												
Effective ac	0.4331	0.4246	0.4161	0.3737	0.3652	0.3227	0.3227	0.3142	0.3397	0.3652	0.3822	0.3992 (22b)
	0.5938	0.5902	0.5866	0.5698	0.5667	0.5521	0.5521	0.5494	0.5577	0.5667	0.5730	0.5797 (25)

#### 3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K					
Front Door			2.3300	1.4000	3.2620		(26)					
Window (Uw = 1.40)			27.4500	1.3258	36.3920		(27)					
Garage Door			2.1000	1.4000	2.9400		(26)					
Lantern Rooflight (Uw = 1.40)			1.8000	1.3258	2.3864		(27a)					
Heat Loss Floor			55.3500	0.1200	6.6420	75.0000	4151.2500 (28a)					
Exposed Floor			24.5900	0.1500	3.6885	20.0000	491.8000 (28b)					
External Walls	187.1700	29.4200	157.7500	0.1800	28.3950	60.0000	9465.0000 (29a)					
Dormer Walls	9.2400	2.4600	6.7800	0.1700	1.1526	9.0000	61.0200 (29a)					
Bay Roof	2.3100		2.3100	0.1500	0.3465	9.0000	20.7900 (30)					
Flat Roof	9.6400	1.8000	7.8400	0.1400	1.0976	9.0000	70.5600 (30)					
Pitched Cold Roof	67.9900		67.9900	0.1000	6.7990	9.0000	611.9100 (30)					
Pitched Sloping Roof	18.4600		18.4600	0.1300	2.3998	9.0000	166.1400 (30)					
Dormer Flat Roof	3.0700		3.0700	0.1300	0.3991	9.0000	27.6300 (30)					
Over Garage Flat Roof	7.5100		7.5100	0.1400	1.0514	9.0000	67.5900 (30)					
Total net area of external elements Aum(A, m2)			385.3300				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	96.9519		(33)					
Party Wall			10.5600	0.0000	0.0000	70.0000	739.2000 (32)					
Internal Wall Masonry			40.0500			75.0000	3003.7500 (32c)					
Internal Wall Timber			163.9400			9.0000	1475.4600 (32c)					
Internal Floor			67.9900			18.0000	1223.8200 (32d)					
Internal Ceiling			67.9900			9.0000	611.9100 (32e)					
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	22187.8300 (34)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							128.6027 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							37.8918 (36)					
Total fabric heat loss						(33) + (36) =	134.8437 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 87.3733	Feb 86.8373	Mar 86.3120	Apr 83.8445	May 83.3828	Jun 81.2337	Jul 81.2337	Aug 80.8358	Sep 82.0615	Oct 83.3828	Nov 84.3168	Dec 85.2932 (38)
Heat transfer coeff	222.2170	221.6810	221.1557	218.6882	218.2265	216.0774	216.0774	215.6795	216.9052	218.2265	219.1605	220.1369 (39)
Average = Sum(39)m / 12 =												218.6860 (39)
HLP	Jan 1.2880	Feb 1.2849	Mar 1.2818	Apr 1.2675	May 1.2649	Jun 1.2524	Jul 1.2524	Aug 1.2501	Sep 1.2572	Oct 1.2649	Nov 1.2703	Dec 1.2759 (40)
HLP (average)												1.2675 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

#### 4. Water heating energy requirements (kWh/year)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

-----												
Assumed occupancy											2.9659 (42)	
Average daily hot water use (litres/day)											104.6413 (43)	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Daily hot water use	115.1054	110.9198	106.7341	102.5485	98.3628	94.1772	94.1772	98.3628	102.5485	106.7341	110.9198	115.1054 (44)
Energy conte	170.6980	149.2936	154.0576	134.3111	128.8747	111.2091	103.0516	118.2532	119.6655	139.4586	152.2300	165.3119 (45)
Energy content (annual)											Total = Sum(45)m =	1646.4149 (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	36.2733	31.7249	32.7372	28.5411	27.3859	23.6319	21.8985	25.1288	25.4289	29.6350	32.3489	35.1288 (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	148.2974	148.2974	148.2974	148.2974	148.2974	148.2974	148.2974	148.2974	148.2974	148.2974	148.2974	148.2974 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	31.5855	28.0540	22.8150	17.2724	12.9113	10.9003	11.7782	15.3097	20.5486	26.0912	30.4523	32.4634 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	344.1212	347.6921	338.6935	319.5367	295.3546	272.6268	257.4433	253.8724	262.8709	282.0278	306.2099	328.9376 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.8297	37.8297	37.8297	37.8297	37.8297	37.8297	37.8297	37.8297	37.8297	37.8297	37.8297	37.8297 (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)	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380 (71)
Water heating gains (Table 5)	48.7545	47.2096	44.0017	39.6404	36.8090	32.8221	29.4334	33.7753	35.3179	39.8319	44.9290	47.2161 (72)
Total internal gains	491.9504	490.4449	472.9994	443.9388	412.5641	383.8385	366.1441	370.4466	386.2268	415.4402	449.0804	476.1063 (73)

#### 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	Specific data or Table 6b	Specific data FF or Table 6c	Access factor Table 6d	Gains W						
Northeast	3.7800	11.2829	0.6300	0.7000	0.7700	13.0342 (75)						
Southeast	10.7200	36.7938	0.6300	0.7000	0.7700	120.5429 (77)						
Southwest	1.3400	36.7938	0.6300	0.7000	0.7700	15.0679 (79)						
Northwest	11.6100	11.2829	0.6300	0.7000	0.7700	40.0338 (81)						
North	1.8000	26.0000	0.6300	0.7000	1.0000	18.5749 (82)						
Solar gains	207.2537	377.5954	579.2625	818.3965	1005.4409	1036.3857	983.3440	838.5075	661.5300	434.4615	252.7796	174.3954 (83)
Total gains	699.2041	868.0404	1052.2619	1262.3352	1418.0050	1420.2242	1349.4881	1208.9541	1047.7568	849.9017	701.8600	650.5017 (84)

#### 7. Mean internal temperature (heating season)

-----												
Temperature during heating periods in the living area from Table 9, Th1 (C)											21.0000 (85)	
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
tau	27.7354	27.8025	27.8685	28.1830	28.2426	28.5235	28.5235	28.5761	28.4146	28.2426	28.1223	27.9975
alpha	2.8490	2.8535	2.8579	2.8789	2.8828	2.9016	2.9016	2.9051	2.8943	2.8828	2.8748	2.8665
util living area	0.9930	0.9865	0.9718	0.9342	0.8574	0.7337	0.6034	0.6665	0.8576	0.9623	0.9887	0.9943 (86)
MIT	18.4392	18.6952	19.1427	19.7475	20.3047	20.7077	20.8830	20.8401	20.4878	19.7596	18.9930	18.4008 (87)
Th 2	19.8503	19.8527	19.8551	19.8664	19.8685	19.8783	19.8783	19.8801	19.8745	19.8685	19.8642	19.8597 (88)
util rest of house	0.9916	0.9838	0.9657	0.9186	0.8204	0.6575	0.4831	0.5511	0.8054	0.9507	0.9859	0.9932 (89)
MIT 2	17.5055	17.7620	18.2076	18.8088	19.3393	19.7010	19.8299	19.8077	19.5245	18.8306	18.0679	17.4737 (90)
Living area fraction											fLA = Living area / (4) =	0.1137 (91)
MIT	17.6117	17.8681	18.3139	18.9155	19.4491	19.8155	19.9497	19.9251	19.6341	18.9362	18.1731	17.5791 (92)
Temperature adjustment												
adjusted MIT	17.6117	17.8681	18.3139	18.9155	19.4491	19.8155	19.9497	19.9251	19.6341	18.9362	18.1731	17.5791 (93)

#### 8. Space heating requirement

-----												
Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	0.9874	0.9769	0.9542	0.9017	0.8038	0.6526	0.4916	0.5564	0.7914	0.9373	0.9798	0.9897 (94)
Useful gains	690.4032	847.9612	1004.1000	1138.2497	1139.7633	926.8462	663.4256	672.6296	829.1604	796.6454	687.6479	643.8018 (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	2958.0765	2874.7805	2612.7134	2190.2738	1691.0535	1126.9549	723.7876	760.2984	1200.3665	1819.1827	2426.7814	2945.2350 (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	1687.1490	1362.0226	1196.8084	757.4574	410.1599	0.0000	0.0000	0.0000	0.0000	760.7678	1252.1761	1712.2663 (98)
Space heating											9138.8073 (98)	
Space heating per m2											(98) / (4) =	52.9694 (99)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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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	0.0000	2031.1280	1598.9731	1639.1639	0.0000	0.0000	0.0000	0.0000 (100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.6904	0.7628	0.7170	0.0000	0.0000	0.0000	0.0000 (101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	1402.2530	1219.6866	1175.3521	0.0000	0.0000	0.0000	0.0000 (102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1769.2958	1684.7698	1527.1811	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	0.0000	264.2708	346.0219	261.7608	0.0000	0.0000	0.0000	0.0000 (104)
Space cooling												
Cooled fraction												872.0534 (104)
Intermittency factor (Table 10b)												1.0000 (105)
0.0000	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	0.0000	66.0677	86.5055	65.4402	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												218.0134 (107)
Space cooling per m2												1.2636 (108)
Energy for space heating												52.9694 (99)
Energy for space cooling												1.2636 (108)
Total												54.2330 (109)
Dwelling Fabric Energy Efficiency (DFEE)												54.2 (109)

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# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### 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 (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	79.9400 (1b)	x 2.5200 (2b)	= 201.4488 (1b) - (3b)
First floor	92.5900 (1c)	x 2.6400 (2c)	= 244.4376 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	172.5300		(4)
Dwelling volume		(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	= 445.8864 (5)

#### 2. Ventilation rate

	main heating	secondary heating	other	total	m <sup>3</sup> per hour
Number of chimneys	0	+	0	=	0 * 40 = 0.0000 (6a)
Number of open flues	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)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =					40.0000 / (5) = 0.0897 (8)
Pressure test					Yes
Measured/design AP50					5.0000
Infiltration rate					0.3397 (18)
Number of sides sheltered					0 (19)
Shelter factor				(20) = 1 - [0.075 x (19)] =	1.0000 (20)
Infiltration rate adjusted to include shelter factor				(21) = (18) x (20) =	0.3397 (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												
Effective ac	0.4331	0.4246	0.4161	0.3737	0.3652	0.3227	0.3227	0.3142	0.3397	0.3652	0.3822	0.3992 (22b)
	0.5938	0.5902	0.5866	0.5698	0.5667	0.5521	0.5521	0.5494	0.5577	0.5667	0.5730	0.5797 (25)

#### 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
TER Opaque door			4.4300	1.0000	4.4300		(26)
TER Opening Type (Uw = 1.40)			27.4500	1.3258	36.3920		(27)
TER Room Window (Uw = 1.70)			1.8000	1.5918	2.8652		(27a)
Heat Loss Floor			55.3500	0.1300	7.1955		(28a)
Exposed Floor			24.5900	0.1300	3.1967		(28b)
External Walls	187.1700	29.4200	157.7500	0.1800	28.3950		(29a)
Dormer Walls	9.2400	2.4600	6.7800	0.1800	1.2204		(29a)
Bay Roof	2.3100		2.3100	0.1300	0.3003		(30)
Flat Roof	9.6400	1.8000	7.8400	0.1300	1.0192		(30)
Pitched Cold Roof	67.9900		67.9900	0.1300	8.8387		(30)
Pitched Sloping Roof	18.4600		18.4600	0.1300	2.3998		(30)
Dormer Flat Roof	3.0700		3.0700	0.1300	0.3991		(30)
Over Garage Flat Roof	7.5100		7.5100	0.1300	0.9763		(30)
Total net area of external elements Aum(A, m <sup>2</sup> )			385.3300				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	97.6282		(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							250.0000 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							30.6216 (36)
Total fabric heat loss						(33) + (36) =	128.2498 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	87.3733	86.8373	86.3120	83.8445	83.3828	81.2337	81.2337	80.8358	82.0615	83.3828	84.3168	85.2932 (38)
Heat transfer coeff	215.6231	215.0871	214.5618	212.0943	211.6327	209.4836	209.4836	209.0856	210.3114	211.6327	212.5666	213.5430 (39)
Average = Sum(39)m / 12 =												212.0921 (39)
HLP	1.2498	1.2467	1.2436	1.2293	1.2266	1.2142	1.2142	1.2119	1.2190	1.2266	1.2321	1.2377 (40)
HLP (average)												1.2293 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

#### 4. Water heating energy requirements (kWh/year)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Assumed occupancy												2.9659 (42)
Average daily hot water use (litres/day)												104.6413 (43)
Daily hot water use	115.1054	110.9198	106.7341	102.5485	98.3628	94.1772	94.1772	98.3628	102.5485	106.7341	110.9198	115.1054 (44)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Energy conte	170.6980	149.2936	154.0576	134.3111	128.8747	111.2091	103.0516	118.2532	119.6655	139.4586	152.2300	165.3119 (45)
Energy content (annual)	Total = Sum(45)m = 1646.4149 (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												
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 (57)
Heat gains from water heating, kWh/month	36.2733	31.7249	32.7372	28.5411	27.3859	23.6319	21.8985	25.1288	25.4289	29.6350	32.3489	35.1288 (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	148.2974	148.2974	148.2974	148.2974	148.2974	148.2974	148.2974	148.2974	148.2974	148.2974	148.2974	148.2974 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	31.5855	28.0540	22.8150	17.2724	12.9113	10.9003	11.7782	15.3097	20.5486	26.0912	30.4523	32.4634 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	344.1212	347.6921	338.6935	319.5367	295.3546	272.6268	257.4433	253.8724	262.8709	282.0278	306.2099	328.9376 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	37.8297	37.8297	37.8297	37.8297	37.8297	37.8297	37.8297	37.8297	37.8297	37.8297	37.8297	37.8297 (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)	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380 (71)
Water heating gains (Table 5)	48.7545	47.2096	44.0017	39.6404	36.8090	32.8221	29.4334	33.7753	35.3179	39.8319	44.9290	47.2161 (72)
Total internal gains	491.9504	490.4449	472.9994	443.9388	412.5641	383.8385	366.1441	370.4466	386.2268	415.4402	449.0804	476.1063 (73)

#### 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W						
Northeast	3.7800	11.2829	0.6300	0.7000	0.7700	13.0342 (75)						
Southeast	10.7200	36.7938	0.6300	0.7000	0.7700	120.5429 (77)						
Southwest	1.3400	36.7938	0.6300	0.7000	0.7700	15.0679 (79)						
Northwest	11.6100	11.2829	0.6300	0.7000	0.7700	40.0338 (81)						
North	1.8000	26.0000	0.6300	0.7000	1.0000	18.5749 (82)						
Solar gains	207.2537	377.5954	579.2625	818.3965	1005.4409	1036.3857	983.3440	838.5075	661.5300	434.4615	252.7796	174.3954 (83)
Total gains	699.2041	868.0404	1052.2619	1262.3352	1418.0050	1420.2242	1349.4881	1208.9541	1047.7568	849.9017	701.8600	650.5017 (84)

#### 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (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	55.5657	55.7042	55.8406	56.4902	56.6134	57.1942	57.1942	57.3031	56.9691	56.6134	56.3647	56.1070
alpha	4.7044	4.7136	4.7227	4.7660	4.7742	4.8129	4.8129	4.8202	4.7979	4.7742	4.7576	4.7405
util living area	0.9996	0.9989	0.9960	0.9824	0.9312	0.8033	0.6442	0.7222	0.9314	0.9934	0.9992	0.9998 (86)
MIT	19.4485	19.6114	19.8958	20.2884	20.6523	20.8925	20.9718	20.9522	20.7445	20.2717	19.7914	19.4263 (87)
Th 2	19.8804	19.8828	19.8853	19.8966	19.8987	19.9087	19.9087	19.9105	19.9048	19.8987	19.8944	19.8899 (88)
util rest of house	0.9995	0.9985	0.9945	0.9747	0.8987	0.7140	0.5033	0.5844	0.8842	0.9896	0.9988	0.9997 (89)
MIT 2	18.4579	18.6226	18.9082	19.3053	19.6514	19.8559	19.9012	19.8957	19.7466	19.2938	18.8118	18.4432 (90)
Living area fraction	fLA = Living area / (4) = 0.1137 (91)											
MIT	18.5706	18.7351	19.0205	19.4171	19.7652	19.9738	20.0229	20.0158	19.8601	19.4050	18.9232	18.5550 (92)
Temperature adjustment	0.0000											
adjusted MIT	18.5706	18.7351	19.0205	19.4171	19.7652	19.9738	20.0229	20.0158	19.8601	19.4050	18.9232	18.5550 (93)

#### 8. Space heating requirement

Utilisation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Useful gains	698.6967	866.1907	1044.5723	1224.5811	1267.3264	1022.7796	700.6100	724.4950	923.7554	838.8903	700.6887	650.1719 (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	3077.0674	2975.7447	2686.4231	2230.6179	1706.8575	1125.7251	717.0462	756.0199	1211.4043	1863.4247	2513.2151	3065.4122 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh	1769.5078	1417.6203	1221.5370	724.3465	327.0111	0.0000	0.0000	0.0000	0.0000	762.2536	1305.0190	1796.9388 (98)
Space heating	9324.2340 (98)											
Space heating per m2	(98) / (4) = 54.0441 (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
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# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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													
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	1969.1454	1550.1783	1589.0503	0.0000	0.0000	0.0000	0.0000	0.0000 (100)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.7809	0.8605	0.8113	0.0000	0.0000	0.0000	0.0000	0.0000 (101)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1537.6715	1333.9738	1289.2523	0.0000	0.0000	0.0000	0.0000	0.0000 (102)
Month fracti	0.0000	0.0000	0.0000	0.0000	0.0000	1769.2958	1684.7698	1527.1811	0.0000	0.0000	0.0000	0.0000	0.0000 (103)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000 (103a)
Space cooling Cooled fraction	0.0000	0.0000	0.0000	0.0000	0.0000	166.7695	260.9922	177.0191	0.0000	0.0000	0.0000	0.0000	0.0000 (104)
Intermittency factor (Table 10b)													604.7808 (104)
FC = cooled area / (4) =													1.0000 (105)
Space cooling kWh	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling Energy for space heating	0.0000	0.0000	0.0000	0.0000	0.0000	41.6924	65.2481	44.2548	0.0000	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling Energy for space cooling													151.1952 (107)
Total													0.8763 (108)
Target Fabric Energy Efficiency (TFEE)													54.0441 (99)
													0.8763 (108)
													54.9205 (109)
													63.2 (109)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### 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	79.9400 (1b)	2.5200 (2b)	201.4488 (1b) - (3b)
First floor	92.5900 (1c)	2.6400 (2c)	244.4376 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	172.5300		(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 445.8864 (5)
Dwelling volume			

#### 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)							
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =				40.0000 / (5) =	0.0897 (8)							
Pressure test				Yes								
Measured/design AP50				5.0000								
Infiltration rate				0.3397 (18)								
Number of sides sheltered				0 (19)								
Shelter factor			(20) = 1 - [0.075 x (19)] =		1.0000 (20)							
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.3397 (21)							
Wind speed	Jan 4.1000	Feb 3.8000	Mar 3.9000	Apr 3.7000	May 3.6000	Jun 3.3000	Jul 3.3000	Aug 3.2000	Sep 3.2000	Oct 3.4000	Nov 3.3000	Dec 3.7000 (22)
Wind factor	1.0250	0.9500	0.9750	0.9250	0.9000	0.8250	0.8250	0.8000	0.8000	0.8500	0.8250	0.9250 (22a)
Adj infilt rate												
Effective ac	0.3482	0.3227	0.3312	0.3142	0.3057	0.2803	0.2803	0.2718	0.2718	0.2888	0.2803	0.3142 (22b)
	0.5606	0.5521	0.5549	0.5494	0.5467	0.5393	0.5393	0.5369	0.5369	0.5417	0.5393	0.5494 (25)

#### 3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K					
Front Door			2.3300	1.4000	3.2620		(26)					
Window (Uw = 1.40)			27.4500	1.3258	36.3920		(27)					
Garage Door			2.1000	1.4000	2.9400		(26)					
Lantern Rooflight (Uw = 1.40)			1.8000	1.3258	2.3864		(27a)					
Heat Loss Floor			55.3500	0.1200	6.6420	75.0000	4151.2500 (28a)					
Exposed Floor			24.5900	0.1500	3.6885	20.0000	491.8000 (28b)					
External Walls	187.1700	29.4200	157.7500	0.1800	28.3950	60.0000	9465.0000 (29a)					
Dormer Walls	9.2400	2.4600	6.7800	0.1700	1.1526	9.0000	61.0200 (29a)					
Bay Roof	2.3100		2.3100	0.1500	0.3465	9.0000	20.7900 (30)					
Flat Roof	9.6400	1.8000	7.8400	0.1400	1.0976	9.0000	70.5600 (30)					
Pitched Cold Roof	67.9900		67.9900	0.1000	6.7990	9.0000	611.9100 (30)					
Pitched Sloping Roof	18.4600		18.4600	0.1300	2.3998	9.0000	166.1400 (30)					
Dormer Flat Roof	3.0700		3.0700	0.1300	0.3991	9.0000	27.6300 (30)					
Over Garage Flat Roof	7.5100		7.5100	0.1400	1.0514	9.0000	67.5900 (30)					
Total net area of external elements Aum(A, m2)			385.3300				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	96.9519		(33)					
Party Wall			10.5600	0.0000	0.0000	70.0000	739.2000 (32)					
Internal Wall Masonry			40.0500			75.0000	3003.7500 (32c)					
Internal Wall Timber			163.9400			9.0000	1475.4600 (32c)					
Internal Floor			67.9900			18.0000	1223.8200 (32d)					
Internal Ceiling			67.9900			18.0000	1223.8200 (32e)					
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	22799.7400 (34)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							132.1494 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							37.8918 (36)					
Total fabric heat loss						(33) + (36) =	134.8437 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 82.4914	Feb 81.2337	Mar 81.6423	Apr 80.8358	May 80.4484	Jun 79.3500	Jul 79.3500	Aug 79.0050	Sep 79.0050	Oct 79.7055	Nov 79.3500	Dec 80.8358 (38)
Heat transfer coeff	217.3351	216.0774	216.4860	215.6795	215.2921	214.1937	214.1937	213.8487	213.8487	214.5492	214.1937	215.6795 (39)
Average = Sum(39)m / 12 =												215.1148 (39)
HLP	Jan 1.2597	Feb 1.2524	Mar 1.2548	Apr 1.2501	May 1.2479	Jun 1.2415	Jul 1.2415	Aug 1.2395	Sep 1.2395	Oct 1.2435	Nov 1.2415	Dec 1.2501 (40)
HLP (average)												1.2468 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

#### 4. Water heating energy requirements (kWh/year)



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF HEAT DEMAND 09 Jan 2014

Assumed occupancy												2.9659 (42)
Average daily hot water use (litres/day)												104.6413 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	115.1054	110.9198	106.7341	102.5485	98.3628	94.1772	94.1772	98.3628	102.5485	106.7341	110.9198	115.1054 (44)
Energy content (annual)	170.6980	149.2936	154.0576	134.3111	128.8747	111.2091	103.0516	118.2532	119.6655	139.4586	152.2300	165.3119 (45)
Distribution loss (46)m = 0.15 x (45)m												Total = Sum(45)m = 1646.4149 (45)
Water storage loss:	25.6047	22.3940	23.1086	20.1467	19.3312	16.6814	15.4577	17.7380	17.9498	20.9188	22.8345	24.7968 (46)
Store volume												210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.9500 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												1.0530 (55)
Total storage loss	32.6430	29.4840	32.6430	31.5900	32.6430	31.5900	32.6430	32.6430	31.5900	32.6430	31.5900	32.6430 (56)
If cylinder contains dedicated solar storage	32.6430	29.4840	32.6430	31.5900	32.6430	31.5900	32.6430	32.6430	31.5900	32.6430	31.5900	32.6430 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Total heat required for water heating calculated for each month	226.6034	199.7888	209.9630	188.4131	184.7801	165.3111	158.9570	174.1586	173.7675	195.3640	206.3320	221.2173 (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)
Output from w/h	226.6034	199.7888	209.9630	188.4131	184.7801	165.3111	158.9570	174.1586	173.7675	195.3640	206.3320	221.2173 (64)
RHI water heating demand												Total per year (kWh/year) = Sum(64)m = 2304.6559 (64)
Heat gains from water heating, kWh/month	101.4814	90.0363	95.9485	87.9401	87.5752	80.2586	78.9890	84.0435	83.0704	91.0943	93.8981	99.6905 (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	177.9569	177.9569	177.9569	177.9569	177.9569	177.9569	177.9569	177.9569	177.9569	177.9569	177.9569	177.9569 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	78.9637	70.1349	57.0375	43.1811	32.2784	27.2508	29.4454	38.2743	51.3716	65.2281	76.1308	81.1584 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	513.6137	518.9434	505.5127	476.9204	440.8277	406.9057	384.2437	378.9140	392.3447	420.9370	457.0297	490.9517 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.7616	55.7616	55.7616	55.7616	55.7616	55.7616	55.7616	55.7616	55.7616	55.7616	55.7616	55.7616 (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)	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380 (71)
Water heating gains (Table 5)	136.3997	133.9825	128.9630	122.1390	117.7086	111.4703	106.1680	112.9617	115.3755	122.4386	130.4140	133.9926 (72)
Total internal gains	844.0578	838.1415	806.5939	757.3211	705.8953	660.7074	634.9377	645.2306	674.1724	723.6843	778.6551	821.1834 (73)

#### 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W						
Northeast	3.7800	14.6223	0.6300	0.7000	0.7700	16.8920 (75)						
Southeast	10.7200	45.2918	0.6300	0.7000	0.7700	148.3836 (77)						
Southwest	1.3400	45.2918	0.6300	0.7000	0.7700	18.5479 (79)						
Northwest	11.6100	14.6223	0.6300	0.7000	0.7700	51.8825 (81)						
North	1.8000	34.0000	0.6300	0.7000	1.0000	24.2903 (82)						
Solar gains	259.9962	404.6861	623.4369	887.8836	1035.3728	1161.4125	1082.0321	946.1665	749.4001	497.0547	309.0510	206.8899 (83)
Total gains	1104.0540	1242.8276	1430.0308	1645.2047	1741.2681	1822.1199	1716.9697	1591.3971	1423.5725	1220.7389	1087.7061	1028.0733 (84)

#### 7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Thl (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	29.1405	29.3101	29.2548	29.3642	29.4171	29.5679	29.5679	29.6156	29.6156	29.5189	29.5679	29.3642
alpha	2.9427	2.9540	2.9503	2.9576	2.9611	2.9712	2.9712	2.9744	2.9744	2.9679	2.9712	2.9576
util living area	0.9764	0.9651	0.9362	0.8712	0.7571	0.5705	0.4148	0.4638	0.7148	0.8992	0.9618	0.9803 (86)
MIT	19.3954	19.5640	19.8813	20.2742	20.6127	20.8217	20.8858	20.8759	20.7276	20.3135	19.8074	19.3641 (87)
Th 2	19.8725	19.8783	19.8764	19.8801	19.8819	19.8870	19.8870	19.8885	19.8885	19.8853	19.8870	19.8801 (88)
util rest of house	0.9717	0.9581	0.9229	0.8432	0.7016	0.4781	0.2920	0.3379	0.6327	0.8705	0.9526	0.9763 (89)
MIT 2	17.7438	17.9914	18.4453	18.9982	19.4481	19.6907	19.7452	19.7414	19.6018	19.0693	18.3524	17.7040 (90)
Living area fraction												fLA = Living area / (4) = 0.1137 (91)
MIT	17.9317	18.1703	18.6086	19.1433	19.5805	19.8193	19.8749	19.8704	19.7298	19.2108	18.5179	17.8928 (92)
Temperature adjustment												0.0000
adjusted MIT	17.9317	18.1703	18.6086	19.1433	19.5805	19.8193	19.8749	19.8704	19.7298	19.2108	18.5179	17.8928 (93)

#### 8. Space heating requirement

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF HEAT DEMAND 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9602	0.9436	0.9033	0.8208	0.6843	0.4720	0.2906	0.3357	0.6191	0.8482	0.9371	0.9661 (94)
Useful gains	1060.0776	1172.6918	1291.7589	1350.3089	1191.6215	859.9638	498.9667	534.2112	881.3629	1035.4555	1019.2525	993.2371 (95)
Ext temp.	5.0000	5.6000	7.3000	9.7000	12.7000	15.5000	17.5000	17.3000	14.9000	11.5000	8.0000	5.0000 (96)
Heat loss rate W												
	2810.5025	2716.1489	2448.1495	2036.7185	1481.3171	925.1730	508.6855	549.6740	1032.8442	1654.3363	2252.8572	2780.7062 (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												
	1302.3161	1037.2032	860.3546	494.2150	215.5336	0.0000	0.0000	0.0000	0.0000	460.4473	888.1954	1329.8770 (98)
Space heating												6588.1421 (98)
RHI space heating demand												6588 (98)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### 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 (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	79.9400 (1b)	x 2.5200 (2b)	= 201.4488 (1b) - (3b)
First floor	92.5900 (1c)	x 2.6400 (2c)	= 244.4376 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	172.5300		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 445.8864 (5)

#### 2. Ventilation rate

	main heating	secondary heating	other	total	m <sup>3</sup> 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)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =				40.0000 / (5) =	0.0897 (8)
Pressure test				Yes	
Measured/design AP50				5.0000	
Infiltration rate				0.3397 (18)	
Number of sides sheltered				0 (19)	
Shelter factor			(20) = 1 - [0.075 x (19)] =		1.0000 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.3397 (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												
Effective ac	0.4331	0.4246	0.4161	0.3737	0.3652	0.3227	0.3227	0.3142	0.3397	0.3652	0.3822	0.3992 (22b)
	0.5938	0.5902	0.5866	0.5698	0.5667	0.5521	0.5521	0.5494	0.5577	0.5667	0.5730	0.5797 (25)

#### 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
Front Door			2.3300	1.4000	3.2620		(26)
Window (Uw = 1.40)			27.4500	1.3258	36.3920		(27)
Garage Door			2.1000	1.4000	2.9400		(26)
Lantern Rooflight (Uw = 1.40)			1.8000	1.3258	2.3864		(27a)
Heat Loss Floor			55.3500	0.1200	6.6420	75.0000	4151.2500 (28a)
Exposed Floor			24.5900	0.1500	3.6885	20.0000	491.8000 (28b)
External Walls	187.1700	29.4200	157.7500	0.1800	28.3950	60.0000	9465.0000 (29a)
Dormer Walls	9.2400	2.4600	6.7800	0.1700	1.1526	9.0000	61.0200 (29a)
Bay Roof	2.3100		2.3100	0.1500	0.3465	9.0000	20.7900 (30)
Flat Roof	9.6400	1.8000	7.8400	0.1400	1.0976	9.0000	70.5600 (30)
Pitched Cold Roof	67.9900		67.9900	0.1000	6.7990	9.0000	611.9100 (30)
Pitched Sloping Roof	18.4600		18.4600	0.1300	2.3998	9.0000	166.1400 (30)
Dormer Flat Roof	3.0700		3.0700	0.1300	0.3991	9.0000	27.6300 (30)
Over Garage Flat Roof	7.5100		7.5100	0.1400	1.0514	9.0000	67.5900 (30)
Total net area of external elements Aum(A, m <sup>2</sup> )			385.3300				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	96.9519		(33)
Party Wall			10.5600	0.0000	0.0000	70.0000	739.2000 (32)
Internal Wall Masonry			40.0500			75.0000	3003.7500 (32c)
Internal Wall Timber			163.9400			9.0000	1475.4600 (32c)
Internal Floor			67.9900			18.0000	1223.8200 (32d)
Internal Ceiling			67.9900			18.0000	1223.8200 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	22799.7400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							132.1494 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							37.8918 (36)
Total fabric heat loss						(33) + (36) =	134.8437 (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	87.3733	86.8373	86.3120	83.8445	83.3828	81.2337	81.2337	80.8358	82.0615	83.3828	84.3168	85.2932 (38)
Heat transfer coeff	222.2170	221.6810	221.1557	218.6882	218.2265	216.0774	216.0774	215.6795	216.9052	218.2265	219.1605	220.1369 (39)
Average = Sum(39)m / 12 =												218.6860 (39)
HLP	1.2880	1.2849	1.2818	1.2675	1.2649	1.2524	1.2524	1.2501	1.2572	1.2649	1.2703	1.2759 (40)
HLP (average)												1.2675 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

#### 4. Water heating energy requirements (kWh/year)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF ENERGY RATINGS 09 Jan 2014

Assumed occupancy												2.9659 (42)
Average daily hot water use (litres/day)												104.6413 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	115.1054	110.9198	106.7341	102.5485	98.3628	94.1772	94.1772	98.3628	102.5485	106.7341	110.9198	115.1054 (44)
Energy content (annual)	170.6980	149.2936	154.0576	134.3111	128.8747	111.2091	103.0516	118.2532	119.6655	139.4586	152.2300	165.3119 (45)
Distribution loss (46)m = 0.15 x (45)m												Total = Sum(45)m = 1646.4149 (45)
Water storage loss:	25.6047	22.3940	23.1086	20.1467	19.3312	16.6814	15.4577	17.7380	17.9498	20.9188	22.8345	24.7968 (46)
Store volume												210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.9500 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												1.0530 (55)
Total storage loss	32.6430	29.4840	32.6430	31.5900	32.6430	31.5900	32.6430	32.6430	31.5900	32.6430	31.5900	32.6430 (56)
If cylinder contains dedicated solar storage	32.6430	29.4840	32.6430	31.5900	32.6430	31.5900	32.6430	32.6430	31.5900	32.6430	31.5900	32.6430 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Total heat required for water heating calculated for each month	226.6034	199.7888	209.9630	188.4131	184.7801	165.3111	158.9570	174.1586	173.7675	195.3640	206.3320	221.2173 (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)
Output from w/h	226.6034	199.7888	209.9630	188.4131	184.7801	165.3111	158.9570	174.1586	173.7675	195.3640	206.3320	221.2173 (64)
Heat gains from water heating, kWh/month	101.4814	90.0363	95.9485	87.9401	87.5752	80.2586	78.9890	84.0435	83.0704	91.0943	93.8981	99.6905 (65)
Total per year (kWh/year) = Sum(64)m =												2304.6559 (64)

5. Internal gains (see Table 5 and 5a)												
Metabolic gains (Table 5), Watts												
(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	177.9569	177.9569	177.9569	177.9569	177.9569	177.9569	177.9569	177.9569	177.9569	177.9569	177.9569	177.9569 (66)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	78.9637	70.1349	57.0375	43.1811	32.2784	27.2508	29.4454	38.2743	51.3716	65.2281	76.1308	81.1584 (67)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	513.6137	518.9434	505.5127	476.9204	440.8277	406.9057	384.2437	378.9140	392.3447	420.9370	457.0297	490.9517 (68)
Pumps, fans	55.7616	55.7616	55.7616	55.7616	55.7616	55.7616	55.7616	55.7616	55.7616	55.7616	55.7616	55.7616 (69)
Losses e.g. evaporation (negative values) (Table 5)	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)
Water heating gains (Table 5)	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380 (71)
Total internal gains	136.3997	133.9825	128.9630	122.1390	117.7086	111.4703	106.1680	112.9617	115.3755	122.4386	130.4140	133.9926 (72)
844.0578	838.1415	806.5939	757.3211	705.8953	660.7074	634.9377	645.2306	674.1724	723.6843	778.6551	821.1834 (73)	

6. Solar gains												
[Jan]	Area	Solar flux	g	FF	Access	Gains						
	m <sup>2</sup>	Table 6a	Specific data	Specific data	factor	W						
		W/m <sup>2</sup>	or Table 6b	or Table 6c	Table 6d							
Northeast	3.7800	11.2829	0.6300	0.7000	0.7700	13.0342 (75)						
Southeast	10.7200	36.7938	0.6300	0.7000	0.7700	120.5429 (77)						
Southwest	1.3400	36.7938	0.6300	0.7000	0.7700	15.0679 (79)						
Northwest	11.6100	11.2829	0.6300	0.7000	0.7700	40.0338 (81)						
North	1.8000	26.0000	0.6300	0.7000	1.0000	18.5749 (82)						
Solar gains	207.2537	377.5954	579.2625	818.3965	1005.4409	1036.3857	983.3440	838.5075	661.5300	434.4615	252.7796	174.3954 (83)
Total gains	1051.3115	1215.7369	1385.8564	1575.7175	1711.3362	1697.0931	1618.2817	1483.7381	1335.7024	1158.1458	1031.4347	995.5787 (84)

7. Mean internal temperature (heating season)												
Temperature during heating periods in the living area from Table 9, Thl (C)												21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)												
tau	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
alpha	28.5003	28.5693	28.6371	28.9602	29.0215	29.3101	29.3101	29.3642	29.1983	29.0215	28.8978	28.7697
util living area	2.9000	2.9046	2.9091	2.9307	2.9348	2.9540	2.9540	2.9576	2.9466	2.9348	2.9265	2.9180
MIT	0.9814	0.9707	0.9486	0.8982	0.8055	0.6664	0.5301	0.5841	0.7874	0.9268	0.9718	0.9840 (86)
Th 2	19.2308	19.4113	19.7216	20.1337	20.4984	20.7497	20.8503	20.8297	20.6279	20.1551	19.6228	19.2010 (87)
util rest of house	19.8503	19.8527	19.8551	19.8664	19.8685	19.8783	19.8783	19.8801	19.8745	19.8685	19.8642	19.8597 (88)
MIT 2	0.9777	0.9649	0.9380	0.8761	0.7609	0.5860	0.4154	0.4702	0.7221	0.9063	0.9653	0.9809 (89)
Living area fraction	17.4897	17.7527	18.2017	18.7939	19.2911	19.6099	19.7116	19.6979	19.4746	18.8368	18.0702	17.4528 (90)
MIT	17.6877	17.9414	18.3746	18.9462	19.4284	19.7395	19.8411	19.8266	19.6058	18.9867	18.2467	17.6516 (92)
Temperature adjustment												0.0000
adjusted MIT	17.6877	17.9414	18.3746	18.9462	19.4284	19.7395	19.8411	19.8266	19.6058	18.9867	18.2467	17.6516 (93)

8. Space heating requirement												
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF ENERGY RATINGS 09 Jan 2014

Utilisation	0.9678	0.9515	0.9199	0.8536	0.7404	0.5749	0.4113	0.4641	0.7034	0.8852	0.9520	0.9720 (94)
Useful gains	1017.4373	1156.8344	1274.7866	1345.0292	1267.0486	975.6402	665.5956	688.6339	939.5871	1025.1482	981.9718	967.7258 (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	2974.9701	2891.0205	2626.1301	2196.9944	1686.5337	1110.5286	700.3214	739.0421	1194.2367	1830.2078	2442.9224	2961.2023 (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	1456.4044	1165.3730	1005.3996	613.4149	312.0969	0.0000	0.0000	0.0000	0.0000	598.9643	1051.8844	1483.1465 (98)
Space heating												7686.6841 (98)
Space heating per m2												(98) / (4) = 44.5527 (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)												0.1000 (201)	
Fraction of space heat from main system(s)												0.9000 (202)	
Efficiency of main space heating system 1 (in %)												90.7000 (206)	
Efficiency of secondary/supplementary heating system, %												65.0000 (208)	
Space heating requirement												7627.3602 (211)	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	1456.4044	1165.3730	1005.3996	613.4149	312.0969	0.0000	0.0000	0.0000	0.0000	598.9643	1051.8844	1483.1465 (98)	
Space heating efficiency (main heating system 1)	90.7000	90.7000	90.7000	90.7000	90.7000	0.0000	0.0000	0.0000	0.0000	90.7000	90.7000	90.7000 (210)	
Space heating fuel (main heating system)	1445.1642	1156.3790	997.6402	608.6807	309.6882	0.0000	0.0000	0.0000	0.0000	594.3417	1043.7662	1471.6999 (211)	
Water heating requirement	224.0622	179.2882	154.6769	94.3715	48.0149	0.0000	0.0000	0.0000	0.0000	92.1484	161.8284	228.1764 (215)	
Water heating requirement	226.6034	199.7888	209.9630	188.4131	184.7801	165.3111	158.9570	174.1586	173.7675	195.3640	206.3320	221.2173 (64)	
Efficiency of water heater	88.9465	88.7996	88.4714	87.7149	86.1289	80.0000	80.0000	80.0000	80.0000	87.5839	88.5799	89.0075 (217)	
Fuel for water heating, kWh/month	254.7638	224.9884	237.3230	214.8018	214.5391	206.6389	198.6962	217.6982	217.2094	223.0593	232.9332	248.5377 (219)	
Water heating fuel used												2691.1889 (219)	
Annual totals kWh/year													
Space heating fuel - main system													7627.3602 (211)
Space heating fuel - secondary													1182.5668 (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)													557.8098 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.80 * 1029 * 1.00) =										-2305.3782			-2305.3782 (233)
Total delivered energy for all uses													9828.5474 (238)

#### 10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	7627.3602	3.4800	265.4321 (240)
Space heating - secondary	1182.5668	4.2300	50.0226 (242)
Water heating (other fuel)	2691.1889	3.4800	93.6534 (247)
Pumps and fans for heating	75.0000	13.1900	9.8925 (249)
Energy for lighting	557.8098	13.1900	73.5751 (250)
Additional standing charges			120.0000 (251)
Energy saving/generation technologies			
PV Unit	-2305.3782	13.1900	-304.0794 (252)
Total energy cost			308.4963 (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] =	0.5956 (257)
SAP value		91.6909
SAP rating (Section 12)		92 (258)
SAP band		A

#### 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	7627.3602	0.2160	1647.5098 (261)
Space heating - secondary	1182.5668	0.0190	22.4688 (263)
Water heating (other fuel)	2691.1889	0.2160	581.2968 (264)
Space and water heating			2251.2754 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF ENERGY RATINGS 09 Jan 2014

Energy for lighting	557.8098	0.5190	289.5033 (268)
Energy saving/generation technologies			
PV Unit	-2305.3782	0.5190	-1196.4913 (269)
Total kg/year			1383.2123 (272)
CO2 emissions per m2			8.0200 (273)
EI value			91.4793
EI rating			91 (274)
EI band			B

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 Calculation of stars for heating and DHW  
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Main heating energy efficiency	$3.48 \times (1 + 0.29 \times 0.25) / 0.9070 = 4.115$ , stars = 4
Main heating environmental impact	$0.216 \times (1 + 0.29 \times 0.25) / 0.9070 = 0.2554$ , stars = 4
Water heating energy efficiency	$3.48 / 0.8544 = 4.073$ , stars = 4
Water heating environmental impact	$0.216 / 0.8544 = 0.2528$ , stars = 4

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# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### 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 (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	79.9400 (1b)	x 2.5200 (2b)	= 201.4488 (1b) - (3b)
First floor	92.5900 (1c)	x 2.6400 (2c)	= 244.4376 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	172.5300		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 445.8864 (5)

#### 2. Ventilation rate

	main heating	secondary heating	other	total	m <sup>3</sup> 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)							
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =				40.0000 / (5) =	0.0897 (8)							
Pressure test				Yes								
Measured/design AP50				5.0000								
Infiltration rate				0.3397 (18)								
Number of sides sheltered				0 (19)								
Shelter factor			(20) = 1 - [0.075 x (19)] =		1.0000 (20)							
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.3397 (21)							
Wind speed	Jan 4.1000	Feb 3.8000	Mar 3.9000	Apr 3.7000	May 3.6000	Jun 3.3000	Jul 3.3000	Aug 3.2000	Sep 3.2000	Oct 3.4000	Nov 3.3000	Dec 3.7000 (22)
Wind factor	1.0250	0.9500	0.9750	0.9250	0.9000	0.8250	0.8250	0.8000	0.8000	0.8500	0.8250	0.9250 (22a)
Adj infilt rate												
Effective ac	0.3482	0.3227	0.3312	0.3142	0.3057	0.2803	0.2803	0.2718	0.2718	0.2888	0.2803	0.3142 (22b)
	0.5606	0.5521	0.5549	0.5494	0.5467	0.5393	0.5393	0.5369	0.5369	0.5417	0.5393	0.5494 (25)

#### 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K					
Front Door			2.3300	1.4000	3.2620		(26)					
Window (Uw = 1.40)			27.4500	1.3258	36.3920		(27)					
Garage Door			2.1000	1.4000	2.9400		(26)					
Lantern Rooflight (Uw = 1.40)			1.8000	1.3258	2.3864		(27a)					
Heat Loss Floor			55.3500	0.1200	6.6420	75.0000	4151.2500 (28a)					
Exposed Floor			24.5900	0.1500	3.6885	20.0000	491.8000 (28b)					
External Walls	187.1700	29.4200	157.7500	0.1800	28.3950	60.0000	9465.0000 (29a)					
Dormer Walls	9.2400	2.4600	6.7800	0.1700	1.1526	9.0000	61.0200 (29a)					
Bay Roof	2.3100		2.3100	0.1500	0.3465	9.0000	20.7900 (30)					
Flat Roof	9.6400	1.8000	7.8400	0.1400	1.0976	9.0000	70.5600 (30)					
Pitched Cold Roof	67.9900		67.9900	0.1000	6.7990	9.0000	611.9100 (30)					
Pitched Sloping Roof	18.4600		18.4600	0.1300	2.3998	9.0000	166.1400 (30)					
Dormer Flat Roof	3.0700		3.0700	0.1300	0.3991	9.0000	27.6300 (30)					
Over Garage Flat Roof	7.5100		7.5100	0.1400	1.0514	9.0000	67.5900 (30)					
Total net area of external elements Aum(A, m <sup>2</sup> )			385.3300				(31)					
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	96.9519		(33)					
Party Wall			10.5600	0.0000	0.0000	70.0000	739.2000 (32)					
Internal Wall Masonry			40.0500			75.0000	3003.7500 (32c)					
Internal Wall Timber			163.9400			9.0000	1475.4600 (32c)					
Internal Floor			67.9900			18.0000	1223.8200 (32d)					
Internal Ceiling			67.9900			18.0000	1223.8200 (32e)					
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	22799.7400 (34)					
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							132.1494 (35)					
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							37.8918 (36)					
Total fabric heat loss						(33) + (36) =	134.8437 (37)					
Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)												
(38)m	Jan 82.4914	Feb 81.2337	Mar 81.6423	Apr 80.8358	May 80.4484	Jun 79.3500	Jul 79.3500	Aug 79.0050	Sep 79.0050	Oct 79.7055	Nov 79.3500	Dec 80.8358 (38)
Heat transfer coeff												
Average = Sum(39)m / 12 =	217.3351	216.0774	216.4860	215.6795	215.2921	214.1937	214.1937	213.8487	213.8487	214.5492	214.1937	215.6795 (39)
												215.1148 (39)
HLP	Jan 1.2597	Feb 1.2524	Mar 1.2548	Apr 1.2501	May 1.2479	Jun 1.2415	Jul 1.2415	Aug 1.2395	Sep 1.2395	Oct 1.2435	Nov 1.2415	Dec 1.2501 (40)
HLP (average)												1.2468 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

#### 4. Water heating energy requirements (kWh/year)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

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

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Assumed occupancy											2.9659 (42)	
Average daily hot water use (litres/day)											104.6413 (43)	
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy conte	115.1054	110.9198	106.7341	102.5485	98.3628	94.1772	94.1772	98.3628	102.5485	106.7341	110.9198	115.1054 (44)
Energy conte	170.6980	149.2936	154.0576	134.3111	128.8747	111.2091	103.0516	118.2532	119.6655	139.4586	152.2300	165.3119 (45)
Energy content (annual)											Total = Sum(45)m =	1646.4149 (45)
Distribution loss (46)m = 0.15 x (45)m												24.7968 (46)
Water storage loss:												
Store volume											210.0000 (47)	
a) If manufacturer declared loss factor is known (kWh/day):											1.9500 (48)	
Temperature factor from Table 2b											0.5400 (49)	
Enter (49) or (54) in (55)											1.0530 (55)	
Total storage loss												
	32.6430	29.4840	32.6430	31.5900	32.6430	31.5900	32.6430	32.6430	31.5900	32.6430	31.5900	32.6430 (56)
If cylinder contains dedicated solar storage												
	32.6430	29.4840	32.6430	31.5900	32.6430	31.5900	32.6430	32.6430	31.5900	32.6430	31.5900	32.6430 (57)
Primary loss	23.2624	21.0112	23.2624	22.5120	23.2624	22.5120	23.2624	23.2624	22.5120	23.2624	22.5120	23.2624 (59)
Total heat required for water heating calculated for each month												
	226.6034	199.7888	209.9630	188.4131	184.7801	165.3111	158.9570	174.1586	173.7675	195.3640	206.3320	221.2173 (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												
	226.6034	199.7888	209.9630	188.4131	184.7801	165.3111	158.9570	174.1586	173.7675	195.3640	206.3320	221.2173 (64)
											Total per year (kWh/year) = Sum(64)m =	2304.6559 (64)
Heat gains from water heating, kWh/month												
	101.4814	90.0363	95.9485	87.9401	87.5752	80.2586	78.9890	84.0435	83.0704	91.0943	93.8981	99.6905 (65)

-----												
5. Internal gains (see Table 5 and 5a)												
-----												
Metabolic gains (Table 5), Watts												
(66)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	177.9569	177.9569	177.9569	177.9569	177.9569	177.9569	177.9569	177.9569	177.9569	177.9569	177.9569	177.9569 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5												
	78.9637	70.1349	57.0375	43.1811	32.2784	27.2508	29.4454	38.2743	51.3716	65.2281	76.1308	81.1584 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5												
	513.6137	518.9434	505.5127	476.9204	440.8277	406.9057	384.2437	378.9140	392.3447	420.9370	457.0297	490.9517 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5												
	55.7616	55.7616	55.7616	55.7616	55.7616	55.7616	55.7616	55.7616	55.7616	55.7616	55.7616	55.7616 (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)												
	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380 (71)
Water heating gains (Table 5)												
	136.3997	133.9825	128.9630	122.1390	117.7086	111.4703	106.1680	112.9617	115.3755	122.4386	130.4140	133.9926 (72)
Total internal gains												
	844.0578	838.1415	806.5939	757.3211	705.8953	660.7074	634.9377	645.2306	674.1724	723.6843	778.6551	821.1834 (73)

-----												
6. Solar gains												
-----												
[Jan]	Area	Solar flux	g	FF	Access	Gains						
	m <sup>2</sup>	Table 6a	Specific data	Specific data	factor	W						
		W/m <sup>2</sup>	or Table 6b	or Table 6c	Table 6d							
Northeast	3.7800	14.6223	0.6300	0.7000	0.7700	16.8920 (75)						
Southeast	10.7200	45.2918	0.6300	0.7000	0.7700	148.3836 (77)						
Southwest	1.3400	45.2918	0.6300	0.7000	0.7700	18.5479 (79)						
Northwest	11.6100	14.6223	0.6300	0.7000	0.7700	51.8825 (81)						
North	1.8000	34.0000	0.6300	0.7000	1.0000	24.2903 (82)						
Solar gains	259.9962	404.6861	623.4369	887.8836	1035.3728	1161.4125	1082.0321	946.1665	749.4001	497.0547	309.0510	206.8899 (83)
Total gains	1104.0540	1242.8276	1430.0308	1645.2047	1741.2681	1822.1199	1716.9697	1591.3971	1423.5725	1220.7389	1087.7061	1028.0733 (84)

-----												
7. Mean internal temperature (heating season)												
-----												
Temperature during heating periods in the living area from Table 9, Thl (C)												
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	29.1405	29.3101	29.2548	29.3642	29.4171	29.5679	29.5679	29.6156	29.6156	29.5189	29.5679	29.3642
alpha	2.9427	2.9540	2.9503	2.9576	2.9611	2.9712	2.9712	2.9744	2.9744	2.9679	2.9712	2.9576
util living area	0.9764	0.9651	0.9362	0.8712	0.7571	0.5705	0.4148	0.4638	0.7148	0.8992	0.9618	0.9803 (86)
MIT	19.3954	19.5640	19.8813	20.2742	20.6127	20.8217	20.8858	20.8759	20.7276	20.3135	19.8074	19.3641 (87)
Th 2	19.8725	19.8783	19.8764	19.8801	19.8819	19.8870	19.8870	19.8885	19.8885	19.8853	19.8870	19.8801 (88)
util rest of house	0.9717	0.9581	0.9229	0.8432	0.7016	0.4781	0.2920	0.3379	0.6327	0.8705	0.9526	0.9763 (89)
MIT 2	17.7438	17.9914	18.4453	18.9982	19.4481	19.6907	19.7452	19.7414	19.6018	19.0693	18.3524	17.7040 (90)
Living area fraction											fLA = Living area / (4) =	0.1137 (91)
MIT	17.9317	18.1703	18.6086	19.1433	19.5805	19.8193	19.8749	19.8704	19.7298	19.2108	18.5179	17.8928 (92)
Temperature adjustment											0.0000	
adjusted MIT	17.9317	18.1703	18.6086	19.1433	19.5805	19.8193	19.8749	19.8704	19.7298	19.2108	18.5179	17.8928 (93)

-----												
8. Space heating requirement												
-----												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

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

Utilisation	0.9602	0.9436	0.9033	0.8208	0.6843	0.4720	0.2906	0.3357	0.6191	0.8482	0.9371	0.9661 (94)
Useful gains	1060.0776	1172.6918	1291.7589	1350.3089	1191.6215	859.9638	498.9667	534.2112	881.3629	1035.4555	1019.2525	993.2371 (95)
Ext temp.	5.0000	5.6000	7.3000	9.7000	12.7000	15.5000	17.5000	17.3000	14.9000	11.5000	8.0000	5.0000 (96)
Heat loss rate W	2810.5025	2716.1489	2448.1495	2036.7185	1481.3171	925.1730	508.6855	549.6740	1032.8442	1654.3363	2252.8572	2780.7062 (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	1302.3161	1037.2032	860.3546	494.2150	215.5336	0.0000	0.0000	0.0000	0.0000	460.4473	888.1954	1329.8770 (98)
Space heating												6588.1421 (98)
Space heating per m2												(98) / (4) = 38.1855 (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)												0.1000 (201)
Fraction of space heat from main system(s)												0.9000 (202)
Efficiency of main space heating system 1 (in %)												90.7000 (206)
Efficiency of secondary/supplementary heating system, %												65.0000 (208)
Space heating requirement												6537.2965 (211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement	1302.3161	1037.2032	860.3546	494.2150	215.5336	0.0000	0.0000	0.0000	0.0000	460.4473	888.1954	1329.8770 (98)
Space heating efficiency (main heating system 1)	90.7000	90.7000	90.7000	90.7000	90.7000	0.0000	0.0000	0.0000	0.0000	90.7000	90.7000	90.7000 (210)
Space heating fuel (main heating system)	1292.2652	1029.1983	853.7146	490.4007	213.8702	0.0000	0.0000	0.0000	0.0000	456.8936	881.3406	1319.6133 (211)
Water heating requirement	200.3563	159.5697	132.3622	76.0331	33.1590	0.0000	0.0000	0.0000	0.0000	70.8380	136.6455	204.5965 (215)
Water heating												
Water heating requirement	226.6034	199.7888	209.9630	188.4131	184.7801	165.3111	158.9570	174.1586	173.7675	195.3640	206.3320	221.2173 (64)
Efficiency of water heater	88.7763	88.6106	88.1840	87.2285	85.1443	80.0000	80.0000	80.0000	80.0000	86.9730	88.2776	88.8463 (217)
(217)m												
Fuel for water heating, kWh/month	255.2521	225.4682	238.0964	215.9995	217.0200	206.6389	198.6962	217.6982	217.2094	224.6260	233.7307	248.9888 (219)
Water heating fuel used												2699.4246 (219)
Annual totals kWh/year												
Space heating fuel - main system												6537.2965 (211)
Space heating fuel - secondary												1013.5603 (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)												557.8098 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 2.80 * 1139 * 1.00) =										-2551.5583		-2551.5583 (233)
Total delivered energy for all uses												8331.5329 (238)

#### 10a. Fuel costs - using BEDF prices (512)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	6537.2965	9.7400	636.7327 (240)
Space heating - secondary	1013.5603	10.2500	103.8899 (242)
Water heating (other fuel)	2699.4246	9.7400	262.9240 (247)
Pumps and fans for heating	75.0000	36.8500	27.6375 (249)
Energy for lighting	557.8098	36.8500	205.5529 (250)
Additional standing charges			104.0000 (251)
Energy saving/generation technologies			
PV Unit	-2551.5583	36.8500	-940.2492 (252)
Total energy cost			400.4878 (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	6537.2965	0.2160	1412.0560 (261)
Space heating - secondary	1013.5603	0.0190	19.2576 (263)
Water heating (other fuel)	2699.4246	0.2160	583.0757 (264)
Space and water heating			2014.3894 (265)
Pumps and fans	75.0000	0.5190	38.9250 (267)
Energy for lighting	557.8098	0.5190	289.5033 (268)
Energy saving/generation technologies			
PV Unit	-2551.5583	0.5190	-1324.2587 (269)
Total kg/year			1018.5589 (272)

#### 13a. Primary energy - Individual heating systems including micro-CHP

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year
Space heating - main system 1	6537.2965	1.2200	7975.5017 (261)
Space heating - secondary	1013.5603	1.0400	1054.1027 (263)
Water heating (other fuel)	2699.4246	1.2200	3293.2980 (264)
Space and water heating			12322.9024 (265)
Pumps and fans	75.0000	3.0700	230.2500 (267)
Energy for lighting	557.8098	3.0700	1712.4761 (268)
Energy saving/generation technologies			
PV Unit	-2551.5583	3.0700	-7833.2839 (269)
Primary energy kWh/year			6432.3446 (272)
Primary energy kWh/m2/year			37.2825 (273)

#### SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: A 92  
 Current environmental impact rating: B 91

(For testing purposes):

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 1.1	-£ 116	-273 kg (26.8%)

Recommended measures	Typical annual savings	Energy efficiency	Environmental impact
Solar water heating	£116	1.58 kg/m <sup>2</sup>	A 93
<b>Total Savings</b>	<b>£116</b>	<b>1.58 kg/m<sup>2</sup></b>	<b>A 93</b>

Potential energy efficiency rating: A 93  
 Potential environmental impact rating: A 93

Fuel prices for cost data on this page from database revision number 512 TEST (15 Feb 2023)  
 Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£233	£252	-£18
Mains gas	£1004	£869	£135
Wood	£104	£105	-£1
Space heating	£872	£878	-£5
Water heating	£263	£142	£121
Lighting	£206	£206	£0
Generated (PV)	-£940	-£940	£0
Total cost of fuels	£401	£286	£116
Total cost of uses	£401	£286	£116
Delivered energy	48 kWh/m <sup>2</sup>	41 kWh/m <sup>2</sup>	8 kWh/m <sup>2</sup>
Carbon dioxide emissions	1.0 tonnes	0.7 tonnes	0.3 tonnes
CO2 emissions per m <sup>2</sup>	6 kg/m <sup>2</sup>	4 kg/m <sup>2</sup>	2 kg/m <sup>2</sup>
Primary energy	37 kWh/m <sup>2</sup>	28 kWh/m <sup>2</sup>	9 kWh/m <sup>2</sup>

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

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

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# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### 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	79.9400 (1b)	x 2.5200 (2b)	= 201.4488 (1b) - (3b)
First floor	92.5900 (1c)	x 2.6400 (2c)	= 244.4376 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	172.5300		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 445.8864 (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)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =				40.0000 / (5) =	0.0897 (8)
Pressure test				Yes	
Measured/design AP50				5.0000	
Infiltration rate				0.3397 (18)	
Number of sides sheltered				0 (19)	
Shelter factor			(20) = 1 - [0.075 x (19)] =		1.0000 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.3397 (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												
Effective ac	0.4331	0.4246	0.4161	0.3737	0.3652	0.3227	0.3227	0.3142	0.3397	0.3652	0.3822	0.3992 (22b)
	0.5938	0.5902	0.5866	0.5698	0.5667	0.5521	0.5521	0.5494	0.5577	0.5667	0.5730	0.5797 (25)

#### 3. Heat losses and heat loss parameter

Element	Gross m2	Openings m2	NetArea m2	U-value W/m2K	A x U W/K	K-value kJ/m2K	A x K kJ/K
Front Door			2.3300	1.4000	3.2620		(26)
Window (Uw = 1.40)			27.4500	1.3258	36.3920		(27)
Garage Door			2.1000	1.4000	2.9400		(26)
Lantern Rooflight (Uw = 1.40)			1.8000	1.3258	2.3864		(27a)
Heat Loss Floor			55.3500	0.1200	6.6420	75.0000	4151.2500 (28a)
Exposed Floor			24.5900	0.1500	3.6885	20.0000	491.8000 (28b)
External Walls	187.1700	29.4200	157.7500	0.1800	28.3950	60.0000	9465.0000 (29a)
Dormer Walls	9.2400	2.4600	6.7800	0.1700	1.1526	9.0000	61.0200 (29a)
Bay Roof	2.3100		2.3100	0.1500	0.3465	9.0000	20.7900 (30)
Flat Roof	9.6400	1.8000	7.8400	0.1400	1.0976	9.0000	70.5600 (30)
Pitched Cold Roof	67.9900		67.9900	0.1000	6.7990	9.0000	611.9100 (30)
Pitched Sloping Roof	18.4600		18.4600	0.1300	2.3998	9.0000	166.1400 (30)
Dormer Flat Roof	3.0700		3.0700	0.1300	0.3991	9.0000	27.6300 (30)
Over Garage Flat Roof	7.5100		7.5100	0.1400	1.0514	9.0000	67.5900 (30)
Total net area of external elements Aum(A, m2)			385.3300				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	96.9519		(33)
Party Wall			10.5600	0.0000	0.0000	70.0000	739.2000 (32)
Internal Wall Masonry			40.0500			75.0000	3003.7500 (32c)
Internal Wall Timber			163.9400			9.0000	1475.4600 (32c)
Internal Floor			67.9900			18.0000	1223.8200 (32d)
Internal Ceiling			67.9900			18.0000	1223.8200 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	22799.7400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							132.1494 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							37.8918 (36)
Total fabric heat loss						(33) + (36) =	134.8437 (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	87.3733	86.8373	86.3120	83.8445	83.3828	81.2337	81.2337	80.8358	82.0615	83.3828	84.3168	85.2932 (38)
Heat transfer coeff	222.2170	221.6810	221.1557	218.6882	218.2265	216.0774	216.0774	215.6795	216.9052	218.2265	219.1605	220.1369 (39)
Average = Sum(39)m / 12 =												218.6860 (39)
HLP	1.2880	1.2849	1.2818	1.2675	1.2649	1.2524	1.2524	1.2501	1.2572	1.2649	1.2703	1.2759 (40)
HLP (average)												1.2675 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

#### 4. Water heating energy requirements (kWh/year)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Assumed occupancy												2.9659 (42)
Average daily hot water use (litres/day)												104.6413 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy content (annual)	115.1054	110.9198	106.7341	102.5485	98.3628	94.1772	94.1772	98.3628	102.5485	106.7341	110.9198	115.1054 (44)
Distribution loss (46)m = 0.15 x (45)m	170.6980	149.2936	154.0576	134.3111	128.8747	111.2091	103.0516	118.2532	119.6655	139.4586	152.2300	165.3119 (45)
Water storage loss:												Total = Sum(45)m = 1646.4149 (45)
Store volume	25.6047	22.3940	23.1086	20.1467	19.3312	16.6814	15.4577	17.7380	17.9498	20.9188	22.8345	24.7968 (46)
a) If manufacturer declared loss factor is known (kWh/day):												210.0000 (47)
Temperature factor from Table 2b												1.9500 (48)
Enter (49) or (54) in (55)												0.5400 (49)
Total storage loss												1.0530 (55)
If cylinder contains dedicated solar storage	32.6430	29.4840	32.6430	31.5900	32.6430	31.5900	32.6430	32.6430	31.5900	32.6430	31.5900	32.6430 (56)
Primary loss	20.9848	18.9540	20.9848	20.3079	20.9848	20.3079	20.9848	20.9848	20.3079	20.9848	20.3079	20.9848 (57)
Total heat required for water heating calculated for each month	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624 (59)
Aperture area of solar collector	214.9452	189.2588	196.9090	170.3774	160.3276	141.4222	134.2718	150.4039	157.0825	182.3101	195.0498	209.5591 (62)
Zero-loss collector efficiency												3.0000 (H1)
Collector heat loss coefficient												0.7000 (H2)
Collector 2nd order heat loss coefficient												1.8000 (H3)
Collector effective heat loss coefficient												0.0050 (H3a)
Collector performance ratio												1.8063 (H3b)
Annual solar radiation per m2												2.5804 (H4)
Overshading factor												1079.5246 (H5)
Solar energy available												0.8000 (H6)
Adjustment factor for showers												1813.6014 (H7)
Solar-to-load ratio												1.0000 (H7a)
Utilisation factor												1.1015 (H8)
Collector performance factor												0.5966 (H9)
Dedicated solar storage volume												0.8793 (H10)
Effective solar volume												75.0000 (H11)
Daily hot water demand												115.5000 (H13)
Volume ratio Veff/V												104.6413 (H14)
Solar storage volume factor												1.1038 (H15)
Solar input												1.0000 (H16)
Solar input	-27.5882	-46.0368	-78.4060	-105.0794	-129.8168	-127.6306	-125.9439	-110.0378	-86.1817	-58.8519	-32.7236	-951.3834 (H17)
Output from w/h	187.3570	143.2220	118.5031	65.2980	30.5108	13.7916	8.3279	40.3661	70.9008	123.4581	162.3262	186.4725 (64)
Heat gains from water heating, kWh/month	92.1548	81.6123	85.5053	73.5115	68.0131	61.1475	59.2408	65.0398	69.7224	80.6511	84.8724	90.3640 (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	177.9569	177.9569	177.9569	177.9569	177.9569	177.9569	177.9569	177.9569	177.9569	177.9569	177.9569	177.9569 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	78.9637	70.1349	57.0375	43.1811	32.2784	27.2508	29.4454	38.2743	51.3716	65.2281	76.1308	81.1584 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	513.6137	518.9434	505.5127	476.9204	440.8277	406.9057	384.2437	378.9140	392.3447	420.9370	457.0297	490.9517 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.7616	55.7616	55.7616	55.7616	55.7616	55.7616	55.7616	55.7616	55.7616	55.7616	55.7616	55.7616 (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)	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380 (71)
Water heating gains (Table 5)	123.8640	121.4468	114.9265	102.0992	91.4155	84.9271	79.6248	87.4191	96.8366	108.4021	117.8783	121.4569 (72)
Total internal gains	831.5221	825.6058	792.5574	737.2814	679.6022	634.1642	608.3945	619.6879	655.6335	709.6478	766.1194	808.6477 (73)
6. Solar gains												
[Jan]	Area	Solar flux	g	Specific data	FF	Access	Gains					
	m2	Table 6a	W/m2	or Table 6b	or Table 6c	factor	W					
						Table 6d						
Northeast	3.7800	11.2829	0.6300		0.7000	0.7700	13.0342 (75)					
Southeast	10.7200	36.7938	0.6300		0.7000	0.7700	120.5429 (77)					
Southwest	1.3400	36.7938	0.6300		0.7000	0.7700	15.0679 (79)					
Northwest	11.6100	11.2829	0.6300		0.7000	0.7700	40.0338 (81)					
North	1.8000	26.0000	0.6300		0.7000	1.0000	18.5749 (82)					
Solar gains	207.2537	377.5954	579.2625	818.3965	1005.4409	1036.3857	983.3440	838.5075	661.5300	434.4615	252.7796	174.3954 (83)
Total gains	1038.7758	1203.2012	1371.8198	1555.6778	1685.0431	1670.5499	1591.7385	1458.1955	1317.1635	1144.1093	1018.8989	983.0430 (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	28.5003	28.5693	28.6371	28.9602	29.0215	29.3101	29.3101	29.3642	29.1983	29.0215	28.8978	28.7697
alpha	2.9000	2.9046	2.9091	2.9307	2.9348	2.9540	2.9540	2.9576	2.9466	2.9348	2.9265	2.9180
util living area												

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	0.9819	0.9714	0.9498	0.9008	0.8105	0.6728	0.5369	0.5914	0.7921	0.9288	0.9726	0.9845 (86)
MIT	19.2235	19.4043	19.7143	20.1249	20.4904	20.7453	20.8482	20.8270	20.6227	20.1483	19.6157	19.1936 (87)
Th 2	19.8503	19.8527	19.8551	19.8664	19.8685	19.8783	19.8783	19.8801	19.8745	19.8685	19.8642	19.8597 (88)
util rest of house												
	0.9784	0.9658	0.9394	0.8791	0.7664	0.5927	0.4215	0.4770	0.7275	0.9087	0.9663	0.9815 (89)
MIT 2	17.4791	17.7426	18.1914	18.7821	19.2813	19.6057	19.7103	19.6959	19.4688	18.8276	18.0600	17.4421 (90)
Living area fraction									fLA = Living area / (4) =			0.1137 (91)
MIT	17.6774	17.9316	18.3646	18.9348	19.4188	19.7353	19.8397	19.8246	19.6001	18.9778	18.2369	17.6413 (92)
Temperature adjustment												0.0000
adjusted MIT	17.6774	17.9316	18.3646	18.9348	19.4188	19.7353	19.8397	19.8246	19.6001	18.9778	18.2369	17.6413 (93)

#### 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Utilisation	0.9686	0.9526	0.9214	0.8567	0.7457	0.5811	0.4171	0.4707	0.7086	0.8877	0.9533	0.9728 (94)
Useful gains	1006.2049	1146.1916	1264.0564	1332.8104	1256.5748	970.8317	663.9792	686.3123	933.2851	1015.6086	971.3159	956.3375 (95)
Ext temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000 (96)
Heat loss rate W	2972.6962	2888.8500	2623.9220	2194.4918	1684.4437	1109.6209	700.0204	738.6079	1192.9916	1828.2515	2440.7654	2958.9173 (97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	1.0000 (97a)
Space heating kWh	1463.0695	1171.0664	1011.7400	620.4106	318.3345	0.0000	0.0000	0.0000	0.0000	604.6063	1058.0036	1489.9194 (98)
Space heating												7737.1505 (98)
Space heating per m2												(98) / (4) = 44.8452 (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)												0.1000 (201)
Fraction of space heat from main system(s)												0.9000 (202)
Efficiency of main space heating system 1 (in %)												90.7000 (206)
Efficiency of secondary/supplementary heating system, % requirement												65.0000 (208)
Space heating requirement												7677.4371 (211)
Space heating requirement	1463.0695	1171.0664	1011.7400	620.4106	318.3345	0.0000	0.0000	0.0000	0.0000	604.6063	1058.0036	1489.9194 (98)
Space heating efficiency (main heating system 1)	90.7000	90.7000	90.7000	90.7000	90.7000	0.0000	0.0000	0.0000	0.0000	90.7000	90.7000	90.7000 (210)
Space heating fuel (main heating system)	1451.7779	1162.0284	1003.9317	615.6224	315.8777	0.0000	0.0000	0.0000	0.0000	599.9401	1049.8382	1478.4206 (211)
Water heating requirement	225.0876	180.1641	155.6523	95.4478	48.9745	0.0000	0.0000	0.0000	0.0000	93.0164	162.7698	229.2184 (215)
Water heating requirement	187.3570	143.2220	118.5031	65.2980	30.5108	13.7916	8.3279	40.3661	70.9008	123.4581	162.3262	186.4725 (64)
Efficiency of water heater (217)m	89.2137	89.2716	89.3242	89.4474	89.5473	80.0000	80.0000	80.0000	80.0000	88.5108	88.9669	89.2428 (217)
Fuel for water heating, kWh/month	210.0092	160.4340	132.6662	73.0015	34.0723	17.2396	10.4099	50.4576	88.6260	139.4837	182.4569	208.9497 (219)
Water heating fuel used												1307.8066 (219)
Annual totals kWh/year												
Space heating fuel - main system												7677.4371 (211)
Space heating fuel - secondary												1190.3308 (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)												557.8098 (232)
Energy saving/generation technologies (Appendices M ,N and Q)												
PV Unit 0 (0.80 * 2.80 * 1029 * 1.00) =										-2305.3782		-2305.3782 (233)
Total delivered energy for all uses												8553.0060 (238)

#### 10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year
Space heating - main system 1	7677.4371	3.4800	267.1748 (240)
Space heating - secondary	1190.3308	4.2300	50.3510 (242)
Water heating (other fuel)	1307.8066	3.4800	45.5117 (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	557.8098	13.1900	73.5751 (250)
Additional standing charges			120.0000 (251)
Energy saving/generation technologies			
PV Unit	-2305.3782	13.1900	-304.0794 (252)
Total energy cost			269.0207 (255)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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 11a. SAP rating - Individual heating systems  
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Energy cost deflator (Table 12):		0.4200 (256)
Energy cost factor (ECF)	$[(255) \times (256)] / [(4) + 45.0] =$	0.5194 (257)
SAP value		92.7541
SAP rating (Section 12)		93 (258)
SAP band		A

-----  
 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	7677.4371	0.2160	1658.3264 (261)
Space heating - secondary	1190.3308	0.0190	22.6163 (263)
Water heating (other fuel)	1307.8066	0.2160	282.4862 (264)
Space and water heating			1963.4289 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	557.8098	0.5190	289.5033 (268)
Energy saving/generation technologies			
PV Unit	-2305.3782	0.5190	-1196.4913 (269)
Total kg/year			1121.3159 (272)
CO2 emissions per m2			6.5000 (273)
EI value			93.0926
EI rating			93 (274)
EI band			A

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# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### 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 (m <sup>2</sup> )	Storey height (m)	Volume (m <sup>3</sup> )
Ground floor	79.9400 (1b)	x 2.5200 (2b)	= 201.4488 (1b) - (3b)
First floor	92.5900 (1c)	x 2.6400 (2c)	= 244.4376 (1c) - (3c)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	172.5300		(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n) = 445.8864 (5)

#### 2. Ventilation rate

	main heating	secondary heating	other	total	m <sup>3</sup> 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)
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =				40.0000 / (5) =	0.0897 (8)
Pressure test				Yes	
Measured/design AP50				5.0000	
Infiltration rate				0.3397 (18)	
Number of sides sheltered				0 (19)	
Shelter factor			(20) = 1 - [0.075 x (19)] =		1.0000 (20)
Infiltration rate adjusted to include shelter factor			(21) = (18) x (20) =		0.3397 (21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind speed	4.1000	3.8000	3.9000	3.7000	3.6000	3.3000	3.3000	3.2000	3.2000	3.4000	3.3000	3.7000 (22)
Wind factor	1.0250	0.9500	0.9750	0.9250	0.9000	0.8250	0.8250	0.8000	0.8000	0.8500	0.8250	0.9250 (22a)
Adj infilt rate												
Effective ac	0.3482	0.3227	0.3312	0.3142	0.3057	0.2803	0.2803	0.2718	0.2718	0.2888	0.2803	0.3142 (22b)
	0.5606	0.5521	0.5549	0.5494	0.5467	0.5393	0.5393	0.5369	0.5369	0.5417	0.5393	0.5494 (25)

#### 3. Heat losses and heat loss parameter

Element	Gross m <sup>2</sup>	Openings m <sup>2</sup>	NetArea m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	K-value kJ/m <sup>2</sup> K	A x K kJ/K
Front Door			2.3300	1.4000	3.2620		(26)
Window (Uw = 1.40)			27.4500	1.3258	36.3920		(27)
Garage Door			2.1000	1.4000	2.9400		(26)
Lantern Rooflight (Uw = 1.40)			1.8000	1.3258	2.3864		(27a)
Heat Loss Floor			55.3500	0.1200	6.6420	75.0000	4151.2500 (28a)
Exposed Floor			24.5900	0.1500	3.6885	20.0000	491.8000 (28b)
External Walls	187.1700	29.4200	157.7500	0.1800	28.3950	60.0000	9465.0000 (29a)
Dormer Walls	9.2400	2.4600	6.7800	0.1700	1.1526	9.0000	61.0200 (29a)
Bay Roof	2.3100		2.3100	0.1500	0.3465	9.0000	20.7900 (30)
Flat Roof	9.6400	1.8000	7.8400	0.1400	1.0976	9.0000	70.5600 (30)
Pitched Cold Roof	67.9900		67.9900	0.1000	6.7990	9.0000	611.9100 (30)
Pitched Sloping Roof	18.4600		18.4600	0.1300	2.3998	9.0000	166.1400 (30)
Dormer Flat Roof	3.0700		3.0700	0.1300	0.3991	9.0000	27.6300 (30)
Over Garage Flat Roof	7.5100		7.5100	0.1400	1.0514	9.0000	67.5900 (30)
Total net area of external elements Aum(A, m <sup>2</sup> )			385.3300				(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	96.9519		(33)
Party Wall			10.5600	0.0000	0.0000	70.0000	739.2000 (32)
Internal Wall Masonry			40.0500			75.0000	3003.7500 (32c)
Internal Wall Timber			163.9400			9.0000	1475.4600 (32c)
Internal Floor			67.9900			18.0000	1223.8200 (32d)
Internal Ceiling			67.9900			18.0000	1223.8200 (32e)
Heat capacity Cm = Sum(A x k)						(28)...(30) + (32) + (32a)...(32e) =	22799.7400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m <sup>2</sup> K							132.1494 (35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							37.8918 (36)
Total fabric heat loss						(33) + (36) =	134.8437 (37)

Ventilation heat loss calculated monthly (38)m = 0.33 x (25)m x (5)

(38)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat transfer coeff	82.4914	81.2337	81.6423	80.8358	80.4484	79.3500	79.3500	79.0050	79.0050	79.7055	79.3500	80.8358 (38)
Average = Sum(39)m / 12 =	217.3351	216.0774	216.4860	215.6795	215.2921	214.1937	214.1937	213.8487	213.8487	214.5492	214.1937	215.6795 (39)
												215.1148 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
HLP	1.2597	1.2524	1.2548	1.2501	1.2479	1.2415	1.2415	1.2395	1.2395	1.2435	1.2415	1.2501 (40)
HLP (average)												1.2468 (40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31 (41)

#### 4. Water heating energy requirements (kWh/year)



# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

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

Assumed occupancy												2.9659 (42)
Average daily hot water use (litres/day)												104.6413 (43)
Daily hot water use	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Energy content (annual)	115.1054	110.9198	106.7341	102.5485	98.3628	94.1772	94.1772	98.3628	102.5485	106.7341	110.9198	115.1054 (44)
Distribution loss (46)m = 0.15 x (45)m	170.6980	149.2936	154.0576	134.3111	128.8747	111.2091	103.0516	118.2532	119.6655	139.4586	152.2300	165.3119 (45)
												Total = Sum(45)m = 1646.4149 (45)
Water storage loss:	25.6047	22.3940	23.1086	20.1467	19.3312	16.6814	15.4577	17.7380	17.9498	20.9188	22.8345	24.7968 (46)
Store volume												210.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):												1.9500 (48)
Temperature factor from Table 2b												0.5400 (49)
Enter (49) or (54) in (55)												1.0530 (55)
Total storage loss	32.6430	29.4840	32.6430	31.5900	32.6430	31.5900	32.6430	32.6430	31.5900	32.6430	31.5900	32.6430 (56)
If cylinder contains dedicated solar storage	20.9848	18.9540	20.9848	20.3079	20.9848	20.3079	20.9848	20.9848	20.3079	20.9848	20.3079	20.9848 (57)
Primary loss	23.2624	21.0112	21.8667	15.7584	10.4681	9.9053	10.2355	11.1660	17.1091	21.8667	22.5120	23.2624 (59)
Total heat required for water heating calculated for each month	214.9452	189.2588	196.9090	170.3774	160.3276	141.4222	134.2718	150.4039	157.0825	182.3101	195.0498	209.5591 (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												1190.5240 (H5)
Overshading factor												0.8000 (H6)
Solar energy available												2000.0804 (H7)
Adjustment factor for showers												1.0000 (H7a)
Solar-to-load ratio												1.2148 (H8)
Utilisation factor												0.5610 (H9)
Collector performance factor												0.8793 (H10)
Dedicated solar storage volume												75.0000 (H11)
Effective solar volume												115.5000 (H13)
Daily hot water demand												104.6413 (H14)
Volume ratio Veff/V												1.1038 (H15)
Solar storage volume factor												1.0000 (H16)
Solar input												-986.5440 (H17)
Solar input	-32.7091	-46.5045	-79.1633	-106.4924	-124.6877	-133.4012	-129.2509	-115.8842	-91.4099	-63.3544	-37.7854	-25.9009 (63)
												Solar input (sum of months) = Sum(63)m = -986.5440 (63)
Output from w/h	182.2361	142.7542	117.7457	63.8850	35.6399	8.0210	5.0209	34.5197	65.6726	118.9556	157.2644	183.6582 (64)
												Total per year (kWh/year) = Sum(64)m = 1115.3735 (64)
Heat gains from water heating, kWh/month	92.1548	81.6123	85.5053	73.5115	68.0131	61.1475	59.2408	65.0398	69.7224	80.6511	84.8724	90.3640 (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	177.9569	177.9569	177.9569	177.9569	177.9569	177.9569	177.9569	177.9569	177.9569	177.9569	177.9569	177.9569 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	78.9637	70.1349	57.0375	43.1811	32.2784	27.2508	29.4454	38.2743	51.3716	65.2281	76.1308	81.1584 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	513.6137	518.9434	505.5127	476.9204	440.8277	406.9057	384.2437	378.9140	392.3447	420.9370	457.0297	490.9517 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	55.7616	55.7616	55.7616	55.7616	55.7616	55.7616	55.7616	55.7616	55.7616	55.7616	55.7616	55.7616 (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)	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380	-118.6380 (71)
Water heating gains (Table 5)	123.8640	121.4468	114.9265	102.0992	91.4155	84.9271	79.6248	87.4191	96.8366	108.4021	117.8783	121.4569 (72)
Total internal gains	831.5221	825.6058	792.5574	737.2814	679.6022	634.1642	608.3945	619.6879	655.6335	709.6478	766.1194	808.6477 (73)

#### 6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W						
Northeast	3.7800	14.6223	0.6300	0.7000	0.7700	16.8920 (75)						
Southeast	10.7200	45.2918	0.6300	0.7000	0.7700	148.3836 (77)						
Southwest	1.3400	45.2918	0.6300	0.7000	0.7700	18.5479 (79)						
Northwest	11.6100	14.6223	0.6300	0.7000	0.7700	51.8825 (81)						
North	1.8000	34.0000	0.6300	0.7000	1.0000	24.2903 (82)						
Solar gains	259.9962	404.6861	623.4369	887.8836	1035.3728	1161.4125	1082.0321	946.1665	749.4001	497.0547	309.0510	206.8899 (83)
Total gains	1091.5183	1230.2919	1415.9943	1625.1650	1714.9750	1795.5767	1690.4266	1565.8544	1405.0336	1206.7024	1075.1704	1015.5376 (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	29.1405	29.3101	29.2548	29.3642	29.4171	29.5679	29.5679	29.6156	29.6156	29.5189	29.5679	29.3642
alpha	2.9427	2.9540	2.9503	2.9576	2.9611	2.9712	2.9712	2.9744	2.9744	2.9679	2.9712	2.9576
util living area												

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	0.9771	0.9660	0.9376	0.8742	0.7627	0.5767	0.4205	0.4702	0.7200	0.9016	0.9628	0.9809 (86)
MIT	19.3881	19.5570	19.8742	20.2663	20.6061	20.8191	20.8849	20.8747	20.7238	20.3073	19.8005	19.3567 (87)
Th 2	19.8725	19.8783	19.8764	19.8801	19.8819	19.8870	19.8870	19.8885	19.8885	19.8853	19.8870	19.8801 (88)
util rest of house												
	0.9725	0.9592	0.9246	0.8467	0.7076	0.4839	0.2964	0.3430	0.6382	0.8734	0.9539	0.9770 (89)
MIT 2	17.7334	17.9814	18.4354	18.9877	19.4406	19.6886	19.7448	19.7408	19.5980	19.0612	18.3426	17.6933 (90)
Living area fraction									fLA = Living area / (4) =			0.1137 (91)
MIT	17.9216	18.1606	18.5991	19.1331	19.5731	19.8172	19.8745	19.8697	19.7260	19.2029	18.5084	17.8825 (92)
Temperature adjustment												0.0000
adjusted MIT	17.9216	18.1606	18.5991	19.1331	19.5731	19.8172	19.8745	19.8697	19.7260	19.2029	18.5084	17.8825 (93)

#### 8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9612	0.9448	0.9051	0.8242	0.6901	0.4775	0.2949	0.3407	0.6243	0.8512	0.9386	0.9671	(94)
Useful gains	1049.1376	1162.3454	1281.6331	1339.4837	1183.4330	857.4492	498.4820	533.4421	877.1574	1027.0944	1009.1317	982.0810	(95)
Ext temp.	5.0000	5.6000	7.3000	9.7000	12.7000	15.5000	17.5000	17.3000	14.9000	11.5000	8.0000	5.0000	(96)
Heat loss rate W	2808.3096	2714.0671	2446.0900	2034.5335	1479.7274	924.7117	508.5926	549.5287	1032.0421	1652.6438	2250.8272	2778.4888	(97)
Month fracti	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	0.0000	1.0000	1.0000	1.0000	(97a)
Space heating kWh	1308.8240	1042.7570	866.3559	500.4358	220.4430	0.0000	0.0000	0.0000	0.0000	465.4087	894.0207	1336.5274	(98)
Space heating												6634.7725	(98)
Space heating per m2												(98) / (4) =	38.4558 (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)													0.1000 (201)
Fraction of space heat from main system(s)													0.9000 (202)
Efficiency of main space heating system 1 (in %)													90.7000 (206)
Efficiency of secondary/supplementary heating system, %													65.0000 (208)
Space heating requirement													6583.5670 (211)
Space heating requirement	1308.8240	1042.7570	866.3559	500.4358	220.4430	0.0000	0.0000	0.0000	0.0000	465.4087	894.0207	1336.5274	(98)
Space heating efficiency (main heating system 1)	90.7000	90.7000	90.7000	90.7000	90.7000	0.0000	0.0000	0.0000	0.0000	90.7000	90.7000	90.7000	(210)
Space heating fuel (main heating system)	1298.7228	1034.7093	859.6696	496.5736	218.7417	0.0000	0.0000	0.0000	0.0000	461.8168	887.1209	1326.2124	(211)
Water heating requirement	201.3575	160.4242	133.2855	76.9901	33.9143	0.0000	0.0000	0.0000	0.0000	71.6013	137.5417	205.6196	(215)
Water heating requirement	182.2361	142.7542	117.7457	63.8850	35.6399	8.0210	5.0209	34.5197	65.6726	118.9556	157.2644	183.6582	(64)
Efficiency of water heater (217)m	89.1033	89.1261	89.1359	89.2177	88.8895	80.0000	80.0000	80.0000	80.0000	88.0939	88.7590	89.1211	(217)
Fuel for water heating, kWh/month	204.5223	160.1710	132.0969	71.6058	40.0946	10.0263	6.2762	43.1496	82.0908	135.0327	177.1813	206.0771	(219)
Water heating fuel used												1268.3245	(219)
Annual totals kWh/year													
Space heating fuel - main system													6583.5670 (211)
Space heating fuel - secondary													1020.7342 (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)													557.8098 (232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.80 * 1139 * 1.00) =										-2551.5583			-2551.5583 (233)
Total delivered energy for all uses													7003.8773 (238)

#### 10a. Fuel costs - using BEDF prices (512)

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	6583.5670	9.7400	641.2394	(240)
Space heating - secondary	1020.7342	10.2500	104.6253	(242)
Water heating (other fuel)	1268.3245	9.7400	123.5348	(247)
Pumps and fans for heating	75.0000	36.8500	27.6375	(249)
Pump for solar water heating	50.0000	36.8500	18.4250	(249)
Energy for lighting	557.8098	36.8500	205.5529	(250)
Additional standing charges			104.0000	(251)
Energy saving/generation technologies				
PV Unit	-2551.5583	36.8500	-940.2492	(252)
Total energy cost			284.7657	(255)

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

### CALCULATION OF EPC COSTS, EMISSIONS AND PRIMARY ENERGY 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	6583.5670	0.2160	1422.0505 (261)
Space heating - secondary	1020.7342	0.0190	19.3940 (263)
Water heating (other fuel)	1268.3245	0.2160	273.9581 (264)
Space and water heating			1715.4025 (265)
Pumps and fans	125.0000	0.5190	64.8750 (267)
Energy for lighting	557.8098	0.5190	289.5033 (268)
Energy saving/generation technologies			
PV Unit	-2551.5583	0.5190	-1324.2587 (269)
<b>Total kg/year</b>			<b>745.5221 (272)</b>

#### 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	6583.5670	1.2200	8031.9517 (261)
Space heating - secondary	1020.7342	1.0400	1061.5636 (263)
Water heating (other fuel)	1268.3245	1.2200	1547.3559 (264)
Space and water heating			10640.8713 (265)
Pumps and fans	125.0000	3.0700	383.7500 (267)
Energy for lighting	557.8098	3.0700	1712.4761 (268)
Energy saving/generation technologies			
PV Unit	-2551.5583	3.0700	-7833.2839 (269)
Primary energy kWh/year			4903.8135 (272)
Primary energy kWh/m2/year			28.4230 (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	Yes
SAP Region	Southern England
Front of dwelling faces	North West
Overshading	Average or unknown
Thermal mass parameter	132.1 (calculated from construction elements)
Night ventilation	Yes
Ventilation rate during hot weather (ach)	8.00 (Windows fully open)

#### Overheating Calculation

Summer ventilation heat loss coefficient	1177.14 (P1)
Transmission heat loss coefficient	134.84 (37)
Summer heat loss coefficient	1311.98 (P2)

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

Solar shading	Z blinds	Solar access	Z overhangs	Z summer
Orientation				
North	1.000	1.00	1.000	1.000 (P8)
North East	1.000	0.90	1.000	0.900 (P8)
South East	1.000	0.90	1.000	0.900 (P8)
South West	1.000	0.90	1.000	0.900 (P8)
North West	1.000	0.90	1.000	0.900 (P8)

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
North East	3.7800	106.0502	0.6300	0.7000	0.9000	143.1947
South East	10.7200	127.3119	0.6300	0.7000	0.9000	487.5142
South West	1.3400	127.3119	0.6300	0.7000	0.9000	60.9393
North West	11.6100	106.0502	0.6300	0.7000	0.9000	439.8123
North	1.8000	217.0000	0.6300	0.7000	1.0000	155.0291

total: 1286.4896

	Jun	Jul	Aug	
Solar gains	1389	1286	1120	(P3)
Internal gains	661	635	645	
<b>Total summer gains</b>	<b>2050</b>	<b>1921</b>	<b>1765</b>	<b>(P5)</b>
Summer gain/loss ratio	1.56	1.46	1.35	(P6)
Summer external temperature	15.40	17.30	17.30	

# FULL SAP CALCULATION PRINTOUT

## Calculation Type: New Build (As Designed)

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

Thermal mass temperature increment (TMP = 132.1)	1.07	1.07	1.07	
Threshold temperature	18.04	19.84	19.72	(P7)
Likelihood of high internal temperature	Not significant	Not significant	Not significant	
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Assessment of likelihood of high internal temperature:	Not significant			
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# PREDICTED ENERGY ASSESSMENT

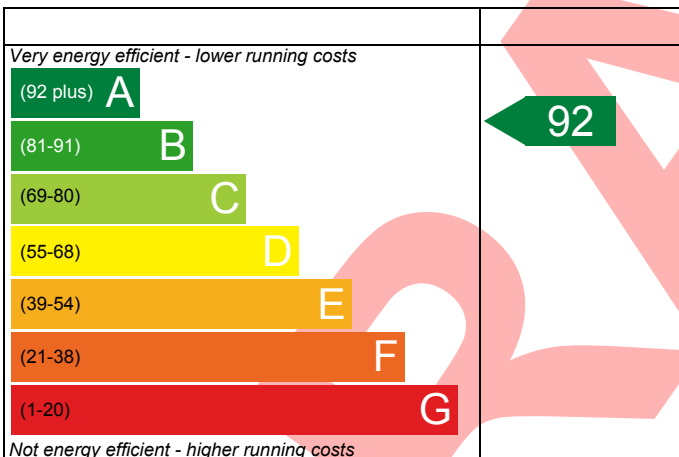
Tree House, Larg Drive,  
Winchester,  
Hampshire,  
SO22 6NU

Dwelling type: House, Semi-Detached  
Date of assessment: 01/03/2023  
Produced by: Scott Spearing  
Total floor area: 172.53 m<sup>2</sup>

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<sub>2</sub>) emissions.

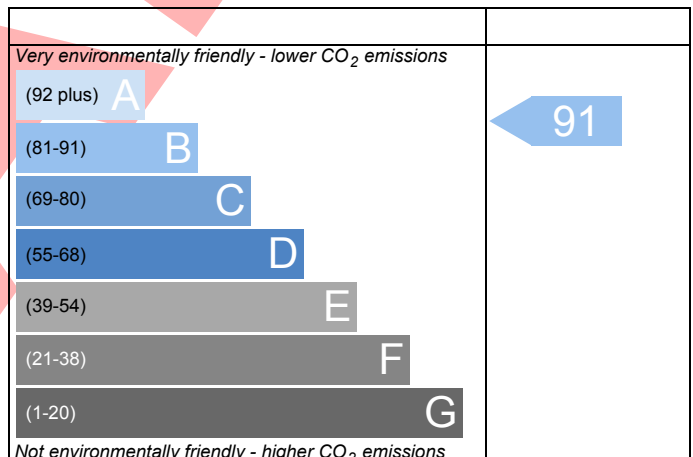
## Energy Efficiency Rating



**England** EU Directive 2002/91/EC

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

## Environmental Impact (CO<sub>2</sub>) Rating



**England** EU Directive 2002/91/EC

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO<sub>2</sub>) emissions. The higher the rating the less impact it has on the environment.

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