NYMNPA

22/10/2020

From: Michael Clements [
Sent: 22 October 2020 15:40
To: Ailsa Teasdale
Cc: Niall Roberts; Planning
Subject: RE: NYM/2020/0702/FL

Dear Ailsa

Further to the attached letter dated 23/09 (attached for reference) and the Council's request for further information relating to NYM Local Plan Policy ENV 8, I have sent you via wetransfer a link containing the following documents:

- A completed version of the form contained within the Authority's Renewable Energy Supplementary Planning Document Section 7 Appendix 4 relating to each of the proposed Woodland Rooms
- SAP Calculations (zip file)
- Summary document 'Woodland View-AG-73940-DS-Rev A v4'

The energy consultant has confirmed that each of the rooms has met the 10% betterment figure over standard Part L, as demonstrated by the attached documents.

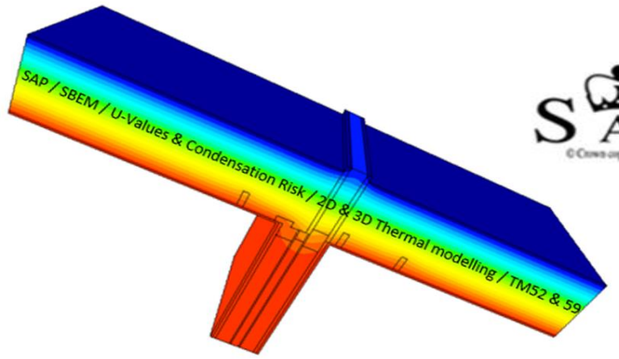
I trust that this information is sufficient in relation to the Council's request. Please do let me know should you have any trouble accessing the link or require any further information.

I would be grateful if you could please confirm receipt of these documents. Thanks.

Kind Regards

Michael Clements
Planner

Anderson Goddard Ltd



Site	Woodland View	Assessor	Paul Goddard
Client	Energy Unique	Accreditation	EES/05113
Date	07/10/2020	Tel	0161-775-7770
Ref	AG-73940-Design-Rev A	Web	www.andersongoddard.com
Drawing ref	RTWT-HMA-08	email	Info@andersongoddard.com

Thermal Values				Thermal Mass	Kappa
Ground Floor Exposed		0.20	W/m²K	Suspended	75
Upper floor			W/m²K	Timber	18
Main wall		0.23	W/m²K	Timber	9
Party walls	Filled and sealed cavity	0.00	W/m²K	Timber	20
Roof Flat (FL)		0.18	W/m²K	Timber, plaster board	9
Windows	Double glazed Hard coat g-Value 0.72	1.40	W/m²K		
Doors		1.40	W/m²K		

Heating, Ventilation, LZC etc.				Comments
Air permeability		5.00	m³	
Thermal Bridging	K1 Accredited Details	variable	Y-Value	
LE lights	Minimum of 100%	100	%	
Heating	Air to Water Heat Pump		%	
Domestic Hot Water (DHW)	from main system			
Emitter	Radiators			
Controls	Programmer, Room thermostats and TRV's			
Ventilation	Part F, System 1, Intermittent Fans			
Secondary heating	None			
LZC	None			
Appendix G (FGHRS / WWHRS)	None			
Appendix Q (other Tech)	None			
Overheating	Assumed, Windows can be fully opened and Cross Ventilation is possible			

Property details			AD.L1a 2013 Criterion 1 & CfSH input data										Block Compliance				M & E		Low or Zero Carbon Technologies (LZC)							
Plot N°	Front Orient	Det	GIFA	DER	TER	DER / TER %	DER =< TER	DFEE	TFEE	DFEE / TFEE %	DFEE =< TFEE	SAP Rating	EI Rating	DER x TFA	TER x TFA	DFEE x TFA	TFEE x TFA	Heating	Ventilation	Orientation	Roof Angle	Min PV Kw Peak	No Panels	Panel size watts	* ASR	Actual PV Peak	* Yield PA
Woodlands Room 1	SE	Det	35.37	38.61	43.57	11.38%	PASS	84.35	85.87	1.77%	PASS	76	78	1365.64	1541.07	2983.46	3037.22	ASHP	System 1	-	-	-	-	-	-	-	-
Woodlands Room 2	SE	Det	35.37	38.61	43.57	11.38%	PASS	84.35	85.87	1.77%	PASS	76	78	1365.64	1541.07	2983.46	3037.22	ASHP	System 1	-	-	-	-	-	-	-	-
Woodlands Room 3	South	Det	35.37	38.61	43.57	11.38%	PASS	84.35	85.87	1.77%	PASS	76	78	1365.64	1541.07	2983.46	3037.22	ASHP	System 1	-	-	-	-	-	-	-	-
Woodlands Room 4	East	Det	35.37	39.94	44.70	10.64%	PASS	88.13	89.61	1.65%	PASS	75	78	1412.68	1581.04	3117.16	3169.51	ASHP	System 1	-	-	-	-	-	-	-	-
Woodlands Room 5	East	Semi	35.37	35.10	41.12	14.64%	PASS	76.66	77.55	1.14%	PASS	78	80	1241.49	1454.41	2711.46	2742.94	ASHP	System 1	-	-	-	-	-	-	-	-
Woodlands Room 6	East	Semi	35.37	35.10	41.12	14.64%	PASS	76.66	77.55	1.14%	PASS	78	80	1241.49	1454.41	2711.46	2742.94	ASHP	System 1	-	-	-	-	-	-	-	-
Woodlands Room 7	East	Semi	35.37	35.14	40.98	14.25%	PASS	76.81	77.07	0.33%	PASS	78	80	1242.90	1449.46	2716.77	2725.97	ASHP	System 1	-	-	-	-	-	-	-	-
Woodlands Room 8	East	Semi	35.37	38.15	43.60	12.50%	PASS	85.89	85.92	0.03%	PASS	76	79	1349.37	1542.13	3037.93	3038.99	ASHP	System 1	-	-	-	-	-	-	-	-
Woodlands Room 9	West	Semi	35.37	34.93	40.90	14.59%	PASS	76.30	76.91	0.79%	PASS	78	80	1235.47	1446.63	2698.73	2720.31	ASHP	System 1	-	-	-	-	-	-	-	-
Woodlands Room 10	West	Semi	35.37	34.93	40.90	14.59%	PASS	76.30	76.91	0.79%	PASS	78	80	1235.47	1446.63	2698.73	2720.31	ASHP	System 1	-	-	-	-	-	-	-	-
Woodlands Room 11	West	Semi	35.37	34.23	40.09	14.61%	PASS	73.97	74.10	0.17%	PASS	79	81	1210.72	1417.98	2616.32	2620.92	ASHP	System 1	-	-	-	-	-	-	-	-
Woodlands Room 12	West	Semi	35.37	34.23	40.09	14.61%	PASS	73.97	74.10	0.17%	PASS	79	81	1210.72	1417.98	2616.32	2620.92	ASHP	System 1	-	-	-	-	-	-	-	-

Rev	Date	Description

APPENDIX 4 CALCULATING THE 10% REQUIREMENT

See Section 7 for detailed guidance on how to undertake the calculations.

Stage 1. Work out the annual CO_2 emissions of the buildings

Complete either calculations 1, 2, 3 or 4

1. Calculations where there is no Standard Assessment Procedure or Simplified Building Energy Model data

Where there is more than one type of building you will need to undertake this calculation separately for each building type.

Building type 1:	Annual benchmark CO_2 emissions per m^2 **(a)**		$kgCO_2/yr$
	x floor area **(b)**		m^2
	= annual CO_2 emissions **(c)**		$kgCO_2/yr$
Building type 2:	Annual benchmark CO_2 emissions per m^2 **(a)**		$kgCO_2/yr$
	x floor area **(b)**		m^2
	= annual CO_2 emissions **(c)**		$kgCO_2/yr$
Building type 3:	Annual benchmark CO_2 emissions per m^2 **(a)**		$kgCO_2/yr$
	x floor area **(b)**		m^2
	= annual CO_2 emissions **(c)**		$kgCO_2/yr$
	Total CO_2 emissions **(c) + (c) + (c) = (d)**		$kgCO_2/yr$

OR

2. Annual CO_2 emissions from SAP assessment

Target figure

CO_2 emissions **(d)** 1,542 $kgCO_2/yr$

OR

3. Annual CO_2 emissions from SBEM assessment

CO_2 emissions **(d)** $kgCO_2/yr$

OR

4. Annual CO_2 emissions from Act on CO_2 website

CO_2 emissions **(d)** $kgCO_2/yr$

Stage 2. Work out 10% of the annual CO_2 emissions

10% of CO_2 emissions **((d)/100) x 10 = (e)** 154 $kgCO_2/yr$

Stage 3. Select the renewable technology (or technologies) you wish to incorporate and work out the annual CO_2 savings

Electricity generating technologies

Electricity generating renewable energy **(f)** kWh/yr

x 0.422[21] **(g)** $kgCO_2/yr$

Heat generating technologies

ASHP + efficient fans + lighting

Heat generating renewable energy **(h)** kWh/yr

Actual figure

x 0.194 or **x** 0.265[22] **(i)** 1,365 $kgCO_2/yr$

[21] Standard conversion factor for kWh electricity to $kgCO_2$
[22] Standard conversion factors - use x 0.194 if displacing gas or x 0.265 if displacing oil

(1,542-1,365)

Total CO_2 savings **(g) + (i) = (j)** 177 $kgCO_2/yr$

Stage 4. Check that your chosen technology will provide enough CO_2 savings

(j) should be equal to or greater than **(e)** to ensure that at least 10% of predicted CO_2 emissions are offset through renewable energy.

(177÷1,542)x100%

% of CO_2 emissions which will be offset by renewable energy **(j) / (d)** 11 %

If this figure is less than 10%, look at increasing the size / capacity of the installation, try other technologies or look at using a mix of technologies.

APPENDIX 4 CALCULATING THE 10% REQUIREMENT

See Section 7 for detailed guidance on how to undertake the calculations.

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Building type 1:			
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	x floor area **(b)**		m^2
	= annual CO_2 emissions **(c)**		$kgCO_2/yr$
Building type 2:			
	Annual benchmark CO_2 emissions per m^2 **(a)**		$kgCO_2/yr$
	x floor area **(b)**		m^2
	= annual CO_2 emissions **(c)**		$kgCO_2/yr$
Building type 3:			
	Annual benchmark CO_2 emissions per m^2 **(a)**		$kgCO_2/yr$
	x floor area **(b)**		m^2
	= annual CO_2 emissions **(c)**		$kgCO_2/yr$
	Total CO_2 emissions **(c) + (c) + (c) = (d)**		$kgCO_2/yr$

OR

2. Annual CO_2 emissions from SAP assessment

Target figure

CO_2 emissions **(d)** 1,542 $kgCO_2/yr$

OR

3. Annual CO_2 emissions from SBEM assessment

CO_2 emissions **(d)** $kgCO_2/yr$

OR

4. Annual CO_2 emissions from Act on CO_2 website

CO_2 emissions **(d)** $kgCO_2/yr$

Stage 2. Work out 10% of the annual CO_2 emissions

10% of CO_2 emissions **((d)/100) x 10 = (e)** 154 $kgCO_2/yr$

Stage 3. Select the renewable technology (or technologies) you wish to incorporate and work out the annual CO_2 savings

Electricity generating technologies

Electricity generating renewable energy **(f)** kWh/yr

x 0.422[21] **(g)** $kgCO_2/yr$

Heat generating technologies

ASHP + efficient fans + lighting

Heat generating renewable energy **(h)** kWh/yr

Actual figure

x 0.194 or **x** 0.265[22] **(i)** 1,365 $kgCO_2/yr$

[21] Standard conversion factor for kWh electricity to $kgCO_2$
[22] Standard conversion factors - use x 0.194 if displacing gas or x 0.265 if displacing oil

(1,542-1,365)

Total CO_2 savings **(g) + (i) = (j)** 177 $kgCO_2/yr$

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(177÷1,542)x100%

% of CO_2 emissions which will be offset by renewable energy **(j) / (d)** 11 %

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APPENDIX 4 CALCULATING THE 10% REQUIREMENT

See Section 7 for detailed guidance on how to undertake the calculations.

Stage 1. Work out the annual CO_2 emissions of the buildings

Complete either calculations 1, 2, 3 or 4

1. Calculations where there is no Standard Assessment Procedure or Simplified Building Energy Model data

Where there is more than one type of building you will need to undertake this calculation separately for each building type.

Building type 1:	Annual benchmark CO_2 emissions per m^2 **(a)**		$kgCO_2/yr$
	x floor area **(b)**		m^2
	= annual CO_2 emissions **(c)**		$kgCO_2/yr$
Building type 2:	Annual benchmark CO_2 emissions per m^2 **(a)**		$kgCO_2/yr$
	x floor area **(b)**		m^2
	= annual CO_2 emissions **(c)**		$kgCO_2/yr$
Building type 3:	Annual benchmark CO_2 emissions per m^2 **(a)**		$kgCO_2/yr$
	x floor area **(b)**		m^2
	= annual CO_2 emissions **(c)**		$kgCO_2/yr$
	Total CO_2 emissions **(c) + (c) + (c) = (d)**		$kgCO_2/yr$

OR

2. Annual CO_2 emissions from SAP assessment

Target figure

CO_2 emissions **(d)** 1,542 $kgCO_2/yr$

OR

3. Annual CO_2 emissions from SBEM assessment

CO_2 emissions **(d)** $kgCO_2/yr$

OR

4. Annual CO_2 emissions from Act on CO_2 website

CO_2 emissions **(d)** $kgCO_2/yr$

Stage 2. Work out 10% of the annual CO_2 emissions

10% of CO_2 emissions **((d)/100) x 10 = (e)** 154 $kgCO_2/yr$

Stage 3. Select the renewable technology (or technologies) you wish to incorporate and work out the annual CO_2 savings

Electricity generating technologies

Electricity generating renewable energy **(f)** kWh/yr

x 0.422[21] **(g)** $kgCO_2/yr$

Heat generating technologies

ASHP + efficient fans + lighting

Heat generating renewable energy **(h)** kWh/yr

Actual figure

x 0.194 or **x** 0.265[22] **(i)** 1,365 $kgCO_2/yr$

[21] Standard conversion factor for kWh electricity to $kgCO_2$
[22] Standard conversion factors - use x 0.194 if displacing gas or x 0.265 if displacing oil

(1,542-1,365)

Total CO_2 savings **(g) + (i) = (j)** 177 $kgCO_2/yr$

Stage 4. Check that your chosen technology will provide enough CO_2 savings

(j) should be equal to or greater than **(e)** to ensure that at least 10% of predicted CO_2 emissions are offset through renewable energy.

(177÷1,542)x100%

% of CO_2 emissions which will be offset by renewable energy **(j) / (d)** 11 %

If this figure is less than 10%, look at increasing the size / capacity of the installation, try other technologies or look at using a mix of technologies.

APPENDIX 4 CALCULATING THE 10% REQUIREMENT

See Section 7 for detailed guidance on how to undertake the calculations.

Stage 1. Work out the annual CO_2 emissions of the buildings

Complete either calculations 1, 2, 3 or 4

1. Calculations where there is no Standard Assessment Procedure or Simplified Building Energy Model data

Where there is more than one type of building you will need to undertake this calculation separately for each building type.

Building type 1:	Annual benchmark CO_2 emissions per m^2 **(a)**		$kgCO_2/yr$
	x floor area **(b)**		m^2
	= annual CO_2 emissions **(c)**		$kgCO_2/yr$
Building type 2:	Annual benchmark CO_2 emissions per m^2 **(a)**		$kgCO_2/yr$
	x floor area **(b)**		m^2
	= annual CO_2 emissions **(c)**		$kgCO_2/yr$
Building type 3:	Annual benchmark CO_2 emissions per m^2 **(a)**		$kgCO_2/yr$
	x floor area **(b)**		m^2
	= annual CO_2 emissions **(c)**		$kgCO_2/yr$
	Total CO_2 emissions **(c) + (c) + (c) = (d)**		$kgCO_2/yr$

OR

2. Annual CO_2 emissions from SAP assessment

Target figure

CO_2 emissions **(d)** 1,582 $kgCO_2/yr$

OR

3. Annual CO_2 emissions from SBEM assessment

CO_2 emissions **(d)** $kgCO_2/yr$

OR

4. Annual CO_2 emissions from Act on CO_2 website

CO_2 emissions **(d)** $kgCO_2/yr$

Stage 2. Work out 10% of the annual CO_2 emissions

10% of CO_2 emissions **((d)/100) x 10 = (e)** 158 $kgCO_2/yr$

Stage 3. Select the renewable technology (or technologies) you wish to incorporate and work out the annual CO_2 savings

Electricity generating technologies

Electricity generating renewable energy **(f)** kWh/yr

x 0.422[21] **(g)** $kgCO_2/yr$

Heat generating technologies

ASHP + efficient fans + lighting

Heat generating renewable energy **(h)** kWh/yr

Actual figure

x 0.194 or **x** 0.265[22] **(i)** 1,413 $kgCO_2/yr$

[21] Standard conversion factor for kWh electricity to $kgCO_2$
[22] Standard conversion factors - use x 0.194 if displacing gas or x 0.265 if displacing oil

(1,582-1,412)

Total CO_2 savings **(g) + (i) = (j)** 170 $kgCO_2/yr$

Stage 4. Check that your chosen technology will provide enough CO_2 savings

(j) should be equal to or greater than **(e)** to ensure that at least 10% of predicted CO_2 emissions are offset through renewable energy.

(170÷1,582)x100%

% of CO_2 emissions which will be offset by renewable energy **(j) / (d)** 10.7 %

If this figure is less than 10%, look at increasing the size / capacity of the installation, try other technologies or look at using a mix of technologies.

APPENDIX 4 CALCULATING THE 10% REQUIREMENT

See Section 7 for detailed guidance on how to undertake the calculations.

Stage 1. Work out the annual CO_2 emissions of the buildings

Complete either calculations 1, 2, 3 or 4

1. Calculations where there is no Standard Assessment Procedure or Simplified Building Energy Model data

Where there is more than one type of building you will need to undertake this calculation separately for each building type.

Building type 1:	Annual benchmark CO_2 emissions per m^2 **(a)**		$kgCO_2/yr$
	x floor area **(b)**		m^2
	= annual CO_2 emissions **(c)**		$kgCO_2/yr$
Building type 2:	Annual benchmark CO_2 emissions per m^2 **(a)**		$kgCO_2/yr$
	x floor area **(b)**		m^2
	= annual CO_2 emissions **(c)**		$kgCO_2/yr$
Building type 3:	Annual benchmark CO_2 emissions per m^2 **(a)**		$kgCO_2/yr$
	x floor area **(b)**		m^2
	= annual CO_2 emissions **(c)**		$kgCO_2/yr$
	Total CO_2 emissions **(c) + (c) + (c) = (d)**		$kgCO_2/yr$

OR

2. Annual CO_2 emissions from SAP assessment

Target figure

CO_2 emissions **(d)** 1,455 $kgCO_2/yr$

OR

3. Annual CO_2 emissions from SBEM assessment

CO_2 emissions **(d)** $kgCO_2/yr$

OR

4. Annual CO_2 emissions from Act on CO_2 website

CO_2 emissions **(d)** $kgCO_2/yr$

Stage 2. Work out 10% of the annual CO_2 emissions

10% of CO_2 emissions **((d)/100) x 10 = (e)** 145 $kgCO_2/yr$

Stage 3. Select the renewable technology (or technologies) you wish to incorporate and work out the annual CO_2 savings

Electricity generating technologies

Electricity generating renewable energy **(f)** kWh/yr

x 0.422[21] **(g)** $kgCO_2/yr$

Heat generating technologies

ASHP + efficient fans + lighting

Heat generating renewable energy **(h)** kWh/yr

Actual figure

x 0.194 or **x** 0.265[22] **(i)** 1,242 $kgCO_2/yr$

[21] Standard conversion factor for kWh electricity to $kgCO_2$
[22] Standard conversion factors - use x 0.194 if displacing gas or x 0.265 if displacing oil

(1,455-1,242)

Total CO_2 savings **(g) + (i) = (j)** 213 $kgCO_2/yr$

Stage 4. Check that your chosen technology will provide enough CO_2 savings

(j) should be equal to or greater than **(e)** to ensure that at least 10% of predicted CO_2 emissions are offset through renewable energy.

(213÷1,455)x100%

% of CO_2 emissions which will be offset by renewable energy **(j) / (d)** 14.6 %

If this figure is less than 10%, look at increasing the size / capacity of the installation, try other technologies or look at using a mix of technologies.

APPENDIX 4 CALCULATING THE 10% REQUIREMENT

See Section 7 for detailed guidance on how to undertake the calculations.

Stage 1. Work out the annual CO_2 emissions of the buildings

Complete either calculations 1, 2, 3 or 4

1. Calculations where there is no Standard Assessment Procedure or Simplified Building Energy Model data

Where there is more than one type of building you will need to undertake this calculation separately for each building type.

Building type 1:	Annual benchmark CO_2 emissions per m^2 **(a)**		$kgCO_2/yr$
	x floor area **(b)**		m^2
	= annual CO_2 emissions **(c)**		$kgCO_2/yr$
Building type 2:	Annual benchmark CO_2 emissions per m^2 **(a)**		$kgCO_2/yr$
	x floor area **(b)**		m^2
	= annual CO_2 emissions **(c)**		$kgCO_2/yr$
Building type 3:	Annual benchmark CO_2 emissions per m^2 **(a)**		$kgCO_2/yr$
	x floor area **(b)**		m^2
	= annual CO_2 emissions **(c)**		$kgCO_2/yr$
	Total CO_2 emissions **(c) + (c) + (c) = (d)**		$kgCO_2/yr$

OR

2. Annual CO_2 emissions from SAP assessment

Target figure

CO_2 emissions **(d)** 1,455 $kgCO_2/yr$

OR

3. Annual CO_2 emissions from SBEM assessment

CO_2 emissions **(d)** $kgCO_2/yr$

OR

4. Annual CO_2 emissions from Act on CO_2 website

CO_2 emissions **(d)** $kgCO_2/yr$

Stage 2. Work out 10% of the annual CO_2 emissions

10% of CO_2 emissions **((d)/100) x 10 = (e)** 145 $kgCO_2/yr$

Stage 3. Select the renewable technology (or technologies) you wish to incorporate and work out the annual CO_2 savings

Electricity generating technologies

Electricity generating renewable energy **(f)** kWh/yr

x 0.422[21] **(g)** $kgCO_2/yr$

Heat generating technologies

ASHP + efficient fans + lighting

Heat generating renewable energy **(h)** kWh/yr

Actual figure

x 0.194 or **x** 0.265[22] **(i)** 1,242 $kgCO_2/yr$

[21] Standard conversion factor for kWh electricity to $kgCO_2$
[22] Standard conversion factors - use x 0.194 if displacing gas or x 0.265 if displacing oil

(1,455-1,242)

Total CO_2 savings **(g) + (i) = (j)** 213 $kgCO_2/yr$

Stage 4. Check that your chosen technology will provide enough CO_2 savings

(j) should be equal to or greater than **(e)** to ensure that at least 10% of predicted CO_2 emissions are offset through renewable energy.

(213÷1,455)x100%

% of CO_2 emissions which will be offset by renewable energy **(j) / (d)** 14.6 %

If this figure is less than 10%, look at increasing the size / capacity of the installation, try other technologies or look at using a mix of technologies.

APPENDIX 4 CALCULATING THE 10% REQUIREMENT

See Section 7 for detailed guidance on how to undertake the calculations.

Stage 1. Work out the annual CO_2 emissions of the buildings

Complete either calculations 1, 2, 3 or 4

1. Calculations where there is no Standard Assessment Procedure or Simplified Building Energy Model data

Where there is more than one type of building you will need to undertake this calculation separately for each building type.

Building type 1:	Annual benchmark CO_2 emissions per m^2 **(a)**		$kgCO_2/yr$
	x floor area **(b)**		m^2
	= annual CO_2 emissions **(c)**		$kgCO_2/yr$
Building type 2:	Annual benchmark CO_2 emissions per m^2 **(a)**		$kgCO_2/yr$
	x floor area **(b)**		m^2
	= annual CO_2 emissions **(c)**		$kgCO_2/yr$
Building type 3:	Annual benchmark CO_2 emissions per m^2 **(a)**		$kgCO_2/yr$
	x floor area **(b)**		m^2
	= annual CO_2 emissions **(c)**		$kgCO_2/yr$
	Total CO_2 emissions **(c) + (c) + (c) = (d)**		$kgCO_2/yr$

OR

2. Annual CO_2 emissions from SAP assessment

Target figure

CO_2 emissions **(d)** 1,450 $kgCO_2/yr$

OR

3. Annual CO_2 emissions from SBEM assessment

CO_2 emissions **(d)** $kgCO_2/yr$

OR

4. Annual CO_2 emissions from Act on CO_2 website

CO_2 emissions **(d)** $kgCO_2/yr$

Stage 2. Work out 10% of the annual CO_2 emissions

10% of CO_2 emissions **((d)/100) x 10 = (e)** 145 $kgCO_2/yr$

Stage 3. Select the renewable technology (or technologies) you wish to incorporate and work out the annual CO_2 savings

Electricity generating technologies

Electricity generating renewable energy **(f)** kWh/yr

x 0.422[21] **(g)** $kgCO_2/yr$

Heat generating technologies

ASHP + efficient fans + lighting

Heat generating renewable energy **(h)** kWh/yr

Actual figure

x 0.194 or **x** 0.265[22] **(i)** 1,243 $kgCO_2/yr$

[21] Standard conversion factor for kWh electricity to $kgCO_2$
[22] Standard conversion factors - use x 0.194 if displacing gas or x 0.265 if displacing oil

(1,450-1,243)

Total CO_2 savings **(g) + (i) = (j)** 207 $kgCO_2/yr$

Stage 4. Check that your chosen technology will provide enough CO_2 savings

(j) should be equal to or greater than **(e)** to ensure that at least 10% of predicted CO_2 emissions are offset through renewable energy.

(207÷1,450)x100%

% of CO_2 emissions which will be offset by renewable energy **(j) / (d)** 14.3 %

If this figure is less than 10%, look at increasing the size / capacity of the installation, try other technologies or look at using a mix of technologies.

APPENDIX 4 CALCULATING THE 10% REQUIREMENT

See Section 7 for detailed guidance on how to undertake the calculations.

Stage 1. Work out the annual CO_2 emissions of the buildings

Complete either calculations 1, 2, 3 or 4

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Building type 1:	Annual benchmark CO_2 emissions per m^2 **(a)**		$kgCO_2/yr$
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	= annual CO_2 emissions **(c)**		$kgCO_2/yr$
Building type 2:	Annual benchmark CO_2 emissions per m^2 **(a)**		$kgCO_2/yr$
	x floor area **(b)**		m^2
	= annual CO_2 emissions **(c)**		$kgCO_2/yr$
Building type 3:	Annual benchmark CO_2 emissions per m^2 **(a)**		$kgCO_2/yr$
	x floor area **(b)**		m^2
	= annual CO_2 emissions **(c)**		$kgCO_2/yr$
	Total CO_2 emissions **(c) + (c) + (c) = (d)**		$kgCO_2/yr$

OR

2. Annual CO_2 emissions from SAP assessment

Target figure

CO_2 emissions **(d)** 1,542 $kgCO_2/yr$

OR

3. Annual CO_2 emissions from SBEM assessment

CO_2 emissions **(d)** $kgCO_2/yr$

OR

4. Annual CO_2 emissions from Act on CO_2 website

CO_2 emissions **(d)** $kgCO_2/yr$

Stage 2. Work out 10% of the annual CO_2 emissions

10% of CO_2 emissions **((d)/100) x 10 = (e)** 154 $kgCO_2/yr$

Stage 3. Select the renewable technology (or technologies) you wish to incorporate and work out the annual CO_2 savings

Electricity generating technologies

Electricity generating renewable energy **(f)** kWh/yr

x 0.422[21] **(g)** $kgCO_2/yr$

Heat generating technologies

ASHP + efficient fans + lighting

Heat generating renewable energy **(h)** kWh/yr

Actual figure

x 0.194 or **x** 0.265[22] **(i)** 1,350 $kgCO_2/yr$

[21] Standard conversion factor for kWh electricity to $kgCO_2$
[22] Standard conversion factors - use x 0.194 if displacing gas or x 0.265 if displacing oil

(1,542-1,350)

Total CO_2 savings **(g) + (i) = (j)** 192 $kgCO_2/yr$

Stage 4. Check that your chosen technology will provide enough CO_2 savings

(j) should be equal to or greater than **(e)** to ensure that at least 10% of predicted CO_2 emissions are offset through renewable energy.

(192÷1,542)x100%

% of CO_2 emissions which will be offset by renewable energy **(j) / (d)** 12.4 %

If this figure is less than 10%, look at increasing the size / capacity of the installation, try other technologies or look at using a mix of technologies.

APPENDIX 4 CALCULATING THE 10% REQUIREMENT

See Section 7 for detailed guidance on how to undertake the calculations.

Stage 1. Work out the annual CO_2 emissions of the buildings

Complete either calculations 1, 2, 3 or 4

1. Calculations where there is no Standard Assessment Procedure or Simplified Building Energy Model data

Where there is more than one type of building you will need to undertake this calculation separately for each building type.

Building type 1:	Annual benchmark CO_2 emissions per m^2 **(a)**		$kgCO_2/yr$
	x floor area **(b)**		m^2
	= annual CO_2 emissions **(c)**		$kgCO_2/yr$
Building type 2:	Annual benchmark CO_2 emissions per m^2 **(a)**		$kgCO_2/yr$
	x floor area **(b)**		m^2
	= annual CO_2 emissions **(c)**		$kgCO_2/yr$
Building type 3:	Annual benchmark CO_2 emissions per m^2 **(a)**		$kgCO_2/yr$
	x floor area **(b)**		m^2
	= annual CO_2 emissions **(c)**		$kgCO_2/yr$
	Total CO_2 emissions **(c) + (c) + (c) = (d)**		$kgCO_2/yr$

OR

2. Annual CO_2 emissions from SAP assessment

Target figure

CO_2 emissions **(d)** 1,447 $kgCO_2/yr$

OR

3. Annual CO_2 emissions from SBEM assessment

CO_2 emissions **(d)** $kgCO_2/yr$

OR

4. Annual CO_2 emissions from Act on CO_2 website

CO_2 emissions **(d)** $kgCO_2/yr$

Stage 2. Work out 10% of the annual CO_2 emissions

10% of CO_2 emissions **((d)/100) x 10 = (e)** 145 $kgCO_2/yr$

Stage 3. Select the renewable technology (or technologies) you wish to incorporate and work out the annual CO_2 savings

Electricity generating technologies

Electricity generating renewable energy **(f)** kWh/yr

x 0.422[21] **(g)** $kgCO_2/yr$

Heat generating technologies

ASHP + efficient fans + lighting

Heat generating renewable energy **(h)** kWh/yr

Actual figure

x 0.194 or **x** 0.265[22] **(i)** 1,236 $kgCO_2/yr$

[21] Standard conversion factor for kWh electricity to $kgCO_2$
[22] Standard conversion factors - use x 0.194 if displacing gas or x 0.265 if displacing oil

(1,447-1,236)

Total CO_2 savings **(g) + (i) = (j)** 211 $kgCO_2/yr$

Stage 4. Check that your chosen technology will provide enough CO_2 savings

(j) should be equal to or greater than **(e)** to ensure that at least 10% of predicted CO_2 emissions are offset through renewable energy.

(211÷1,447)x100%

% of CO_2 emissions which will be offset by renewable energy **(j) / (d)** 14.5 %

If this figure is less than 10%, look at increasing the size / capacity of the installation, try other technologies or look at using a mix of technologies.

APPENDIX 4 CALCULATING THE 10% REQUIREMENT

See Section 7 for detailed guidance on how to undertake the calculations.

Stage 1. Work out the annual CO_2 emissions of the buildings

Complete either calculations 1, 2, 3 or 4

1. Calculations where there is no Standard Assessment Procedure or Simplified Building Energy Model data

Where there is more than one type of building you will need to undertake this calculation separately for each building type.

Building type 1:	Annual benchmark CO_2 emissions per m^2 **(a)**		$kgCO_2/yr$
	x floor area **(b)**		m^2
	= annual CO_2 emissions **(c)**		$kgCO_2/yr$
Building type 2:	Annual benchmark CO_2 emissions per m^2 **(a)**		$kgCO_2/yr$
	x floor area **(b)**		m^2
	= annual CO_2 emissions **(c)**		$kgCO_2/yr$
Building type 3:	Annual benchmark CO_2 emissions per m^2 **(a)**		$kgCO_2/yr$
	x floor area **(b)**		m^2
	= annual CO_2 emissions **(c)**		$kgCO_2/yr$
	Total CO_2 emissions **(c) + (c) + (c) = (d)**		$kgCO_2/yr$

OR

2. Annual CO_2 emissions from SAP assessment

Target figure

CO_2 emissions **(d)** 1,447 $kgCO_2/yr$

OR

3. Annual CO_2 emissions from SBEM assessment

CO_2 emissions **(d)** $kgCO_2/yr$

OR

4. Annual CO_2 emissions from Act on CO_2 website

CO_2 emissions **(d)** $kgCO_2/yr$

Stage 2. Work out 10% of the annual CO_2 emissions

10% of CO_2 emissions **((d)/100) x 10 = (e)** 145 $kgCO_2/yr$

Stage 3. Select the renewable technology (or technologies) you wish to incorporate and work out the annual CO_2 savings

Electricity generating technologies

Electricity generating renewable energy **(f)** kWh/yr

x 0.422[21] **(g)** $kgCO_2/yr$

Heat generating technologies

ASHP + efficient fans + lighting

Heat generating renewable energy **(h)** kWh/yr

Actual figure

x 0.194 or **x** 0.265[22] **(i)** 1,236 $kgCO_2/yr$

[21] Standard conversion factor for kWh electricity to $kgCO_2$
[22] Standard conversion factors - use x 0.194 if displacing gas or x 0.265 if displacing oil

(1,447-1,236)

Total CO_2 savings **(g) + (i) = (j)** 211 $kgCO_2/yr$

Stage 4. Check that your chosen technology will provide enough CO_2 savings

(j) should be equal to or greater than **(e)** to ensure that at least 10% of predicted CO_2 emissions are offset through renewable energy.

(211÷1,447)x100%

% of CO_2 emissions which will be offset by renewable energy **(j) / (d)** 14.5 %

If this figure is less than 10%, look at increasing the size / capacity of the installation, try other technologies or look at using a mix of technologies.

APPENDIX 4 CALCULATING THE 10% REQUIREMENT

See Section 7 for detailed guidance on how to undertake the calculations.

Stage 1. Work out the annual CO_2 emissions of the buildings

Complete either calculations 1, 2, 3 or 4

1. Calculations where there is no Standard Assessment Procedure or Simplified Building Energy Model data

Where there is more than one type of building you will need to undertake this calculation separately for each building type.

Building type 1:	Annual benchmark CO_2 emissions per m^2 **(a)**		$kgCO_2/yr$
	x floor area **(b)**		m^2
	= annual CO_2 emissions **(c)**		$kgCO_2/yr$
Building type 2:	Annual benchmark CO_2 emissions per m^2 **(a)**		$kgCO_2/yr$
	x floor area **(b)**		m^2
	= annual CO_2 emissions **(c)**		$kgCO_2/yr$
Building type 3:	Annual benchmark CO_2 emissions per m^2 **(a)**		$kgCO_2/yr$
	x floor area **(b)**		m^2
	= annual CO_2 emissions **(c)**		$kgCO_2/yr$
	Total CO_2 emissions **(c) + (c) + (c) = (d)**		$kgCO_2/yr$

OR

2. Annual CO_2 emissions from SAP assessment

Target figure

CO_2 emissions **(d)** 1,418 $kgCO_2/yr$

OR

3. Annual CO_2 emissions from SBEM assessment

CO_2 emissions **(d)** $kgCO_2/yr$

OR

4. Annual CO_2 emissions from Act on CO_2 website

CO_2 emissions **(d)** $kgCO_2/yr$

Stage 2. Work out 10% of the annual CO_2 emissions

10% of CO_2 emissions **((d)/100) x 10 = (e)** 142 $kgCO_2/yr$

Stage 3. Select the renewable technology (or technologies) you wish to incorporate and work out the annual CO_2 savings

Electricity generating technologies

Electricity generating renewable energy **(f)** kWh/yr

x 0.422[21] **(g)** $kgCO_2/yr$

Heat generating technologies

ASHP + efficient fans + lighting

Heat generating renewable energy **(h)** kWh/yr

Actual figure

x 0.194 or **x** 0.265[22] **(i)** 1,211 $kgCO_2/yr$

[21] Standard conversion factor for kWh electricity to $kgCO_2$
[22] Standard conversion factors - use x 0.194 if displacing gas or x 0.265 if displacing oil

(1,418-1,211)

Total CO_2 savings **(g) + (i) = (j)** 207 $kgCO_2/yr$

Stage 4. Check that your chosen technology will provide enough CO_2 savings

(j) should be equal to or greater than **(e)** to ensure that at least 10% of predicted CO_2 emissions are offset through renewable energy.

(207÷1,418)x100%

% of CO_2 emissions which will be offset by renewable energy **(j)** / **(d)** 14.5 %

If this figure is less than 10%, look at increasing the size / capacity of the installation, try other technologies or look at using a mix of technologies.

APPENDIX 4 CALCULATING THE 10% REQUIREMENT

See Section 7 for detailed guidance on how to undertake the calculations.

Stage 1. Work out the annual CO_2 emissions of the buildings

Complete either calculations 1, 2, 3 or 4

1. Calculations where there is no Standard Assessment Procedure or Simplified Building Energy Model data

Where there is more than one type of building you will need to undertake this calculation separately for each building type.

Building type 1:			
	Annual benchmark CO_2 emissions per m^2 **(a)**		$kgCO_2/yr$
	x floor area **(b)**		m^2
	= annual CO_2 emissions **(c)**		$kgCO_2/yr$
Building type 2:			
	Annual benchmark CO_2 emissions per m^2 **(a)**		$kgCO_2/yr$
	x floor area **(b)**		m^2
	= annual CO_2 emissions **(c)**		$kgCO_2/yr$
Building type 3:			
	Annual benchmark CO_2 emissions per m^2 **(a)**		$kgCO_2/yr$
	x floor area **(b)**		m^2
	= annual CO_2 emissions **(c)**		$kgCO_2/yr$
	Total CO_2 emissions **(c) + (c) + (c) = (d)**		$kgCO_2/yr$

OR

2. Annual CO_2 emissions from SAP assessment

Target figure

CO_2 emissions **(d)** 1,418 $kgCO_2/yr$

OR

3. Annual CO_2 emissions from SBEM assessment

CO_2 emissions **(d)** $kgCO_2/yr$

OR

4. Annual CO_2 emissions from Act on CO_2 website

CO_2 emissions **(d)** $kgCO_2/yr$

Stage 2. Work out 10% of the annual CO_2 emissions

10% of CO_2 emissions **((d)/100) x 10 = (e)** 142 $kgCO_2/yr$

Stage 3. Select the renewable technology (or technologies) you wish to incorporate and work out the annual CO_2 savings

Electricity generating technologies

Electricity generating renewable energy **(f)** kWh/yr

x 0.422[21] **(g)** $kgCO_2/yr$

Heat generating technologies

ASHP + efficient fans + lighting

Heat generating renewable energy **(h)** kWh/yr

Actual figure

x 0.194 or **x** 0.265[22] **(i)** 1,211 $kgCO_2/yr$

[21] Standard conversion factor for kWh electricity to $kgCO_2$
[22] Standard conversion factors - use x 0.194 if displacing gas or x 0.265 if displacing oil

(1,418-1,211)

Total CO_2 savings **(g) + (i) = (j)** 207 $kgCO_2/yr$

Stage 4. Check that your chosen technology will provide enough CO_2 savings

(j) should be equal to or greater than **(e)** to ensure that at least 10% of predicted CO_2 emissions are offset through renewable energy.

(207÷1,418)x100%

% of CO_2 emissions which will be offset by renewable energy **(j)** / **(d)** 14.5 %

If this figure is less than 10%, look at increasing the size / capacity of the installation, try other technologies or look at using a mix of technologies.

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

Anderson Goddard Ltd

Property Reference	73940-WR01	**Issued on Date**	07/10/2020
Assessment Reference	001	**Prop Type Ref**	Det
Property	Woodlands Room 1, Raithwaite Bay, WHITBY, YO21 3ST		

SAP Rating	76 C	**DER**	38.61	**TER**	43.57
Environmental	78 C	**% DER<TER**	11.39		
CO_2 Emissions (t/year)	1.44	**DFEE**	84.35	**TFEE**	85.87
General Requirements Compliance	Pass	**% DFEE<TFEE**	1.77		

Assessor Details	Mr. Paul Goddard, Anderson Goddard Limited, Tel: 0161 7757770, paul.goddard@andersongoddard.com	**Assessor ID**	B342-0001
Client			

SUMARY FOR INPUT DATA FOR New Build (As Designed)

Criterion 1 – Achieving the TER and TFEE rate

1a TER and DER

Fuel for main heating	Electricity		
Fuel factor	1.55 (electricity)		
Target Carbon Dioxide Emission Rate (TER)	43.57	$kgCO_2/m^2$	
Dwelling Carbon Dioxide Emission Rate (DER)	38.61	$kgCO_2/m^2$	Pass
	-4.96 (-11.4%)	$kgCO_2/m^2$	

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	85.87	$kWh/m^2/yr$	
Dwelling Fabric Energy Efficiency (DFEE)	84.35	$kWh/m^2/yr$	
	-1.6 (-1.9%)	$kWh/m^2/yr$	Pass

Criterion 2 – Limits on design flexibility

Limiting Fabric Standards

2 Fabric U-values

Element	Average	Highest	
External wall	0.23 (max. 0.30)	0.23 (max. 0.70)	Pass
Floor	0.22 (max. 0.25)	0.22 (max. 0.70)	Pass
Roof	0.18 (max. 0.20)	0.18 (max. 0.35)	Pass
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	Pass

2a Thermal bridging

Thermal bridging calculated using user-specified y-value of 0.051

3 Air permeability

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

Limiting System Efficiencies

4 Heating efficiency

Main heating system	Heat pump with radiators or underfloor - Electric Air-to-water heat pump	
Secondary heating system	None	

5 Cylinder insulation

Hot water storage	Measured cylinder loss: 1.05 kWh/day Permitted by DBSCG 1.70		Pass
Primary pipework insulated	Yes		Pass

6 Controls

Space heating controls	Programmer and room thermostat		Pass
Hot water controls	Cylinderstat		Pass
	Independent timer for DHW		Pass

7 Low energy lights

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

8 Mechanical ventilation

Not applicable

Criterion 3 – Limiting the effects of heat gains in summer

9 Summertime temperature

Overheating risk (North East England)	Slight		Pass

Based on:

Overshading	Average		
Windows facing North Windows facing East Windows facing South	4.33 m², No overhang 9.14 m², No overhang 3.12 m², No overhang		
Air change rate	8.00 ach		
Blinds/curtains	None		

Criterion 4 – Building performance consistent with DER and DFEE rate

Air permeability and pressure testing

3 Air permeability

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

10 Key features

None	N/A		

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

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

Anderson Goddard Ltd

Property Reference	73940-WR02	**Issued on Date**	07/10/2020
Assessment Reference	001	**Prop Type Ref**	Det
Property	Woodlands Room 2, Raithwaite Bay, WHITBY, YO21 3ST		

SAP Rating	76 C	**DER**	38.61	**TER**	43.57
Environmental	78 C	**% DER<TER**	11.39		
CO_2 Emissions (t/year)	1.44	**DFEE**	84.35	**TFEE**	85.87
General Requirements Compliance	Pass	**% DFEE<TFEE**	1.77		

Assessor Details	Mr. Paul Goddard, Anderson Goddard Limited, Tel: 0161 7757770, paul.goddard@andersongoddard.com	**Assessor ID**	B342-0001
Client			

SUMARY FOR INPUT DATA FOR New Build (As Designed)

Criterion 1 – Achieving the TER and TFEE rate

1a TER and DER

Fuel for main heating	Electricity		
Fuel factor	1.55 (electricity)		
Target Carbon Dioxide Emission Rate (TER)	43.57	$kgCO_2/m^2$	
Dwelling Carbon Dioxide Emission Rate (DER)	38.61	$kgCO_2/m^2$	Pass
	-4.96 (-11.4%)	$kgCO_2/m^2$	

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	85.87	$kWh/m^2/yr$	
Dwelling Fabric Energy Efficiency (DFEE)	84.35	$kWh/m^2/yr$	
	-1.6 (-1.9%)	$kWh/m^2/yr$	Pass

Criterion 2 – Limits on design flexibility

Limiting Fabric Standards

2 Fabric U-values

Element	Average	Highest	
External wall	0.23 (max. 0.30)	0.23 (max. 0.70)	Pass
Floor	0.22 (max. 0.25)	0.22 (max. 0.70)	Pass
Roof	0.18 (max. 0.20)	0.18 (max. 0.35)	Pass
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	Pass

2a Thermal bridging

Thermal bridging calculated using user-specified y-value of 0.051

3 Air permeability

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

Limiting System Efficiencies

4 Heating efficiency

Main heating system	Heat pump with radiators or underfloor - Electric Air-to-water heat pump	
Secondary heating system	None	

5 Cylinder insulation

Hot water storage	Measured cylinder loss: 1.05 kWh/day Permitted by DBSCG 1.70		Pass
Primary pipework insulated	Yes		Pass

6 Controls

Space heating controls	Programmer and room thermostat		Pass
Hot water controls	Cylinderstat		Pass
	Independent timer for DHW		Pass

7 Low energy lights

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

8 Mechanical ventilation

Not applicable

Criterion 3 – Limiting the effects of heat gains in summer

9 Summertime temperature

Overheating risk (North East England)	Slight		Pass

Based on:

Overshading	Average		
Windows facing North Windows facing East Windows facing South	4.33 m², No overhang 9.14 m², No overhang 3.12 m², No overhang		
Air change rate	8.00 ach		
Blinds/curtains	None		

Criterion 4 – Building performance consistent with DER and DFEE rate

Air permeability and pressure testing

3 Air permeability

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

10 Key features

None	N/A		

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

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

Anderson Goddard Ltd

Property Reference	73940-WR03	**Issued on Date**	07/10/2020
Assessment Reference	001	**Prop Type Ref**	Det
Property	Woodlands Room 3, Raithwaite Bay, WHITBY, YO21 3ST		

SAP Rating	76 C	**DER**	38.61	**TER**	43.57
Environmental	78 C	**% DER<TER**	11.39		
CO_2 Emissions (t/year)	1.44	**DFEE**	84.35	**TFEE**	85.87
General Requirements Compliance	Pass	**% DFEE<TFEE**	1.77		

Assessor Details	Mr. Paul Goddard, Anderson Goddard Limited, Tel: 0161 7757770, paul.goddard@andersongoddard.com	**Assessor ID**	B342-0001
Client			

SUMARY FOR INPUT DATA FOR New Build (As Designed)

Criterion 1 – Achieving the TER and TFEE rate

1a TER and DER

Fuel for main heating	Electricity		
Fuel factor	1.55 (electricity)		
Target Carbon Dioxide Emission Rate (TER)	43.57	$kgCO_2/m^2$	
Dwelling Carbon Dioxide Emission Rate (DER)	38.61	$kgCO_2/m^2$	Pass
	-4.96 (-11.4%)	$kgCO_2/m^2$	

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	85.87	$kWh/m^2/yr$	
Dwelling Fabric Energy Efficiency (DFEE)	84.35	$kWh/m^2/yr$	
	-1.6 (-1.9%)	$kWh/m^2/yr$	Pass

Criterion 2 – Limits on design flexibility

Limiting Fabric Standards

2 Fabric U-values

Element	Average	Highest	
External wall	0.23 (max. 0.30)	0.23 (max. 0.70)	Pass
Floor	0.22 (max. 0.25)	0.22 (max. 0.70)	Pass
Roof	0.18 (max. 0.20)	0.18 (max. 0.35)	Pass
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	Pass

2a Thermal bridging

Thermal bridging calculated using user-specified y-value of 0.051

3 Air permeability

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

Limiting System Efficiencies

4 Heating efficiency

Main heating system	Heat pump with radiators or underfloor - Electric Air-to-water heat pump	
Secondary heating system	None	

5 Cylinder insulation

Hot water storage	Measured cylinder loss: 1.05 kWh/day Permitted by DBSCG 1.70		Pass
Primary pipework insulated	Yes		Pass

6 Controls

Space heating controls	Programmer and room thermostat		Pass
Hot water controls	Cylinderstat		Pass
	Independent timer for DHW		Pass

7 Low energy lights

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

8 Mechanical ventilation

Not applicable

Criterion 3 – Limiting the effects of heat gains in summer

9 Summertime temperature

Overheating risk (North East England)	Slight		Pass

Based on:

Overshading	Average		
Windows facing North Windows facing East Windows facing South	4.33 m², No overhang 9.14 m², No overhang 3.12 m², No overhang		
Air change rate	8.00 ach		
Blinds/curtains	None		

Criterion 4 – Building performance consistent with DER and DFEE rate

Air permeability and pressure testing

3 Air permeability

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

10 Key features

None	N/A		

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

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

Anderson Goddard Ltd

Property Reference	73940-WR04	**Issued on Date**	07/10/2020
Assessment Reference	001	**Prop Type Ref**	Det
Property	Woodlands Room 4, Raithwaite Bay, WHITBY, YO21 3ST		

SAP Rating	75 C	**DER**	39.94	**TER**	44.70
Environmental	78 C	**% DER<TER**	10.65		
CO_2 Emissions (t/year)	1.49	**DFEE**	88.13	**TFEE**	89.61
General Requirements Compliance	Pass	**% DFEE<TFEE**	1.65		

Assessor Details	Mr. Paul Goddard, Anderson Goddard Limited, Tel: 0161 7757770, paul.goddard@andersongoddard.com	**Assessor ID**	B342-0001
Client			

SUMARY FOR INPUT DATA FOR New Build (As Designed)

Criterion 1 – Achieving the TER and TFEE rate

1a TER and DER

Fuel for main heating	Electricity		
Fuel factor	1.55 (electricity)		
Target Carbon Dioxide Emission Rate (TER)	44.70	$kgCO_2/m^2$	
Dwelling Carbon Dioxide Emission Rate (DER)	39.94	$kgCO_2/m^2$	Pass
	-4.76 (-10.6%)	$kgCO_2/m^2$	

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	89.61	$kWh/m^2/yr$	
Dwelling Fabric Energy Efficiency (DFEE)	88.13	$kWh/m^2/yr$	
	-1.5 (-1.7%)	$kWh/m^2/yr$	Pass

Criterion 2 – Limits on design flexibility

Limiting Fabric Standards

2 Fabric U-values

Element	Average	Highest	
External wall	0.23 (max. 0.30)	0.23 (max. 0.70)	Pass
Floor	0.22 (max. 0.25)	0.22 (max. 0.70)	Pass
Roof	0.18 (max. 0.20)	0.18 (max. 0.35)	Pass
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	Pass

2a Thermal bridging

Thermal bridging calculated using user-specified y-value of 0.051

3 Air permeability

Air permeability at 50 pascals	4.95 (design value)	
Maximum	10.0	Pass

Limiting System Efficiencies

4 Heating efficiency

Main heating system	Heat pump with radiators or underfloor - Electric Air-to-water heat pump	
Secondary heating system	None	

5 Cylinder insulation

Hot water storage	Measured cylinder loss: 1.05 kWh/day Permitted by DBSCG 1.70		Pass
Primary pipework insulated	Yes		Pass

6 Controls

Space heating controls	Programmer and room thermostat		Pass
Hot water controls	Cylinderstat		Pass
	Independent timer for DHW		Pass

7 Low energy lights

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

8 Mechanical ventilation

Not applicable

Criterion 3 – Limiting the effects of heat gains in summer

9 Summertime temperature

Overheating risk (North East England)	Not significant		Pass

Based on:

Overshading	Average		
Windows facing North Windows facing East Windows facing West	9.14 m², No overhang 3.12 m², No overhang 4.33 m², No overhang		
Air change rate	8.00 ach		
Blinds/curtains	None		

Criterion 4 – Building performance consistent with DER and DFEE rate

Air permeability and pressure testing

3 Air permeability

Air permeability at 50 pascals	4.95 (design value)		
Maximum	10.0		Pass

10 Key features

None	N/A		

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

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

Anderson Goddard Ltd

Property Reference	73940-WR05	**Issued on Date**	07/10/2020
Assessment Reference	001	**Prop Type Ref**	Semi
Property	Woodlands Room 5, Raithwaite Bay, WHITBY, YO21 3ST		

SAP Rating	78 C	**DER**	35.10	**TER**	41.12
Environmental	80 C	**% DER<TER**	14.65		
CO_2 Emissions (t/year)	1.31	**DFEE**	76.66	**TFEE**	77.55
General Requirements Compliance	Pass	**% DFEE<TFEE**	1.14		

Assessor Details	Mr. Paul Goddard, Anderson Goddard Limited, Tel: 0161 7757770, paul.goddard@andersongoddard.com	**Assessor ID**	B342-0001
Client			

SUMARY FOR INPUT DATA FOR New Build (As Designed)

Criterion 1 – Achieving the TER and TFEE rate

1a TER and DER

Fuel for main heating	Electricity		
Fuel factor	1.55 (electricity)		
Target Carbon Dioxide Emission Rate (TER)	41.12	$kgCO_2/m^2$	
Dwelling Carbon Dioxide Emission Rate (DER)	35.10	$kgCO_2/m^2$	Pass
	-6.02 (-14.6%)	$kgCO_2/m^2$	

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	77.55	$kWh/m^2/yr$	
Dwelling Fabric Energy Efficiency (DFEE)	76.66	$kWh/m^2/yr$	
	-0.9 (-1.2%)	$kWh/m^2/yr$	Pass

Criterion 2 – Limits on design flexibility

Limiting Fabric Standards

2 Fabric U-values

Element	Average	Highest	
External wall	0.23 (max. 0.30)	0.23 (max. 0.70)	Pass
Party wall	0.00 (max. 0.20)	-	Pass
Floor	0.22 (max. 0.25)	0.22 (max. 0.70)	Pass
Roof	0.18 (max. 0.20)	0.18 (max. 0.35)	Pass
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	Pass

2a Thermal bridging

Thermal bridging calculated using user-specified y-value of 0.052

3 Air permeability

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

Limiting System Efficiencies

4 Heating efficiency

Main heating system	Heat pump with radiators or underfloor - Electric Air-to-water heat pump	
Secondary heating system	None	

5 Cylinder insulation

Hot water storage	Measured cylinder loss: 1.05 kWh/day Permitted by DBSCG 1.70	Pass
Primary pipework insulated	Yes	Pass

6 Controls

Space heating controls	Programmer and room thermostat	Pass
Hot water controls	Cylinderstat	Pass
	Independent timer for DHW	Pass

7 Low energy lights

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

8 Mechanical ventilation

Not applicable

Criterion 3 – Limiting the effects of heat gains in summer

9 Summertime temperature

Overheating risk (North East England)	Slight	Pass

Based on:

Overshading	Average
Windows facing East	3.12 m², No overhang
Windows facing South	9.14 m², No overhang
Windows facing West	4.33 m², No overhang
Air change rate	8.00 ach
Blinds/curtains	None

Criterion 4 – Building performance consistent with DER and DFEE rate

Party Walls

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

Air permeability and pressure testing

3 Air permeability

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

10 Key features

Party wall U-value	0.00	W/m²K

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

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

Anderson Goddard Ltd

Property Reference	73940-WR06	**Issued on Date**	07/10/2020
Assessment Reference	001	**Prop Type Ref**	Semi
Property	Woodlands Room 6, Raithwaite Bay, WHITBY, YO21 3ST		

SAP Rating	78 C	**DER**	35.10	**TER**	41.12
Environmental	80 C	**% DER<TER**	14.65		
CO_2 Emissions (t/year)	1.31	**DFEE**	76.66	**TFEE**	77.55
General Requirements Compliance	Pass	**% DFEE<TFEE**	1.14		

Assessor Details	Mr. Paul Goddard, Anderson Goddard Limited, Tel: 0161 7757770, paul.goddard@andersongoddard.com	**Assessor ID**	B342-0001
Client			

SUMARY FOR INPUT DATA FOR New Build (As Designed)

Criterion 1 – Achieving the TER and TFEE rate

1a TER and DER

Fuel for main heating	Electricity		
Fuel factor	1.55 (electricity)		
Target Carbon Dioxide Emission Rate (TER)	41.12	$kgCO_2/m^2$	
Dwelling Carbon Dioxide Emission Rate (DER)	35.10	$kgCO_2/m^2$	Pass
	-6.02 (-14.6%)	$kgCO_2/m^2$	

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	77.55	$kWh/m^2/yr$	
Dwelling Fabric Energy Efficiency (DFEE)	76.66	$kWh/m^2/yr$	
	-0.9 (-1.2%)	$kWh/m^2/yr$	Pass

Criterion 2 – Limits on design flexibility

Limiting Fabric Standards

2 Fabric U-values

Element	Average	Highest	
External wall	0.23 (max. 0.30)	0.23 (max. 0.70)	Pass
Party wall	0.00 (max. 0.20)	-	Pass
Floor	0.22 (max. 0.25)	0.22 (max. 0.70)	Pass
Roof	0.18 (max. 0.20)	0.18 (max. 0.35)	Pass
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	Pass

2a Thermal bridging

Thermal bridging calculated using user-specified y-value of 0.052

3 Air permeability

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

Limiting System Efficiencies

4 Heating efficiency

Main heating system	Heat pump with radiators or underfloor - Electric Air-to-water heat pump	
Secondary heating system	None	

5 Cylinder insulation

Hot water storage	Measured cylinder loss: 1.05 kWh/day Permitted by DBSCG 1.70	Pass
Primary pipework insulated	Yes	Pass

6 Controls

Space heating controls	Programmer and room thermostat	Pass
Hot water controls	Cylinderstat	Pass
	Independent timer for DHW	Pass

7 Low energy lights

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

8 Mechanical ventilation

Not applicable

Criterion 3 – Limiting the effects of heat gains in summer

9 Summertime temperature

Overheating risk (North East England)	Slight	Pass

Based on:

Overshading	Average
Windows facing East	3.12 m², No overhang
Windows facing South	9.14 m², No overhang
Windows facing West	4.33 m², No overhang
Air change rate	8.00 ach
Blinds/curtains	None

Criterion 4 – Building performance consistent with DER and DFEE rate

Party Walls

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

Air permeability and pressure testing

3 Air permeability

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

10 Key features

Party wall U-value	0.00	W/m²K

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

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

Anderson Goddard Ltd

Property Reference	73940-WR07	**Issued on Date**	07/10/2020
Assessment Reference	001	**Prop Type Ref**	Semi
Property	Woodlands Room 7, Raithwaite Bay, WHITBY, YO21 3ST		

SAP Rating	78 C	**DER**	35.14	**TER**	40.98
Environmental	80 C	**% DER<TER**	14.25		
CO_2 Emissions (t/year)	1.31	**DFEE**	76.81	**TFEE**	77.07
General Requirements Compliance	Pass	**% DFEE<TFEE**	0.33		

Assessor Details	Mr. Paul Goddard, Anderson Goddard Limited, Tel: 0161 7757770, paul.goddard@andersongoddard.com	**Assessor ID**	B342-0001
Client			

SUMARY FOR INPUT DATA FOR New Build (As Designed)

Criterion 1 – Achieving the TER and TFEE rate

1a TER and DER

Fuel for main heating	Electricity		
Fuel factor	1.55 (electricity)		
Target Carbon Dioxide Emission Rate (TER)	40.98	$kgCO_2/m^2$	
Dwelling Carbon Dioxide Emission Rate (DER)	35.14	$kgCO_2/m^2$	Pass
	-5.84 (-14.3%)	$kgCO_2/m^2$	

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	77.07	$kWh/m^2/yr$	
Dwelling Fabric Energy Efficiency (DFEE)	76.81	$kWh/m^2/yr$	
	-0.3 (-0.4%)	$kWh/m^2/yr$	Pass

Criterion 2 – Limits on design flexibility

Limiting Fabric Standards

2 Fabric U-values

Element	Average	Highest	
External wall	0.23 (max. 0.30)	0.23 (max. 0.70)	Pass
Party wall	0.00 (max. 0.20)	-	Pass
Floor	0.22 (max. 0.25)	0.22 (max. 0.70)	Pass
Roof	0.18 (max. 0.20)	0.18 (max. 0.35)	Pass
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	Pass

2a Thermal bridging

Thermal bridging calculated using user-specified y-value of 0.056

3 Air permeability

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

Limiting System Efficiencies

4 Heating efficiency

Main heating system	Heat pump with radiators or underfloor - Electric Air-to-water heat pump	
Secondary heating system	None	

5 Cylinder insulation

Hot water storage	Measured cylinder loss: 1.05 kWh/day Permitted by DBSCG 1.70	Pass
Primary pipework insulated	Yes	Pass

6 Controls

Space heating controls	Programmer and room thermostat	Pass
Hot water controls	Cylinderstat	Pass
	Independent timer for DHW	Pass

7 Low energy lights

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

8 Mechanical ventilation

Not applicable

Criterion 3 – Limiting the effects of heat gains in summer

9 Summertime temperature

Overheating risk (North East England)	Slight	Pass

Based on:

Overshading	Average
Windows facing East	3.12 m², No overhang
Windows facing South	9.14 m², No overhang
Windows facing West	4.33 m², No overhang
Air change rate	8.00 ach
Blinds/curtains	None

Criterion 4 – Building performance consistent with DER and DFEE rate

Party Walls

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

Air permeability and pressure testing

3 Air permeability

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

10 Key features

Party wall U-value	0.00	W/m²K

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

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

Anderson Goddard Ltd

Property Reference	73940-WR08	**Issued on Date**	07/10/2020
Assessment Reference	001	**Prop Type Ref**	Semi
Property	Woodlands Room 8, Raithwaite Bay, WHITBY, YO21 3ST		

SAP Rating	76 C	**DER**	38.15	**TER**	43.60
Environmental	79 C	**% DER<TER**	12.49		
CO_2 Emissions (t/year)	1.42	**DFEE**	85.89	**TFEE**	85.92
General Requirements Compliance	Pass	**% DFEE<TFEE**	0.03		

Assessor Details	Mr. Paul Goddard, Anderson Goddard Limited, Tel: 0161 7757770, paul.goddard@andersongoddard.com	**Assessor ID**	B342-0001
Client			

SUMARY FOR INPUT DATA FOR New Build (As Designed)

Criterion 1 – Achieving the TER and TFEE rate

1a TER and DER

Fuel for main heating	Electricity		
Fuel factor	1.55 (electricity)		
Target Carbon Dioxide Emission Rate (TER)	43.60	$kgCO_2/m^2$	
Dwelling Carbon Dioxide Emission Rate (DER)	38.15	$kgCO_2/m^2$	Pass
	-5.45 (-12.5%)	$kgCO_2/m^2$	

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	85.92	$kWh/m^2/yr$	
Dwelling Fabric Energy Efficiency (DFEE)	85.89	$kWh/m^2/yr$	
	0.0 (0.0%)	$kWh/m^2/yr$	Pass

Criterion 2 – Limits on design flexibility

Limiting Fabric Standards

2 Fabric U-values

Element	Average	Highest	
External wall	0.23 (max. 0.30)	0.23 (max. 0.70)	Pass
Party wall	0.00 (max. 0.20)	-	Pass
Floor	0.22 (max. 0.25)	0.22 (max. 0.70)	Pass
Roof	0.18 (max. 0.20)	0.18 (max. 0.35)	Pass
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	Pass

2a Thermal bridging

Thermal bridging calculated using user-specified y-value of 0.056

3 Air permeability

Air permeability at 50 pascals	4.95 (design value)	
Maximum	10.0	Pass

Limiting System Efficiencies

4 Heating efficiency

Main heating system	Heat pump with radiators or underfloor - Electric Air-to-water heat pump	
Secondary heating system	None	

5 Cylinder insulation

Hot water storage	Measured cylinder loss: 1.05 kWh/day Permitted by DBSCG 1.70	Pass
Primary pipework insulated	Yes	Pass

6 Controls

Space heating controls	Programmer and room thermostat	Pass
Hot water controls	Cylinderstat	Pass
	Independent timer for DHW	Pass

7 Low energy lights

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

8 Mechanical ventilation

Not applicable

Criterion 3 – Limiting the effects of heat gains in summer

9 Summertime temperature

Overheating risk (North East England)	Not significant	Pass

Based on:

Overshading	Average
Windows facing North	9.14 m², No overhang
Windows facing East	3.12 m², No overhang
Windows facing West	4.33 m², No overhang
Air change rate	8.00 ach
Blinds/curtains	None

Criterion 4 – Building performance consistent with DER and DFEE rate

Party Walls

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

Air permeability and pressure testing

3 Air permeability

Air permeability at 50 pascals	4.95 (design value)		
Maximum	10.0		Pass

10 Key features

Party wall U-value	0.00	W/m²K

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

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

Anderson Goddard Ltd

Property Reference	73940-WR09	**Issued on Date**	07/10/2020
Assessment Reference	001	**Prop Type Ref**	Semi
Property	Woodlands Room 9, Raithwaite Bay, WHITBY, YO21 3ST		

SAP Rating	78 C	**DER**	34.93	**TER**	40.90
Environmental	80 C	**% DER<TER**	14.60		
CO_2 Emissions (t/year)	1.30	**DFEE**	76.30	**TFEE**	76.91
General Requirements Compliance	Pass	**% DFEE<TFEE**	0.79		

Assessor Details	Mr. Paul Goddard, Anderson Goddard Limited, Tel: 0161 7757770, paul.goddard@andersongoddard.com	**Assessor ID**	B342-0001
Client			

SUMARY FOR INPUT DATA FOR New Build (As Designed)

Criterion 1 – Achieving the TER and TFEE rate

1a TER and DER

Fuel for main heating	Electricity		
Fuel factor	1.55 (electricity)		
Target Carbon Dioxide Emission Rate (TER)	40.90	$kgCO_2/m^2$	
Dwelling Carbon Dioxide Emission Rate (DER)	34.93	$kgCO_2/m^2$	Pass
	-5.97 (-14.6%)	$kgCO_2/m^2$	

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	76.91	$kWh/m^2/yr$	
Dwelling Fabric Energy Efficiency (DFEE)	76.30	$kWh/m^2/yr$	
	-0.6 (-0.8%)	$kWh/m^2/yr$	Pass

Criterion 2 – Limits on design flexibility

Limiting Fabric Standards

2 Fabric U-values

Element	Average	Highest	
External wall	0.23 (max. 0.30)	0.23 (max. 0.70)	Pass
Party wall	0.00 (max. 0.20)	-	Pass
Floor	0.20 (max. 0.25)	0.20 (max. 0.70)	Pass
Roof	0.18 (max. 0.20)	0.18 (max. 0.35)	Pass
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	Pass

2a Thermal bridging

Thermal bridging calculated using user-specified y-value of 0.058

3 Air permeability

Air permeability at 50 pascals	4.95 (design value)	
Maximum	10.0	Pass

Limiting System Efficiencies

4 Heating efficiency

Main heating system	Heat pump with radiators or underfloor - Electric Air-to-water heat pump	
Secondary heating system	None	

5 Cylinder insulation

Hot water storage	Measured cylinder loss: 1.05 kWh/day Permitted by DBSCG 1.70	Pass
Primary pipework insulated	Yes	Pass

6 Controls

Space heating controls	Programmer and room thermostat	Pass
Hot water controls	Cylinderstat	Pass
	Independent timer for DHW	Pass

7 Low energy lights

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

8 Mechanical ventilation

Not applicable

Criterion 3 – Limiting the effects of heat gains in summer

9 Summertime temperature

Overheating risk (North East England)	Slight	Pass

Based on:

Overshading	Average
Windows facing South East	4.33 m², No overhang
Windows facing South West	9.14 m², No overhang
Windows facing North West	3.12 m², No overhang
Air change rate	8.00 ach
Blinds/curtains	None

Criterion 4 – Building performance consistent with DER and DFEE rate

Party Walls

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

Air permeability and pressure testing

3 Air permeability

Air permeability at 50 pascals	4.95 (design value)	
Maximum	10.0	Pass

10 Key features

Party wall U-value	0.00	W/m²K

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

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

Anderson Goddard Ltd

Property Reference	73940-WR10	**Issued on Date**	07/10/2020
Assessment Reference	001	**Prop Type Ref**	Semi
Property	Woodlands Room 10, Raithwaite Bay, WHITBY, YO21 3ST		

SAP Rating	78 C	**DER**	34.93	**TER**	40.90
Environmental	80 C	**% DER<TER**	14.60		
CO_2 Emissions (t/year)	1.30	**DFEE**	76.30	**TFEE**	76.91
General Requirements Compliance	Pass	**% DFEE<TFEE**	0.79		

Assessor Details	Mr. Paul Goddard, Anderson Goddard Limited, Tel: 0161 7757770, paul.goddard@andersongoddard.com	**Assessor ID**	B342-0001
Client			

SUMARY FOR INPUT DATA FOR New Build (As Designed)

Criterion 1 – Achieving the TER and TFEE rate

1a TER and DER

Fuel for main heating	Electricity		
Fuel factor	1.55 (electricity)		
Target Carbon Dioxide Emission Rate (TER)	40.90	$kgCO_2/m^2$	
Dwelling Carbon Dioxide Emission Rate (DER)	34.93	$kgCO_2/m^2$	Pass
	-5.97 (-14.6%)	$kgCO_2/m^2$	

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	76.91	$kWh/m^2/yr$	
Dwelling Fabric Energy Efficiency (DFEE)	76.30	$kWh/m^2/yr$	
	-0.6 (-0.8%)	$kWh/m^2/yr$	Pass

Criterion 2 – Limits on design flexibility

Limiting Fabric Standards

2 Fabric U-values

Element	Average	Highest	
External wall	0.23 (max. 0.30)	0.23 (max. 0.70)	Pass
Party wall	0.00 (max. 0.20)	-	Pass
Floor	0.20 (max. 0.25)	0.20 (max. 0.70)	Pass
Roof	0.18 (max. 0.20)	0.18 (max. 0.35)	Pass
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	Pass

2a Thermal bridging

Thermal bridging calculated using user-specified y-value of 0.058

3 Air permeability

Air permeability at 50 pascals	4.95 (design value)	
Maximum	10.0	Pass

Limiting System Efficiencies

4 Heating efficiency

Main heating system	Heat pump with radiators or underfloor - Electric Air-to-water heat pump	
Secondary heating system	None	

5 Cylinder insulation

Hot water storage	Measured cylinder loss: 1.05 kWh/day Permitted by DBSCG 1.70	Pass
Primary pipework insulated	Yes	Pass

6 Controls

Space heating controls	Programmer and room thermostat	Pass
Hot water controls	Cylinderstat	Pass
	Independent timer for DHW	Pass

7 Low energy lights

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

8 Mechanical ventilation

Not applicable

Criterion 3 – Limiting the effects of heat gains in summer

9 Summertime temperature

Overheating risk (North East England)	Slight	Pass

Based on:

Overshading	Average
Windows facing South East	4.33 m², No overhang
Windows facing South West	9.14 m², No overhang
Windows facing North West	3.12 m², No overhang
Air change rate	8.00 ach
Blinds/curtains	None

Criterion 4 – Building performance consistent with DER and DFEE rate

Party Walls

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

Air permeability and pressure testing

3 Air permeability

Air permeability at 50 pascals	4.95 (design value)	
Maximum	10.0	Pass

10 Key features

Party wall U-value	0.00	W/m²K

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

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

Anderson Goddard Ltd

Property Reference	73940-WR11	**Issued on Date**	07/10/2020
Assessment Reference	001	**Prop Type Ref**	Semi
Property	Woodlands Room 11, Raithwaite Bay, WHITBY, YO21 3ST		

SAP Rating	79 C	**DER**	34.23	**TER**	40.09
Environmental	81 B	**% DER<TER**	14.62		
CO_2 Emissions (t/year)	1.28	**DFEE**	73.97	**TFEE**	74.10
General Requirements Compliance	Pass	**% DFEE<TFEE**	0.18		

Assessor Details	Mr. Paul Goddard, Anderson Goddard Limited, Tel: 0161 7757770, paul.goddard@andersongoddard.com	**Assessor ID**	B342-0001
Client			

SUMARY FOR INPUT DATA FOR New Build (As Designed)

Criterion 1 – Achieving the TER and TFEE rate

1a TER and DER

Fuel for main heating	Electricity		
Fuel factor	1.55 (electricity)		
Target Carbon Dioxide Emission Rate (TER)	40.09	$kgCO_2/m^2$	
Dwelling Carbon Dioxide Emission Rate (DER)	34.23	$kgCO_2/m^2$	Pass
	-5.86 (-14.6%)	$kgCO_2/m^2$	

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	74.10	$kWh/m^2/yr$	
Dwelling Fabric Energy Efficiency (DFEE)	73.97	$kWh/m^2/yr$	
	-0.1 (-0.1%)	$kWh/m^2/yr$	Pass

Criterion 2 – Limits on design flexibility

Limiting Fabric Standards

2 Fabric U-values

Element	Average	Highest	
External wall	0.23 (max. 0.30)	0.23 (max. 0.70)	Pass
Party wall	0.00 (max. 0.20)	-	Pass
Floor	0.20 (max. 0.25)	0.20 (max. 0.70)	Pass
Roof	0.18 (max. 0.20)	0.18 (max. 0.35)	Pass
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	Pass

2a Thermal bridging

Thermal bridging calculated using user-specified y-value of 0.061

3 Air permeability

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

Limiting System Efficiencies

4 Heating efficiency

Main heating system	Heat pump with radiators or underfloor - Electric Air-to-water heat pump	
Secondary heating system	None	

5 Cylinder insulation

Hot water storage	Measured cylinder loss: 1.05 kWh/day Permitted by DBSCG 1.70	Pass
Primary pipework insulated	Yes	Pass

6 Controls

Space heating controls	Programmer and room thermostat	Pass
Hot water controls	Cylinderstat	Pass
	Independent timer for DHW	Pass

7 Low energy lights

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

8 Mechanical ventilation

Not applicable

Criterion 3 – Limiting the effects of heat gains in summer

9 Summertime temperature

Overheating risk (North East England)	Slight	Pass

Based on:

Overshading	Average
Windows facing East	4.33 m², No overhang
Windows facing South	9.14 m², No overhang
Windows facing West	3.12 m², No overhang
Air change rate	8.00 ach
Blinds/curtains	None

Criterion 4 – Building performance consistent with DER and DFEE rate

Party Walls

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

Air permeability and pressure testing

3 Air permeability

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

10 Key features

Party wall U-value	0.00	W/m²K

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

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

Anderson Goddard Ltd

Property Reference	73940-WR12	**Issued on Date**	07/10/2020
Assessment Reference	001	**Prop Type Ref**	Semi
Property	Woodlands Room 12, Raithwaite Bay, WHITBY, YO21 3ST		

SAP Rating	79 C	**DER**	34.23	**TER**	40.09
Environmental	81 B	**% DER<TER**	14.62		
CO_2 Emissions (t/year)	1.28	**DFEE**	73.97	**TFEE**	74.10
General Requirements Compliance	Pass	**% DFEE<TFEE**	0.18		

Assessor Details	Mr. Paul Goddard, Anderson Goddard Limited, Tel: 0161 7757770, paul.goddard@andersongoddard.com	**Assessor ID**	B342-0001
Client			

SUMARY FOR INPUT DATA FOR New Build (As Designed)

Criterion 1 – Achieving the TER and TFEE rate

1a TER and DER

Fuel for main heating	Electricity		
Fuel factor	1.55 (electricity)		
Target Carbon Dioxide Emission Rate (TER)	40.09	$kgCO_2/m^2$	
Dwelling Carbon Dioxide Emission Rate (DER)	34.23	$kgCO_2/m^2$	Pass
	-5.86 (-14.6%)	$kgCO_2/m^2$	

1b TFEE and DFEE

Target Fabric Energy Efficiency (TFEE)	74.10	$kWh/m^2/yr$	
Dwelling Fabric Energy Efficiency (DFEE)	73.97	$kWh/m^2/yr$	
	-0.1 (-0.1%)	$kWh/m^2/yr$	Pass

Criterion 2 – Limits on design flexibility

Limiting Fabric Standards

2 Fabric U-values

Element	Average	Highest	
External wall	0.23 (max. 0.30)	0.23 (max. 0.70)	Pass
Party wall	0.00 (max. 0.20)	-	Pass
Floor	0.20 (max. 0.25)	0.20 (max. 0.70)	Pass
Roof	0.18 (max. 0.20)	0.18 (max. 0.35)	Pass
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	Pass

2a Thermal bridging

Thermal bridging calculated using user-specified y-value of 0.061

3 Air permeability

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

Limiting System Efficiencies

4 Heating efficiency

Main heating system	Heat pump with radiators or underfloor - Electric Air-to-water heat pump	
Secondary heating system	None	

5 Cylinder insulation

Hot water storage	Measured cylinder loss: 1.05 kWh/day Permitted by DBSCG 1.70	Pass
Primary pipework insulated	Yes	Pass

6 Controls

Space heating controls	Programmer and room thermostat	Pass
Hot water controls	Cylinderstat	Pass
	Independent timer for DHW	Pass

7 Low energy lights

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

8 Mechanical ventilation

Not applicable

Criterion 3 – Limiting the effects of heat gains in summer

9 Summertime temperature

Overheating risk (North East England)	Slight	Pass

Based on:

Overshading	Average
Windows facing East	4.33 m², No overhang
Windows facing South	9.14 m², No overhang
Windows facing West	3.12 m², No overhang
Air change rate	8.00 ach
Blinds/curtains	None

Criterion 4 – Building performance consistent with DER and DFEE rate

Party Walls

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

Air permeability and pressure testing

3 Air permeability

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

10 Key features

Party wall U-value	0.00	W/m²K

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

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

Anderson Goddard Ltd

Property Reference	73940-WR01	**Issued on Date**	07/10/2020
Assessment Reference	001	**Prop Type Ref**	Det
Property	Woodlands Room 1, Raithwaite Bay, WHITBY, YO21 3ST		

SAP Rating	76 C	**DER**	38.61	**TER**	43.57
Environmental	78 C	**% DER<TER**	11.39		
CO_2 Emissions (t/year)	1.44	**DFEE**	84.35	**TFEE**	85.87
General Requirements Compliance	Pass	**% DFEE<TFEE**	1.77		

Assessor Details	Mr. Paul Goddard, Anderson Goddard Limited, Tel: 0161 7757770, paul.goddard@andersongoddard.com	**Assessor ID**	B342-0001
Client			

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

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

Detached Bungalow, total floor area 35 m²

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

1a TER and DER
Fuel for main heating:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 43.57 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 38.61 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)85.9 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)84.3 kWh/m²/yrOK

---
2 Fabric U-values

Element	Average	Highest	
External wall	0.23 (max. 0.30)	0.23 (max. 0.70)	OK
Floor	0.22 (max. 0.25)	0.22 (max. 0.70)	OK
Roof	0.18 (max. 0.20)	0.18 (max. 0.35)	OK
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated using user-specified y-value of 0.051

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

---
4 Heating efficiency
Main heating system: Heat pump with radiators or underfloor - Electric
Air-to-water heat pump

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage Measured cylinder loss: 1.05 kWh/day
Permitted by DBSCG 1.70 OK
Primary pipework insulated: Yes OK

---
6 Controls
Space heating controls: Programmer and room thermostat OK

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

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

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (North East England): Slight OK
Based on:
Overshading: Average
Windows facing North: 4.33 m², No overhang
Windows facing East: 9.14 m², No overhang
Windows facing South: 3.12 m², No overhang
Air change rate: 8.00 ach
Blinds/curtains: None

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10 Key features
None

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3424	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2910	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3711	0.3638	0.3565	0.3201	0.3129	0.2765	0.2765	0.2692	0.2910	0.3129	0.3274	0.3420	(22b)
Effective ac	0.5688	0.5662	0.5636	0.5512	0.5489	0.5382	0.5382	0.5362	0.5424	0.5489	0.5536	0.5585	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	74.4500	16.5900	57.8600	0.2300	13.3078	9.0000	520.7400	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			145.1900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.4501			(33)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		4183.9200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							118.2901	(35)
Thermal bridges (User defined value 0.051 * total exposed area)							7.4047	(36)
Total fabric heat loss					(33) + (36) =		56.8548	(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	20.3173	20.2218	20.1282	19.6886	19.6063	19.2235	19.2235	19.1526	19.3709	19.6063	19.7727	19.9467	(38)
Heat transfer coeff	77.1721	77.0766	76.9830	76.5434	76.4611	76.0783	76.0783	76.0074	76.2257	76.4611	76.6275	76.8015	(39)
Average = Sum(39)m / 12 =												76.5430	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1819	2.1792	2.1765	2.1641	2.1618	2.1509	2.1509	2.1489	2.1551	2.1618	2.1665	2.1714	(40)
HLP (average)												2.1641	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.2895	(42)
Average daily hot water use (litres/day)												64.8244	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)

Water storage loss:	
Store volume	125.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):	1.0500 (48)
Temperature factor from Table 2b	0.5400 (49)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Enter (49) or (54) in (55)												0.5670	(55)
Total storage loss													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(56)
If cylinder contains dedicated solar storage													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(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													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(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													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
									Total per year (kWh/year) = Sum(64)m =			1500.7919	(64)
Heat gains from water heating, kWh/month													
	67.8321	60.2614	64.4045	59.2832	59.2173	54.5246	53.8982	57.0294	56.2664	61.3974	62.9741	66.7226	(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	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	9.8146	8.7172	7.0893	5.3671	4.0119	3.3871	3.6598	4.7572	6.3851	8.1073	9.4625	10.0874	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	110.0897	111.2321	108.3533	102.2247	94.4885	87.2176	82.3601	81.2177	84.0965	90.2251	97.9613	105.2323	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	91.1722	89.6747	86.5651	82.3377	79.5931	75.7286	72.4438	76.6525	78.1478	82.5233	87.4640	89.6810	(72)
Total internal gains													
	256.4182	254.9658	247.3495	235.2713	223.4353	211.6749	203.8055	207.9691	213.9712	226.1975	240.2295	250.3424	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.3300	10.6334	0.7200	0.7000	0.7700	16.0814	(74)
East	9.1400	19.6403	0.7200	0.7000	0.7700	62.6985	(76)
South	3.1200	46.7521	0.7200	0.7000	0.7700	50.9471	(78)

Solar gains	129.7270	236.8221	360.4969	498.5971	599.2055	611.0124	582.4954	506.1457	408.7376	272.1152	158.4058	108.9894	(83)
Total gains	386.1452	491.7879	607.8465	733.8684	822.6409	822.6873	786.3009	714.1148	622.7087	498.3127	398.6353	359.3318	(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	15.0599	15.0785	15.0968	15.1835	15.1999	15.2764	15.2764	15.2906	15.2468	15.1999	15.1669	15.1325	
alpha	2.0040	2.0052	2.0065	2.0122	2.0133	2.0184	2.0184	2.0194	2.0165	2.0133	2.0111	2.0088	
util living area													
	0.9357	0.8994	0.8397	0.7420	0.6184	0.4864	0.3785	0.4228	0.6107	0.8071	0.9086	0.9435	(86)
MIT	17.8096	18.2510	18.9132	19.6816	20.3006	20.6993	20.8714	20.8345	20.4956	19.6415	18.5728	17.7194	(87)
Th 2	19.9091	19.9104	19.9117	19.9180	19.9191	19.9245	19.9245	19.9255	19.9225	19.9191	19.9168	19.9143	(88)
util rest of house													
	0.9281	0.8880	0.8217	0.7132	0.5752	0.4246	0.2988	0.3411	0.5511	0.7781	0.8962	0.9368	(89)
MIT 2	16.9982	17.4312	18.0758	18.8126	19.3825	19.7312	19.8623	19.8409	19.5740	18.7963	17.7592	16.9129	(90)
Living area fraction									fLA = Living area / (4) =			0.5900	(91)
MIT	17.4770	17.9149	18.5699	19.3253	19.9242	20.3024	20.4577	20.4272	20.1178	19.2950	18.2393	17.3888	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.4770	17.9149	18.5699	19.3253	19.9242	20.3024	20.4577	20.4272	20.1178	19.2950	18.2393	17.3888	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9058	0.8617	0.7952	0.6956	0.5755	0.4472	0.3395	0.3807	0.5627	0.7585	0.8718	0.9158	(94)
Useful gains	349.7569	423.7775	483.3873	510.4586	473.3983	367.9258	266.9662	271.8334	350.4139	377.9911	347.5240	329.0807	(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													
	1016.8948	1003.1464	929.1760	797.9909	628.8324	433.8312	293.4849	306.0982	458.7117	664.8300	853.5758	1012.9169	(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													
	496.3506	389.3359	331.6668	207.0233	115.6430	0.0000	0.0000	0.0000	0.0000	213.4082	364.3573	508.7742	(98)
Space heating												2626.5593	(98)
Space heating per m2											(98) / (4) =	74.2595	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	170.0000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1545.0349	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	496.3506	389.3359	331.6668	207.0233	115.6430	0.0000	0.0000	0.0000	0.0000	213.4082	364.3573	508.7742	(98)
Space heating efficiency (main heating system 1)													
	170.0000	170.0000	170.0000	170.0000	170.0000	0.0000	0.0000	0.0000	0.0000	170.0000	170.0000	170.0000	(210)
Space heating fuel (main heating system)													
	291.9709	229.0211	195.0981	121.7784	68.0253	0.0000	0.0000	0.0000	0.0000	125.5342	214.3278	299.2789	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
Efficiency of water heater												170.0000	(216)
(217)m	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	(217)
Fuel for water heating, kWh/month													
	86.2267	76.1020	80.1629	72.1922	70.9860	63.7736	61.5759	67.1155	66.8552	74.8429	78.7219	84.2640	(219)
Water heating fuel used												882.8188	(219)
Annual totals kWh/year													
Space heating fuel - main system												1545.0349	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
Total electricity for the above, kWh/year												30.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Total delivered energy for all uses												2631.1821	(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	1545.0349	0.5190	801.8731	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	882.8188	0.5190	458.1829	(264)
Space and water heating			1260.0560	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Total CO2, kg/year			1365.5835	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			38.6100	(273)

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

DER		38.6100	ZC1
Total Floor Area	TFA	35.3700	
Assumed number of occupants	N	1.2895	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		18.4441	ZC2
CO2 emissions from cooking, equation (L16)		4.2394	ZC3
Total CO2 emissions		61.2935	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		61.2935	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000	/ (5) =	0.1848	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.4348	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3696	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4712	0.4620	0.4527	0.4065	0.3973	0.3511	0.3511	0.3419	0.3696	0.3973	0.4158	0.4342	(22b)
Effective ac	0.6110	0.6067	0.6025	0.5826	0.5789	0.5616	0.5616	0.5584	0.5683	0.5789	0.5864	0.5943	(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 Opening Type (Uw = 1.40)			8.8400	1.3258	11.7197			(27)
GF			35.3700	0.1300	4.5981			(28b)
Main	74.4500	8.8400	65.6100	0.1800	11.8098			(29a)
Flat	35.3700		35.3700	0.1300	4.5981			(30)
Total net area of external elements Aum(A, m2)			145.1900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		32.7257			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.5255	(36)
Total fabric heat loss					(33) + (36) =		41.2512	(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	21.8234	21.6694	21.5185	20.8096	20.6770	20.0596	20.0596	19.9453	20.2974	20.6770	20.9453	21.2258	(38)
Heat transfer coeff	63.0746	62.9206	62.7697	62.0608	61.9282	61.3108	61.3108	61.1965	61.5486	61.9282	62.1965	62.4770	(39)
Average = Sum(39)m / 12 =												62.0602	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.7833	1.7789	1.7747	1.7546	1.7509	1.7334	1.7334	1.7302	1.7401	1.7509	1.7585	1.7664	(40)
HLP (average)												1.7546	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.2895	(42)
Average daily hot water use (litres/day)												64.8244	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.2538	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.6770	(55)
Total storage loss													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	20.9878	18.9567	20.9878	20.3108	20.9878	20.3108	20.9878	20.9878	20.3108	20.9878	20.3108	20.9878	(56)
If cylinder contains dedicated solar storage													
	20.9878	18.9567	20.9878	20.3108	20.9878	20.3108	20.9878	20.9878	20.3108	20.9878	20.3108	20.9878	(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													
	149.9962	132.4541	139.6876	126.0274	124.0870	111.7159	108.0898	117.5071	116.9546	130.6437	137.1280	146.6596	(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													
	149.9962	132.4541	139.6876	126.0274	124.0870	111.7159	108.0898	117.5071	116.9546	130.6437	137.1280	146.6596	(64)
								Total per year (kWh/year) = Sum(64)m =				1540.9510	(64)
Heat gains from water heating, kWh/month													
	70.5607	62.7260	67.1331	61.9238	61.9459	57.1652	56.6268	59.7581	58.9070	64.1260	65.6147	69.4513	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	9.8146	8.7172	7.0893	5.3671	4.0119	3.3871	3.6598	4.7572	6.3851	8.1073	9.4625	10.0874	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	110.0897	111.2321	108.3533	102.2247	94.4885	87.2176	82.3601	81.2177	84.0965	90.2251	97.9613	105.2323	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	94.8397	93.3422	90.2326	86.0052	83.2606	79.3961	76.1113	80.3200	81.8153	86.1908	91.1315	93.3485	(72)
Total internal gains													
	260.0857	258.6333	251.0170	238.9388	227.1028	215.3424	207.4730	211.6366	217.6387	229.8650	243.8970	254.0099	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.3100	10.6334	0.6300	0.7000	0.7700	7.5068	(74)
East	4.8700	19.6403	0.6300	0.7000	0.7700	29.2313	(76)
South	1.6600	46.7521	0.6300	0.7000	0.7700	23.7181	(78)

Solar gains	60.4563	110.3727	168.0295	232.4236	279.3427	284.8551	271.5572	235.9501	190.5232	126.8260	73.8227	50.7911	(83)
Total gains	320.5420	369.0060	419.0465	471.3624	506.4456	500.1976	479.0302	447.5868	408.1618	356.6910	317.7197	304.8010	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	38.9420	39.0373	39.1311	39.5781	39.6629	40.0623	40.0623	40.1371	39.9075	39.6629	39.4918	39.3145	
alpha	3.5961	3.6025	3.6087	3.6385	3.6442	3.6708	3.6708	3.6758	3.6605	3.6442	3.6328	3.6210	
util living area													
	0.9903	0.9831	0.9662	0.9227	0.8320	0.6822	0.5311	0.5810	0.8007	0.9446	0.9832	0.9919	(86)
MIT	19.2481	19.4509	19.7954	20.2441	20.6301	20.8772	20.9631	20.9485	20.7654	20.2650	19.6802	19.2161	(87)
Th 2	19.4817	19.4848	19.4878	19.5019	19.5046	19.5170	19.5170	19.5193	19.5122	19.5046	19.4992	19.4936	(88)
util rest of house													
	0.9869	0.9772	0.9538	0.8929	0.7660	0.5615	0.3670	0.4156	0.6996	0.9168	0.9761	0.9891	(89)
MIT 2	17.2459	17.5409	18.0368	18.6714	19.1702	19.4445	19.5063	19.5022	19.3452	18.7179	17.8851	17.2068	(90)
Living area fraction									fLA = Living area / (4) =			0.5900	(91)
MIT	18.4273	18.6679	19.0745	19.5994	20.0316	20.2899	20.3659	20.3556	20.1832	19.6308	18.9443	18.3924	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4273	18.6679	19.0745	19.5994	20.0316	20.2899	20.3659	20.3556	20.1832	19.6308	18.9443	18.3924	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9836	0.9729	0.9495	0.8952	0.7919	0.6284	0.4643	0.5133	0.7503	0.9197	0.9726	0.9862	(94)
Useful gains	315.3006	359.0192	397.8962	421.9821	401.0646	314.3180	222.4004	229.7662	306.2519	328.0568	309.0292	300.5843	(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													
	891.0713	866.2852	789.2973	664.0146	515.9620	348.8520	230.8892	242.0669	374.4105	559.2589	736.6723	886.6977	(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													
	428.3734	340.8828	291.2024	174.2634	85.4837	0.0000	0.0000	0.0000	0.0000	172.0143	307.9031	436.0684	(98)
Space heating												2236.1914	(98)
Space heating per m2											(98) / (4) =	63.2228	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2391.6486	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	428.3734	340.8828	291.2024	174.2634	85.4837	0.0000	0.0000	0.0000	0.0000	172.0143	307.9031	436.0684	(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)	458.1534	364.5805	311.4465	186.3780	91.4264	0.0000	0.0000	0.0000	0.0000	183.9725	329.3081	466.3833	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	149.9962	132.4541	139.6876	126.0274	124.0870	111.7159	108.0898	117.5071	116.9546	130.6437	137.1280	146.6596	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.4587	87.2271	86.7300	85.6786	83.8435	79.8000	79.8000	79.8000	79.8000	85.5486	86.9093	87.5457	(217)
Fuel for water heating, kWh/month	171.5052	151.8496	161.0603	147.0933	147.9984	139.9949	135.4509	147.2520	146.5596	152.7129	157.7829	167.5235	(219)
Water heating fuel used												1826.7835	(219)
Annual totals kWh/year													
Space heating fuel - main system												2391.6486	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Total delivered energy for all uses												4466.7607	(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	2391.6486	0.2160	516.5961	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1826.7835	0.2160	394.5852	(264)
Space and water heating			911.1813	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Total CO2, kg/m2/year			1040.0638	(272)
Emissions per m2 for space and water heating			25.7614	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			2.5433	(272b)
Emissions per m2 for pumps and fans			1.1005	(272c)
Target Carbon Dioxide Emission Rate (TER) = (25.7614 * 1.55) + 2.5433 + 1.1005, rounded to 2 d.p.			43.5700	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1848	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4348	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3696	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4712	0.4620	0.4527	0.4065	0.3973	0.3511	0.3511	0.3419	0.3696	0.3973	0.4158	0.4342	(22b)
Effective ac	0.6110	0.6067	0.6025	0.5826	0.5789	0.5616	0.5616	0.5584	0.5683	0.5789	0.5864	0.5943	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	74.4500	16.5900	57.8600	0.2300	13.3078	9.0000	520.7400	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			145.1900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.4501			(33)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		4183.9200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							118.2901	(35)
Thermal bridges (User defined value 0.051 * total exposed area)							7.4047	(36)
Total fabric heat loss					(33) + (36) =		56.8548	(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	21.8234	21.6694	21.5185	20.8096	20.6770	20.0596	20.0596	19.9453	20.2974	20.6770	20.9453	21.2258	(38)
Heat transfer coeff	78.6782	78.5242	78.3733	77.6645	77.5318	76.9144	76.9144	76.8001	77.1522	77.5318	77.8001	78.0806	(39)
Average = Sum(39)m / 12 =												77.6638	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.2244	2.2201	2.2158	2.1958	2.1920	2.1746	2.1746	2.1713	2.1813	2.1920	2.1996	2.2075	(40)
HLP (average)												2.1958	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.2895	(42)
Average daily hot water use (litres/day)												64.8244	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(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													

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	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													
	22.4710	19.6533	20.2805	17.6810	16.9653	14.6398	13.5659	15.5671	15.7530	18.3586	20.0399	21.7620	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	9.8146	8.7172	7.0893	5.3671	4.0119	3.3871	3.6598	4.7572	6.3851	8.1073	9.4625	10.0874	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	110.0897	111.2321	108.3533	102.2247	94.4885	87.2176	82.3601	81.2177	84.0965	90.2251	97.9613	105.2323	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	30.2030	29.2460	27.2587	24.5569	22.8029	20.3330	18.2338	20.9235	21.8792	24.6756	27.8331	29.2500	(72)
Total internal gains													
	192.4491	191.5371	185.0431	174.4905	163.6451	153.2794	146.5955	149.2402	154.7025	165.3497	177.5987	186.9114	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.3300	10.6334	0.7200	0.7000	0.7700	16.0814	(74)
East	9.1400	19.6403	0.7200	0.7000	0.7700	62.6985	(76)
South	3.1200	46.7521	0.7200	0.7000	0.7700	50.9471	(78)

Solar gains	129.7270	236.8221	360.4969	498.5971	599.2055	611.0124	582.4954	506.1457	408.7376	272.1152	158.4058	108.9894	(83)
Total gains	322.1760	428.3592	545.5400	673.0876	762.8506	764.2918	729.0909	655.3859	563.4401	437.4649	336.0045	295.9008	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	14.7716	14.8005	14.8290	14.9644	14.9900	15.1103	15.1103	15.1328	15.0637	14.9900	14.9383	14.8846	
alpha	1.9848	1.9867	1.9886	1.9976	1.9993	2.0074	2.0074	2.0089	2.0042	1.9993	1.9959	1.9923	
util living area													
	0.9529	0.9198	0.8640	0.7696	0.6476	0.5149	0.4050	0.4540	0.6480	0.8397	0.9311	0.9597	(86)
MIT	17.5721	18.0343	18.7311	19.5542	20.2211	20.6597	20.8513	20.8078	20.4247	19.4936	18.3676	17.4866	(87)
Th 2	19.1879	19.1906	19.1933	19.2060	19.2084	19.2195	19.2195	19.2216	19.2152	19.2084	19.2036	19.1986	(88)
util rest of house													
	0.9429	0.9033	0.8360	0.7222	0.5736	0.4055	0.2609	0.3058	0.5440	0.7939	0.9138	0.9510	(89)
MIT 2	16.2343	16.6850	17.3554	18.1285	18.7123	19.0631	19.1807	19.1654	18.9119	18.1099	17.0300	16.1572	(90)
Living area fraction										fLA = Living area / (4) =		0.5900	(91)
MIT	17.0237	17.4812	18.1671	18.9697	19.6025	20.0052	20.1664	20.1345	19.8045	18.9263	17.8192	16.9416	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.0237	17.4812	18.1671	18.9697	19.6025	20.0052	20.1664	20.1345	19.8045	18.9263	17.8192	16.9416	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9260	0.8827	0.8163	0.7150	0.5915	0.4569	0.3414	0.3866	0.5822	0.7850	0.8959	0.9356	(94)
Useful gains	298.3437	378.0914	445.3423	481.2396	451.2118	349.2330	248.9214	253.3604	328.0417	343.4177	301.0175	276.8314	(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													
	1001.0757	987.9257	914.3929	782.0570	612.6991	415.7358	274.3111	286.8072	440.1160	645.5570	833.9573	994.8713	(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													
	522.8326	409.8086	348.9736	216.5885	120.1466	0.0000	0.0000	0.0000	0.0000	224.7917	383.7166	534.2217	(98)
Space heating												2761.0799	(98)
Space heating per m2											(98) / (4) =	78.0628	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	722.9956	569.1668	583.6807	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7512	0.8044	0.7711	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	543.1257	457.8209	450.0935	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	942.9616	900.9628	815.4510	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	287.8818	329.6976	271.8260	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												889.4054	(104)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Cooled fraction										fC = cooled area / (4) =		1.0000 (105)
Intermittency factor (Table 10b)												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	71.9705	82.4244	67.9565	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												222.3513 (107)
Space cooling per m2												6.2864 (108)
Energy for space heating												78.0628 (99)
Energy for space cooling												6.2864 (108)
Total												84.3492 (109)
Dwelling Fabric Energy Efficiency (DFEE)												84.3 (109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000	/ (5) =	0.1848	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.4348	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3696	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4712	0.4620	0.4527	0.4065	0.3973	0.3511	0.3511	0.3419	0.3696	0.3973	0.4158	0.4342	(22b)
Effective ac	0.6110	0.6067	0.6025	0.5826	0.5789	0.5616	0.5616	0.5584	0.5683	0.5789	0.5864	0.5943	(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 Opening Type (Uw = 1.40)			8.8400	1.3258	11.7197			(27)
GF			35.3700	0.1300	4.5981			(28b)
Main	74.4500	8.8400	65.6100	0.1800	11.8098			(29a)
Flat	35.3700		35.3700	0.1300	4.5981			(30)
Total net area of external elements Aum(A, m2)			145.1900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		32.7257			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.5255	(36)
Total fabric heat loss					(33) + (36) =		41.2512	(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	21.8234	21.6694	21.5185	20.8096	20.6770	20.0596	20.0596	19.9453	20.2974	20.6770	20.9453	21.2258	(38)
Heat transfer coeff	63.0746	62.9206	62.7697	62.0608	61.9282	61.3108	61.3108	61.1965	61.5486	61.9282	62.1965	62.4770	(39)
Average = Sum(39)m / 12 =												62.0602	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.7833	1.7789	1.7747	1.7546	1.7509	1.7334	1.7334	1.7302	1.7401	1.7509	1.7585	1.7664	(40)
HLP (average)												1.7546	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895	(42)
Average daily hot water use (litres/day)	64.8244	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(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)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Heat gains from water heating, kWh/month

	22.4710	19.6533	20.2805	17.6810	16.9653	14.6398	13.5659	15.5671	15.7530	18.3586	20.0399	21.7620 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	9.8146	8.7172	7.0893	5.3671	4.0119	3.3871	3.6598	4.7572	6.3851	8.1073	9.4625	10.0874	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	110.0897	111.2321	108.3533	102.2247	94.4885	87.2176	82.3601	81.2177	84.0965	90.2251	97.9613	105.2323	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	30.2030	29.2460	27.2587	24.5569	22.8029	20.3330	18.2338	20.9235	21.8792	24.6756	27.8331	29.2500	(72)
Total internal gains													
	192.4491	191.5371	185.0431	174.4905	163.6451	153.2794	146.5955	149.2402	154.7025	165.3497	177.5987	186.9114	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.3100	10.6334	0.6300	0.7000	0.7700	7.5068	(74)
East	4.8700	19.6403	0.6300	0.7000	0.7700	29.2313	(76)
South	1.6600	46.7521	0.6300	0.7000	0.7700	23.7181	(78)

Solar gains	60.4563	110.3727	168.0295	232.4236	279.3427	284.8551	271.5572	235.9501	190.5232	126.8260	73.8227	50.7911	(83)
Total gains	252.9053	301.9098	353.0725	406.9141	442.9878	438.1346	418.1526	385.1903	345.2257	292.1758	251.4214	237.7025	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	38.9420	39.0373	39.1311	39.5781	39.6629	40.0623	40.0623	40.1371	39.9075	39.6629	39.4918	39.3145	
alpha	3.5961	3.6025	3.6087	3.6385	3.6442	3.6708	3.6708	3.6758	3.6605	3.6442	3.6328	3.6210	
util living area													
	0.9955	0.9910	0.9797	0.9477	0.8741	0.7406	0.5925	0.6501	0.8584	0.9685	0.9920	0.9964	(86)
MIT	19.0917	19.2994	19.6548	20.1262	20.5483	20.8370	20.9472	20.9253	20.6923	20.1358	19.5296	19.0597	(87)
Th 2	19.4817	19.4848	19.4878	19.5019	19.5046	19.5170	19.5170	19.5193	19.5122	19.5046	19.4992	19.4936	(88)
util rest of house													
	0.9939	0.9877	0.9717	0.9256	0.8175	0.6222	0.4167	0.4759	0.7712	0.9510	0.9884	0.9951	(89)
MIT 2	17.8004	18.0090	18.3622	18.8290	19.2145	19.4477	19.5059	19.5011	19.3519	18.8498	18.2499	17.7773	(90)
Living area fraction									fLA = Living area / (4) =			0.5900	(91)
MIT	18.5624	18.7704	19.1249	19.5944	20.0015	20.2675	20.3563	20.3414	20.1428	19.6086	19.0050	18.5340	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5624	18.7704	19.1249	19.5944	20.0015	20.2675	20.3563	20.3414	20.1428	19.6086	19.0050	18.5340	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9925	0.9856	0.9693	0.9272	0.8389	0.6871	0.5212	0.5790	0.8137	0.9525	0.9869	0.9940	(94)
Useful gains	251.0038	297.5644	342.2271	377.3061	371.6272	301.0574	217.9573	223.0312	280.9010	278.3103	248.1173	236.2665	(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													
	899.5928	872.7338	792.4602	663.7055	514.0994	347.4768	230.3041	241.2021	371.9258	557.8886	740.4493	895.5461	(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													
	482.5502	386.5138	334.9734	206.2076	105.9993	0.0000	0.0000	0.0000	0.0000	208.0063	354.4790	490.5040	(98)
Space heating												2569.2335	(98)
Space heating per m2											(98) / (4) =	72.6388	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	576.3217	453.7000	465.0933	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7757	0.8470	0.8134	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	447.0648	384.2839	378.2852	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	561.7389	537.5285	499.6380	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	82.5653	114.0140	90.2865	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												286.8658	(104)
Cooled fraction									fC = cooled area / (4) =			1.0000	(105)
Intermittency factor (Table 10b)													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	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	20.6413	28.5035	22.5716	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												71.7165 (107)
Space cooling per m2												2.0276 (108)
Energy for space heating												72.6388 (99)
Energy for space cooling												2.0276 (108)
Total												74.6664 (109)
Target Fabric Energy Efficiency (TFEE)												85.9 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3424	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2910	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	6.6000	6.2000	5.9000	5.1000	4.9000	4.6000	4.2000	4.3000	4.9000	5.4000	5.9000	5.7000	(22)
Wind factor	1.6500	1.5500	1.4750	1.2750	1.2250	1.1500	1.0500	1.0750	1.2250	1.3500	1.4750	1.4250	(22a)
Adj infilt rate	0.4802	0.4511	0.4293	0.3711	0.3565	0.3347	0.3056	0.3129	0.3565	0.3929	0.4293	0.4147	(22b)
Effective ac	0.6153	0.6017	0.5921	0.5688	0.5636	0.5560	0.5467	0.5489	0.5636	0.5772	0.5921	0.5860	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	74.4500	16.5900	57.8600	0.2300	13.3078	9.0000	520.7400	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			145.1900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.4501			(33)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		4183.9200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							118.2901	(35)
Thermal bridges (User defined value 0.051 * total exposed area)							7.4047	(36)
Total fabric heat loss					(33) + (36) =		56.8548	(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	21.9764	21.4924	21.1492	20.3173	20.1282	19.8588	19.5260	19.6063	20.1282	20.6151	21.1492	20.9299	(38)
Heat transfer coeff	78.8312	78.3472	78.0040	77.1721	76.9830	76.7136	76.3808	76.4611	76.9830	77.4699	78.0040	77.7847	(39)
Average = Sum(39)m / 12 =												77.4279	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.2288	2.2151	2.2054	2.1819	2.1765	2.1689	2.1595	2.1618	2.1765	2.1903	2.2054	2.1992	(40)
HLP (average)												2.1891	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.2895	(42)
Average daily hot water use (litres/day)												64.8244	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)

Water storage loss:	
Store volume	125.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):	1.0500 (48)
Temperature factor from Table 2b	0.5400 (49)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Enter (49) or (54) in (55) 0.5670 (55)
Total storage loss
17.5770 15.8760 17.5770 17.0100 17.5770 17.0100 17.5770 17.5770 17.0100 17.5770 17.0100 17.5770 (56)
If cylinder contains dedicated solar storage
17.5770 15.8760 17.5770 17.0100 17.5770 17.0100 17.5770 17.5770 17.0100 17.5770 17.0100 17.5770 (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
146.5855 129.3734 136.2768 122.7267 120.6763 108.4151 104.6790 114.0963 113.6538 127.2329 133.8273 143.2488 (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
146.5855 129.3734 136.2768 122.7267 120.6763 108.4151 104.6790 114.0963 113.6538 127.2329 133.8273 143.2488 (64)
Total per year (kWh/year) = Sum(64)m = 1500.7919 (64)
RHI water heating demand 1501 (64)
Heat gains from water heating, kWh/month
67.8321 60.2614 64.4045 59.2832 59.2173 54.5246 53.8982 57.0294 56.2664 61.3974 62.9741 66.7226 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
24.5364 21.7931 17.7233 13.4177 10.0299 8.4676 9.1496 11.8930 15.9627 20.2684 23.6562 25.2184 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
164.3130 166.0181 161.7214 152.5743 141.0276 130.1755 122.9255 121.2205 125.5172 134.6643 146.2109 157.0631 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
44.0262 44.0262 44.0262 44.0262 44.0262 44.0262 44.0262 44.0262 44.0262 44.0262 44.0262 44.0262 (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)
-51.5780 -51.5780 -51.5780 -51.5780 -51.5780 -51.5780 -51.5780 -51.5780 -51.5780 -51.5780 -51.5780 -51.5780 (71)
Water heating gains (Table 5)
91.1722 89.6747 86.5651 82.3377 79.5931 75.7286 72.4438 76.6525 78.1478 82.5233 87.4640 89.6810 (72)
Total internal gains
352.8368 350.3010 338.8250 321.1448 303.4658 287.1868 277.3341 282.5811 292.4429 310.2711 330.1462 344.7776 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.3300	10.3621	0.7200	0.7000	0.7700	15.6711	(74)
East	9.1400	19.0327	0.7200	0.7000	0.7700	60.7588	(76)
South	3.1200	46.2981	0.7200	0.7000	0.7700	50.4524	(78)

Solar gains	126.8823	231.6520	368.8859	516.3558	621.4785	610.6966	588.5247	516.3760	413.2903	267.7693	151.3147	105.6121	(83)
Total gains	479.7191	581.9529	707.7109	837.5006	924.9443	897.8835	865.8588	798.9571	705.7331	578.0404	481.4610	450.3897	(84)

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7. Mean internal temperature (heating season)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	14.7429	14.8340	14.8992	15.0599	15.0968	15.1499	15.2159	15.1999	15.0968	15.0020	14.8992	14.9412	
alpha	1.9829	1.9889	1.9933	2.0040	2.0065	2.0100	2.0144	2.0133	2.0065	2.0001	1.9933	1.9961	
util living area	0.9191	0.8856	0.8289	0.7433	0.6437	0.5488	0.4646	0.4979	0.6458	0.8054	0.8954	0.9277	(86)
MIT	17.7006	18.1069	18.7378	19.4780	20.0809	20.5031	20.7271	20.6834	20.2896	19.4335	18.3925	17.6086	(87)
Th 2	19.8856	19.8925	19.8973	19.9091	19.9117	19.9156	19.9203	19.9191	19.9117	19.9049	19.8973	19.9004	(88)
util rest of house	0.9104	0.8739	0.8119	0.7182	0.6085	0.4999	0.4028	0.4352	0.5992	0.7800	0.8829	0.9200	(89)
MIT 2	16.8709	17.2722	17.8880	18.6043	19.1690	19.5542	19.7476	19.7152	19.3764	18.5791	17.5634	16.7901	(90)
Living area fraction									fLA = Living area / (4) =			0.5900	(91)
MIT	17.3604	17.7647	18.3894	19.1198	19.7071	20.1141	20.3255	20.2865	19.9152	19.0832	18.0527	17.2730	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.3604	17.7647	18.3894	19.1198	19.7071	20.1141	20.3255	20.2865	19.9152	19.0832	18.0527	17.2730	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8850	0.8459	0.7843	0.6979	0.6013	0.5093	0.4269	0.4575	0.5993	0.7578	0.8565	0.8959	(94)
Useful gains	424.5539	492.2709	555.0582	584.4641	556.2127	457.2835	369.6502	365.4995	422.9563	438.0247	412.3785	403.5104	(95)
Ext temp.	3.1000	3.6000	5.0000	7.2000	9.8000	12.7000	14.7000	14.6000	12.4000	9.1000	5.7000	2.9000	(96)
Heat loss rate W	1124.1684	1109.7672	1044.4286	919.8777	762.6764	568.7645	429.6830	434.7961	578.5422	773.3995	963.5566	1118.0028	(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	520.5132	414.9575	364.0916	241.4978	153.6090	0.0000	0.0000	0.0000	0.0000	249.5189	396.8482	531.5823	(98)

Space heating 2872.6185 (98)
RHI space heating demand 2873 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3424	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2910	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3711	0.3638	0.3565	0.3201	0.3129	0.2765	0.2765	0.2692	0.2910	0.3129	0.3274	0.3420	(22b)
Effective ac	0.5688	0.5662	0.5636	0.5512	0.5489	0.5382	0.5382	0.5362	0.5424	0.5489	0.5536	0.5585	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	74.4500	16.5900	57.8600	0.2300	13.3078	9.0000	520.7400	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			145.1900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.4501			(33)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		4183.9200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							118.2901	(35)
Thermal bridges (User defined value 0.051 * total exposed area)							7.4047	(36)
Total fabric heat loss					(33) + (36) =		56.8548	(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	20.3173	20.2218	20.1282	19.6886	19.6063	19.2235	19.2235	19.1526	19.3709	19.6063	19.7727	19.9467	(38)
Heat transfer coeff	77.1721	77.0766	76.9830	76.5434	76.4611	76.0783	76.0783	76.0074	76.2257	76.4611	76.6275	76.8015	(39)
Average = Sum(39)m / 12 =												76.5430	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1819	2.1792	2.1765	2.1641	2.1618	2.1509	2.1509	2.1489	2.1551	2.1618	2.1665	2.1714	(40)
HLP (average)												2.1641	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895 (42)
Average daily hot water use (litres/day)	64.8244 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)

Water storage loss:	
Store volume	125.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):	1.0500 (48)
Temperature factor from Table 2b	0.5400 (49)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Enter (49) or (54) in (55)												0.5670	(55)
Total storage loss													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(56)
If cylinder contains dedicated solar storage													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(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													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(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													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
									Total per year (kWh/year) = Sum(64)m =			1500.7919	(64)
Heat gains from water heating, kWh/month													
	67.8321	60.2614	64.4045	59.2832	59.2173	54.5246	53.8982	57.0294	56.2664	61.3974	62.9741	66.7226	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.5364	21.7931	17.7233	13.4177	10.0299	8.4676	9.1496	11.8930	15.9627	20.2684	23.6562	25.2184	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	164.3130	166.0181	161.7214	152.5743	141.0276	130.1755	122.9255	121.2205	125.5172	134.6643	146.2109	157.0631	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	91.1722	89.6747	86.5651	82.3377	79.5931	75.7286	72.4438	76.6525	78.1478	82.5233	87.4640	89.6810	(72)
Total internal gains													
	352.8368	350.3010	338.8250	321.1448	303.4658	287.1868	277.3341	282.5811	292.4429	310.2711	330.1462	344.7776	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.3300	10.6334	0.7200	0.7000	0.7700	16.0814	(74)
East	9.1400	19.6403	0.7200	0.7000	0.7700	62.6985	(76)
South	3.1200	46.7521	0.7200	0.7000	0.7700	50.9471	(78)

Solar gains	129.7270	236.8221	360.4969	498.5971	599.2055	611.0124	582.4954	506.1457	408.7376	272.1152	158.4058	108.9894	(83)
Total gains	482.5637	587.1231	699.3219	819.7419	902.6713	898.1992	859.8295	788.7268	701.1804	582.3863	488.5520	453.7670	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	15.0599	15.0785	15.0968	15.1835	15.1999	15.2764	15.2764	15.2906	15.2468	15.1999	15.1669	15.1325	
alpha	2.0040	2.0052	2.0065	2.0122	2.0133	2.0184	2.0184	2.0194	2.0165	2.0133	2.0111	2.0088	
util living area													
	0.9078	0.8687	0.8064	0.7079	0.5860	0.4565	0.3517	0.3911	0.5691	0.7652	0.8752	0.9170	(86)
MIT	18.0737	18.4840	19.0975	19.8049	20.3705	20.7335	20.8880	20.8572	20.5606	19.7916	18.7985	17.9852	(87)
Th 2	19.9091	19.9104	19.9117	19.9180	19.9191	19.9245	19.9245	19.9255	19.9225	19.9191	19.9168	19.9143	(88)
util rest of house													
	0.8976	0.8547	0.7860	0.6775	0.5426	0.3964	0.2761	0.3134	0.5095	0.7328	0.8594	0.9077	(89)
MIT 2	17.2554	17.6553	18.2488	18.9229	19.4398	19.7547	19.8709	19.8534	19.6227	18.9312	17.9754	17.1725	(90)
Living area fraction										fLA = Living area / (4) =		0.5900	(91)
MIT	17.7382	18.1443	18.7496	19.4433	19.9890	20.3322	20.4710	20.4457	20.1761	19.4389	18.4611	17.6520	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.7382	18.1443	18.7496	19.4433	19.9890	20.3322	20.4710	20.4457	20.1761	19.4389	18.4611	17.6520	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8717	0.8271	0.7608	0.6628	0.5456	0.4200	0.3155	0.3522	0.5244	0.7164	0.8334	0.8827	(94)
Useful gains	420.6480	485.5859	532.0361	543.3114	492.4699	377.2624	271.3142	277.7704	367.7005	417.2376	407.1800	400.5582	(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													
	1037.0537	1020.8230	943.0081	807.0214	633.7840	436.0975	294.4987	307.5024	463.1547	675.8318	870.5729	1033.1360	(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													
	458.6059	359.6793	305.7632	189.8712	105.1377	0.0000	0.0000	0.0000	0.0000	192.3941	333.6429	470.6378	(98)
Space heating												2415.7321	(98)
Space heating per m2											(98) / (4) =	68.2989	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												170.0000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												1421.0189	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	458.6059	359.6793	305.7632	189.8712	105.1377	0.0000	0.0000	0.0000	0.0000	192.3941	333.6429	470.6378	(98)
Space heating efficiency (main heating system 1)													
	170.0000	170.0000	170.0000	170.0000	170.0000	0.0000	0.0000	0.0000	0.0000	170.0000	170.0000	170.0000	(210)
Space heating fuel (main heating system)													
	269.7682	211.5761	179.8607	111.6890	61.8457	0.0000	0.0000	0.0000	0.0000	113.1730	196.2605	276.8458	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
Efficiency of water heater												170.0000	(216)
(217)m	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	(217)
Fuel for water heating, kWh/month													
	86.2267	76.1020	80.1629	72.1922	70.9860	63.7736	61.5759	67.1155	66.8552	74.8429	78.7219	84.2640	(219)
Water heating fuel used												882.8188	(219)
Annual totals kWh/year													
Space heating fuel - main system												1421.0189	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
Total electricity for the above, kWh/year												30.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Total delivered energy for all uses												2507.1661	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1421.0189	13.1900	187.4324	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	882.8188	13.1900	116.4438	(247)
Pumps and fans for heating	30.0000	13.1900	3.9570	(249)
Energy for lighting	173.3285	13.1900	22.8620	(250)
Additional standing charges			0.0000	(251)
Total energy cost			330.6952	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.7282	(257)
SAP value		75.8922	
SAP rating (Section 12)		76	(258)
SAP band		C	

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	1421.0189	0.5190	737.5088	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	882.8188	0.5190	458.1829	(264)
Space and water heating			1195.6917	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Total kg/year			1301.2192	(272)
CO2 emissions per m2			36.7900	(273)
EI value			78.3049	
EI rating			78	(274)
EI band			C	

Calculation of stars for heating and DHW

Main heating energy efficiency	13.19 × (1 + 0.29 × 0.00) / 1.7000 = 7.759, stars = 2
Main heating environmental impact	0.519 × (1 + 0.29 × 0.00) / 1.7000 = 0.3053, stars = 4
Water heating energy efficiency	13.19 / 1.7000 = 7.759, stars = 2
Water heating environmental impact	0.519 / 1.7000 = 0.3053, stars = 4

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3424	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2910	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	6.6000	6.2000	5.9000	5.1000	4.9000	4.6000	4.2000	4.3000	4.9000	5.4000	5.9000	5.7000	(22)
Wind factor	1.6500	1.5500	1.4750	1.2750	1.2250	1.1500	1.0500	1.0750	1.2250	1.3500	1.4750	1.4250	(22a)
Adj infilt rate	0.4802	0.4511	0.4293	0.3711	0.3565	0.3347	0.3056	0.3129	0.3565	0.3929	0.4293	0.4147	(22b)
Effective ac	0.6153	0.6017	0.5921	0.5688	0.5636	0.5560	0.5467	0.5489	0.5636	0.5772	0.5921	0.5860	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	74.4500	16.5900	57.8600	0.2300	13.3078	9.0000	520.7400	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			145.1900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.4501			(33)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		4183.9200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							118.2901	(35)
Thermal bridges (User defined value 0.051 * total exposed area)							7.4047	(36)
Total fabric heat loss					(33) + (36) =		56.8548	(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	21.9764	21.4924	21.1492	20.3173	20.1282	19.8588	19.5260	19.6063	20.1282	20.6151	21.1492	20.9299	(38)
Heat transfer coeff	78.8312	78.3472	78.0040	77.1721	76.9830	76.7136	76.3808	76.4611	76.9830	77.4699	78.0040	77.7847	(39)
Average = Sum(39)m / 12 =												77.4279	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.2288	2.2151	2.2054	2.1819	2.1765	2.1689	2.1595	2.1618	2.1765	2.1903	2.2054	2.1992	(40)
HLP (average)												2.1891	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.2895	(42)
Average daily hot water use (litres/day)												64.8244	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)

Water storage loss:	
Store volume	125.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):	1.0500 (48)
Temperature factor from Table 2b	0.5400 (49)

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

Enter (49) or (54) in (55) 0.5670 (55)

Total storage loss

	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770 (56)

If cylinder contains dedicated solar storage

	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770 (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

	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488 (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

	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488 (64)

Total per year (kWh/year) = Sum(64)m = 1500.7919 (64)

Heat gains from water heating, kWh/month

	67.8321	60.2614	64.4045	59.2832	59.2173	54.5246	53.8982	57.0294	56.2664	61.3974	62.9741	66.7226 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	(66)

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

	24.5364	21.7931	17.7233	13.4177	10.0299	8.4676	9.1496	11.8930	15.9627	20.2684	23.6562	25.2184	(67)

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

	164.3130	166.0181	161.7214	152.5743	141.0276	130.1755	122.9255	121.2205	125.5172	134.6643	146.2109	157.0631	(68)

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

	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	(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)

	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)

Water heating gains (Table 5)

	91.1722	89.6747	86.5651	82.3377	79.5931	75.7286	72.4438	76.6525	78.1478	82.5233	87.4640	89.6810	(72)

Total internal gains

	352.8368	350.3010	338.8250	321.1448	303.4658	287.1868	277.3341	282.5811	292.4429	310.2711	330.1462	344.7776	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.3300	10.3621	0.7200	0.7000	0.7700	15.6711	(74)
East	9.1400	19.0327	0.7200	0.7000	0.7700	60.7588	(76)
South	3.1200	46.2981	0.7200	0.7000	0.7700	50.4524	(78)

Solar gains	126.8823	231.6520	368.8859	516.3558	621.4785	610.6966	588.5247	516.3760	413.2903	267.7693	151.3147	105.6121	(83)
Total gains	479.7191	581.9529	707.7109	837.5006	924.9443	897.8835	865.8588	798.9571	705.7331	578.0404	481.4610	450.3897	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	14.7429	14.8340	14.8992	15.0599	15.0968	15.1499	15.2159	15.1999	15.0968	15.0020	14.8992	14.9412	
alpha	1.9829	1.9889	1.9933	2.0040	2.0065	2.0100	2.0144	2.0133	2.0065	2.0001	1.9933	1.9961	
util living area	0.9191	0.8856	0.8289	0.7433	0.6437	0.5488	0.4646	0.4979	0.6458	0.8054	0.8954	0.9277	(86)
MIT	17.7006	18.1069	18.7378	19.4780	20.0809	20.5031	20.7271	20.6834	20.2896	19.4335	18.3925	17.6086	(87)
Th 2	19.8856	19.8925	19.8973	19.9091	19.9117	19.9156	19.9203	19.9191	19.9117	19.9049	19.8973	19.9004	(88)
util rest of house	0.9104	0.8739	0.8119	0.7182	0.6085	0.4999	0.4028	0.4352	0.5992	0.7800	0.8829	0.9200	(89)
MIT 2	16.8709	17.2722	17.8880	18.6043	19.1690	19.5542	19.7476	19.7152	19.3764	18.5791	17.5634	16.7901	(90)

Living area fraction fLA = Living area / (4) = 0.5900 (91)

MIT	17.3604	17.7647	18.3894	19.1198	19.7071	20.1141	20.3255	20.2865	19.9152	19.0832	18.0527	17.2730	(92)

Temperature adjustment 0.0000

adjusted MIT	17.3604	17.7647	18.3894	19.1198	19.7071	20.1141	20.3255	20.2865	19.9152	19.0832	18.0527	17.2730	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8850	0.8459	0.7843	0.6979	0.6013	0.5093	0.4269	0.4575	0.5993	0.7578	0.8565	0.8959	(94)
Useful gains	424.5539	492.2709	555.0582	584.4641	556.2127	457.2835	369.6502	365.4995	422.9563	438.0247	412.3785	403.5104	(95)
Ext temp.	3.1000	3.6000	5.0000	7.2000	9.8000	12.7000	14.7000	14.6000	12.4000	9.1000	5.7000	2.9000	(96)
Heat loss rate W	1124.1684	1109.7672	1044.4286	919.8777	762.6764	568.7645	429.6830	434.7961	578.5422	773.3995	963.5566	1118.0028	(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	520.5132	414.9575	364.0916	241.4978	153.6090	0.0000	0.0000	0.0000	0.0000	249.5189	396.8482	531.5823	(98)

Space heating 2872.6185 (98)

Space heating per m2 (98) / (4) = 81.2162 (99)

8c. Space cooling requirement

Not applicable

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

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												170.0000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												1689.7756	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	520.5132	414.9575	364.0916	241.4978	153.6090	0.0000	0.0000	0.0000	0.0000	249.5189	396.8482	531.5823	(98)
Space heating efficiency (main heating system 1)													
	170.0000	170.0000	170.0000	170.0000	170.0000	0.0000	0.0000	0.0000	0.0000	170.0000	170.0000	170.0000	(210)
Space heating fuel (main heating system)													
	306.1842	244.0926	214.1715	142.0576	90.3582	0.0000	0.0000	0.0000	0.0000	146.7758	233.4401	312.6955	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
Efficiency of water heater												170.0000	(216)
(217)m	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	(217)
Fuel for water heating, kWh/month													
	86.2267	76.1020	80.1629	72.1922	70.9860	63.7736	61.5759	67.1155	66.8552	74.8429	78.7219	84.2640	(219)
Water heating fuel used												882.8188	(219)
Annual totals kWh/year													
Space heating fuel - main system												1689.7756	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
Total electricity for the above, kWh/year												30.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Total delivered energy for all uses												2775.9229	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1689.7756	18.7000	315.9880	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	882.8188	18.7000	165.0871	(247)
Pumps and fans for heating	30.0000	18.7000	5.6100	(249)
Energy for lighting	173.3285	18.7000	32.4124	(250)
Additional standing charges			0.0000	(251)
Total energy cost			519.0976	(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	1689.7756	0.5190	876.9935	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	882.8188	0.5190	458.1829	(264)
Space and water heating			1335.1765	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Total kg/year			1440.7040	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	1689.7756	3.0700	5187.6110	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	882.8188	3.0700	2710.2536	(264)
Space and water heating			7897.8646	(265)
Pumps and fans	30.0000	3.0700	92.1000	(267)
Energy for lighting	173.3285	3.0700	532.1186	(268)
Primary energy kWh/year			8522.0832	(272)
Primary energy kWh/m2/year			240.9410	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating:	C 76
Current environmental impact rating:	C 78

(For testing purposes):

A Not considered

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

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 3.7	-£ 73	-203 kg (14.1%)
U Solar photovoltaic panels	+ 16.6	-£ 326	-906 kg (73.2%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£73	5.73 kg/m²	C 80	B 82
Solar photovoltaic panels	£326	25.62 kg/m²	A 96	A 97
Total Savings	£399	31.34 kg/m²		

Potential energy efficiency rating: A 96
Potential environmental impact rating: A 97

Fuel prices for cost data on this page from database revision number 465 TEST (04 Sep 2020)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£519	£446	£73
Space heating	£322	£322	-£1
Water heating	£165	£92	£74
Lighting	£32	£32	£0
Generated (PV)	-£0	-£326	£326
Total cost of fuels	£519	£120	£399
Total cost of uses	£519	£120	£399
Delivered energy	78 kWh/m²	18 kWh/m²	60 kWh/m²
Carbon dioxide emissions	1.4 tonnes	0.3 tonnes	1.1 tonnes
CO2 emissions per m²	41 kg/m²	9 kg/m²	31 kg/m²
Primary energy	241 kWh/m²	56 kWh/m²	185 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000	/ (5) =	0.0924	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3424	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.2910	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3711	0.3638	0.3565	0.3201	0.3129	0.2765	0.2765	0.2692	0.2910	0.3129	0.3274	0.3420	(22b)
Effective ac	0.5688	0.5662	0.5636	0.5512	0.5489	0.5382	0.5382	0.5362	0.5424	0.5489	0.5536	0.5585	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	74.4500	16.5900	57.8600	0.2300	13.3078	9.0000	520.7400	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			145.1900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.4501			(33)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		4183.9200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							118.2901	(35)
Thermal bridges (User defined value 0.051 * total exposed area)							7.4047	(36)
Total fabric heat loss					(33) + (36) =		56.8548	(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	20.3173	20.2218	20.1282	19.6886	19.6063	19.2235	19.2235	19.1526	19.3709	19.6063	19.7727	19.9467	(38)
Heat transfer coeff	77.1721	77.0766	76.9830	76.5434	76.4611	76.0783	76.0783	76.0074	76.2257	76.4611	76.6275	76.8015	(39)
Average = Sum(39)m / 12 =												76.5430	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1819	2.1792	2.1765	2.1641	2.1618	2.1509	2.1509	2.1489	2.1551	2.1618	2.1665	2.1714	(40)
HLP (average)												2.1641	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.2895	(42)
Average daily hot water use (litres/day)												64.8244	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)

Water storage loss:	
Store volume	125.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):	1.0500 (48)
Temperature factor from Table 2b	0.5400 (49)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Enter (49) or (54) in (55)												0.5670	(55)
Total storage loss													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(56)
If cylinder contains dedicated solar storage													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(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													
	146.5855	129.3734	134.8811	115.9731	107.8819	95.8084	91.6521	101.9999	108.2509	125.8372	133.8273	143.2488	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.7781	(H8)
Utilisation factor												0.4302	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												64.8244	(H14)
Volume ratio Veff/V												1.1570	(H15)
Solar storage volume factor												1.0000	(H16)
Solar input												-685.9569	(H17)
Solar input	-19.8914	-33.1930	-56.5315	-75.7633	-93.5992	-92.0229	-90.8068	-79.3384	-62.1378	-42.4328	-23.5940	-16.6457	(63)
								Solar input (sum of months) = Sum(63)m =				-685.9569	(63)
Output from w/h													
	126.6941	96.1804	78.3496	40.2098	14.2827	3.7855	0.8453	22.6615	46.1131	83.4043	110.2332	126.6031	(64)
									Total per year (kWh/year) = Sum(64)m =			749.3626	(64)
Heat gains from water heating, kWh/month													
	67.8321	60.2614	63.2879	53.8803	48.9818	44.4392	43.4766	47.3523	51.9441	60.2808	62.9741	66.7226	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.5364	21.7931	17.7233	13.4177	10.0299	8.4676	9.1496	11.8930	15.9627	20.2684	23.6562	25.2184	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	164.3130	166.0181	161.7214	152.5743	141.0276	130.1755	122.9255	121.2205	125.5172	134.6643	146.2109	157.0631	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	91.1722	89.6747	85.0643	74.8337	65.8358	61.7211	58.4363	63.6455	72.1446	81.0225	87.4640	89.6810	(72)
Total internal gains													
	352.8368	350.3010	337.3242	313.6408	289.7085	273.1794	263.3266	269.5742	286.4397	308.7703	330.1462	344.7776	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.3300	10.6334	0.7200	0.7000	0.7700	16.0814	(74)
East	9.1400	19.6403	0.7200	0.7000	0.7700	62.6985	(76)
South	3.1200	46.7521	0.7200	0.7000	0.7700	50.9471	(78)

Solar gains	129.7270	236.8221	360.4969	498.5971	599.2055	611.0124	582.4954	506.1457	408.7376	272.1152	158.4058	108.9894	(83)
Total gains	482.5637	587.1231	697.8211	812.2379	888.9140	884.1917	845.8220	775.7199	695.1772	580.8855	488.5520	453.7670	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	15.0599	15.0785	15.0968	15.1835	15.1999	15.2764	15.2764	15.2906	15.2468	15.1999	15.1669	15.1325	
alpha	2.0040	2.0052	2.0065	2.0122	2.0133	2.0184	2.0184	2.0194	2.0165	2.0133	2.0111	2.0088	
util living area													
	0.9078	0.8687	0.8069	0.7108	0.5914	0.4618	0.3566	0.3963	0.5721	0.7659	0.8752	0.9170	(86)
MIT	18.0737	18.4840	19.0946	19.7947	20.3592	20.7276	20.8850	20.8536	20.5560	19.7891	18.7985	17.9852	(87)
Th 2	19.9091	19.9104	19.9117	19.9180	19.9191	19.9245	19.9245	19.9255	19.9225	19.9191	19.9168	19.9143	(88)
util rest of house													
	0.8976	0.8547	0.7866	0.6805	0.5480	0.4014	0.2802	0.3179	0.5125	0.7336	0.8594	0.9077	(89)
MIT 2	17.2554	17.6553	18.2461	18.9139	19.4306	19.7507	19.8694	19.8514	19.6194	18.9290	17.9754	17.1725	(90)
Living area fraction										fLA = Living area / (4) =		0.5900	(91)
MIT	17.7382	18.1443	18.7468	19.4336	19.9785	20.3271	20.4687	20.4428	20.1720	19.4365	18.4611	17.6520	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.7382	18.1443	18.7468	19.4336	19.9785	20.3271	20.4687	20.4428	20.1720	19.4365	18.4611	17.6520	(93)

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8. Space heating requirement

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8717	0.8271	0.7613	0.6656	0.5505	0.4248	0.3199	0.3569	0.5272	0.7172	0.8334	0.8827	(94)
Useful gains	420.6480	485.5859	531.2790	540.5914	489.3692	375.6428	270.5498	276.8208	366.4830	416.5833	407.1800	400.5582	(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													
	1037.0537	1020.8230	942.7936	806.2784	632.9842	435.7066	294.3212	307.2790	462.8447	675.6495	870.5729	1033.1360	(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													
	458.6059	359.6793	306.1669	191.2946	106.8496	0.0000	0.0000	0.0000	0.0000	192.7453	333.6429	470.6378	(98)
Space heating												2419.6223	(98)
Space heating per m2											(98) / (4) =	68.4089	(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 %)												170.0000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												1423.3072	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	458.6059	359.6793	306.1669	191.2946	106.8496	0.0000	0.0000	0.0000	0.0000	192.7453	333.6429	470.6378	(98)
Space heating efficiency (main heating system 1)													
	170.0000	170.0000	170.0000	170.0000	170.0000	0.0000	0.0000	0.0000	0.0000	170.0000	170.0000	170.0000	(210)
Space heating fuel (main heating system)													
	269.7682	211.5761	180.0982	112.5263	62.8527	0.0000	0.0000	0.0000	0.0000	113.3796	196.2605	276.8458	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	126.6941	96.1804	78.3496	40.2098	14.2827	3.7855	0.8453	22.6615	46.1131	83.4043	110.2332	126.6031	(64)
Efficiency of water heater												170.0000	(216)
(217)m	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	(217)
Fuel for water heating, kWh/month													
	74.5259	56.5767	46.0880	23.6528	8.4016	2.2268	0.4972	13.3303	27.1254	49.0614	64.8431	74.4724	(219)
Water heating fuel used												440.8015	(219)
Annual totals kWh/year													
Space heating fuel - main system												1423.3072	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												80.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												390.1979	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1423.3072	13.1900	187.7342	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	440.8015	13.1900	58.1417	(247)
Pumps and fans for heating	30.0000	13.1900	3.9570	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	173.3285	13.1900	22.8620	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			51.4671	(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] =	0.2690	(257)
SAP value		96.2480	
SAP rating (Section 12)		96	(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	1423.3072	0.5190	738.6965	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Water heating (other fuel)	440.8015	0.5190	228.7760 (264)
Space and water heating			967.4724 (265)
Pumps and fans	80.0000	0.5190	41.5200 (267)
Energy for lighting	173.3285	0.5190	89.9575 (268)
Energy saving/generation technologies			
PV Unit	-1727.2394	0.5190	-896.4372 (269)
Total kg/year			202.5127 (272)
CO2 emissions per m2			5.7300 (273)
EI value			96.6235
EI rating			97 (274)
EI band			A

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3424	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2910	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	6.6000	6.2000	5.9000	5.1000	4.9000	4.6000	4.2000	4.3000	4.9000	5.4000	5.9000	5.7000	(22)
Wind factor	1.6500	1.5500	1.4750	1.2750	1.2250	1.1500	1.0500	1.0750	1.2250	1.3500	1.4750	1.4250	(22a)
Adj infilt rate	0.4802	0.4511	0.4293	0.3711	0.3565	0.3347	0.3056	0.3129	0.3565	0.3929	0.4293	0.4147	(22b)
Effective ac	0.6153	0.6017	0.5921	0.5688	0.5636	0.5560	0.5467	0.5489	0.5636	0.5772	0.5921	0.5860	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	74.4500	16.5900	57.8600	0.2300	13.3078	9.0000	520.7400	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			145.1900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.4501			(33)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	4183.9200 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		118.2901 (35)
Thermal bridges (User defined value 0.051 * total exposed area)		7.4047 (36)
Total fabric heat loss	(33) + (36) =	56.8548 (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	21.9764	21.4924	21.1492	20.3173	20.1282	19.8588	19.5260	19.6063	20.1282	20.6151	21.1492	20.9299	(38)
Heat transfer coeff	78.8312	78.3472	78.0040	77.1721	76.9830	76.7136	76.3808	76.4611	76.9830	77.4699	78.0040	77.7847	(39)
Average = Sum(39)m / 12 =												77.4279	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.2288	2.2151	2.2054	2.1819	2.1765	2.1689	2.1595	2.1618	2.1765	2.1903	2.2054	2.1992	(40)
HLP (average)												2.1891	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895 (42)
Average daily hot water use (litres/day)	64.8244 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)

Water storage loss:	
Store volume	125.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):	1.0500 (48)
Temperature factor from Table 2b	0.5400 (49)

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

Enter (49) or (54) in (55)												0.5670	(55)
Total storage loss													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(56)
If cylinder contains dedicated solar storage													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(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													
	146.5855	129.3734	134.8811	115.9731	107.8819	95.8084	91.6521	101.9999	108.2509	125.8372	133.8273	143.2488	(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												1091.0709	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1832.9992	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.7972	(H8)
Utilisation factor												0.4267	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												64.8244	(H14)
Volume ratio Veff/V												1.1570	(H15)
Solar storage volume factor												1.0000	(H16)
Solar input												-687.8113	(H17)
Solar input	-19.2686	-32.1683	-57.3554	-77.8632	-96.3853	-91.3308	-91.0993	-80.3442	-62.3188	-41.3797	-22.3236	-15.9741	(63)
								Solar input (sum of months) = Sum(63)m =				-687.8113	(63)
Output from w/h													
	127.3169	97.2050	77.5257	38.1099	11.4966	4.4776	0.5528	21.6557	45.9322	84.4575	111.5037	127.2747	(64)
									Total per year (kWh/year) = Sum(64)m =			747.5082	(64)
Heat gains from water heating, kWh/month													
	67.8321	60.2614	63.2879	53.8803	48.9818	44.4392	43.4766	47.3523	51.9441	60.2808	62.9741	66.7226	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.5364	21.7931	17.7233	13.4177	10.0299	8.4676	9.1496	11.8930	15.9627	20.2684	23.6562	25.2184	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	164.3130	166.0181	161.7214	152.5743	141.0276	130.1755	122.9255	121.2205	125.5172	134.6643	146.2109	157.0631	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	91.1722	89.6747	85.0643	74.8337	65.8358	61.7211	58.4363	63.6455	72.1446	81.0225	87.4640	89.6810	(72)
Total internal gains													
	352.8368	350.3010	337.3242	313.6408	289.7085	273.1794	263.3266	269.5742	286.4397	308.7703	330.1462	344.7776	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.3300	10.3621	0.7200	0.7000	0.7700	15.6711	(74)
East	9.1400	19.0327	0.7200	0.7000	0.7700	60.7588	(76)
South	3.1200	46.2981	0.7200	0.7000	0.7700	50.4524	(78)

Solar gains	126.8823	231.6520	368.8859	516.3558	621.4785	610.6966	588.5247	516.3760	413.2903	267.7693	151.3147	105.6121	(83)
Total gains	479.7191	581.9529	706.2101	829.9966	911.1869	883.8760	851.8513	785.9502	699.7299	576.5396	481.4610	450.3897	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	14.7429	14.8340	14.8992	15.0599	15.0968	15.1499	15.2159	15.1999	15.0968	15.0020	14.8992	14.9412	
alpha	1.9829	1.9889	1.9933	2.0040	2.0065	2.0100	2.0144	2.0133	2.0065	2.0001	1.9933	1.9961	
util living area													
	0.9191	0.8856	0.8294	0.7460	0.6488	0.5543	0.4702	0.5036	0.6488	0.8061	0.8954	0.9277	(86)
MIT	17.7006	18.1069	18.7348	19.4665	20.0664	20.4935	20.7209	20.6765	20.2832	19.4306	18.3925	17.6086	(87)
Th 2	19.8856	19.8925	19.8973	19.9091	19.9117	19.9156	19.9203	19.9191	19.9117	19.9049	19.8973	19.9004	(88)
util rest of house													
	0.9104	0.8739	0.8124	0.7210	0.6137	0.5053	0.4080	0.4406	0.6021	0.7807	0.8829	0.9200	(89)
MIT 2	16.8709	17.2722	17.8851	18.5937	19.1565	19.5467	19.7433	19.7104	19.3712	18.5765	17.5634	16.7901	(90)
Living area fraction									fLA = Living area / (4) =			0.5900	(91)
MIT	17.3604	17.7647	18.3864	19.1087	19.6934	20.1053	20.3202	20.2804	19.9093	19.0805	18.0527	17.2730	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.3604	17.7647	18.3864	19.1087	19.6934	20.1053	20.3202	20.2804	19.9093	19.0805	18.0527	17.2730	(93)

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8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8850	0.8459	0.7848	0.7005	0.6061	0.5144	0.4319	0.4626	0.6020	0.7584	0.8565	0.8959	(94)
Useful gains	424.5539	492.2709	554.2419	581.3768	552.2587	454.6217	367.9556	363.6187	421.2523	437.2738	412.3785	403.5104	(95)
Ext temp.	3.1000	3.6000	5.0000	7.2000	9.8000	12.7000	14.7000	14.6000	12.4000	9.1000	5.7000	2.9000	(96)
Heat loss rate W	1124.1684	1109.7672	1044.1946	919.0184	761.6230	568.0896	429.2716	434.3322	578.0890	773.1862	963.5566	1118.0028	(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	520.5132	414.9575	364.5247	243.1019	155.7670	0.0000	0.0000	0.0000	0.0000	249.9188	396.8482	531.5823	(98)
Space heating												2877.2138	(98)
Space heating per m2											(98) / (4) =	81.3462	(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 %)	170.0000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1692.4787	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	520.5132	414.9575	364.5247	243.1019	155.7670	0.0000	0.0000	0.0000	0.0000	249.9188	396.8482	531.5823	(98)
Space heating efficiency (main heating system 1)													
	170.0000	170.0000	170.0000	170.0000	170.0000	0.0000	0.0000	0.0000	0.0000	170.0000	170.0000	170.0000	(210)
Space heating fuel (main heating system)													
	306.1842	244.0926	214.4263	143.0011	91.6277	0.0000	0.0000	0.0000	0.0000	147.0111	233.4401	312.6955	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	127.3169	97.2050	77.5257	38.1099	11.4966	4.4776	0.5528	21.6557	45.9322	84.4575	111.5037	127.2747	(64)
Efficiency of water heater												170.0000	(216)
(217)m	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	(217)
Fuel for water heating, kWh/month													
	74.8923	57.1794	45.6033	22.4176	6.7627	2.6339	0.3252	12.7386	27.0189	49.6809	65.5904	74.8675	(219)
Water heating fuel used												439.7107	(219)
Annual totals kWh/year													
Space heating fuel - main system												1692.4787	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												80.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1091 * 0.80) =										-1745.7135		-1745.7135	(233)
Total delivered energy for all uses												639.8044	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1692.4787	18.7000	316.4935	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	439.7107	18.7000	82.2259	(247)
Pumps and fans for heating	30.0000	18.7000	5.6100	(249)
Pump for solar water heating	50.0000	18.7000	9.3500	(249)
Energy for lighting	173.3285	18.7000	32.4124	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-1745.7135	18.7000	-326.4484	(252)
Total energy cost			119.6434	(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	1692.4787	0.5190	878.3964	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	439.7107	0.5190	228.2098	(264)
Space and water heating			1106.6063	(265)
Pumps and fans	80.0000	0.5190	41.5200	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Energy saving/generation technologies				
PV Unit	-1745.7135	0.5190	-906.0253	(269)
Total kg/year			332.0585	(272)

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

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	1692.4787	3.0700	5195.9096	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	439.7107	3.0700	1349.9118	(264)
Space and water heating			6545.8214	(265)
Pumps and fans	80.0000	3.0700	245.6000	(267)
Energy for lighting	173.3285	3.0700	532.1186	(268)
Energy saving/generation technologies				
PV Unit	-1745.7135	3.0700	-5359.3404	(269)
Primary energy kWh/year			1964.1995	(272)
Primary energy kWh/m2/year			55.5329	(273)

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

Overheating Calculation Input Data

Dwelling type	Detached Bungalow
Number of storeys	1
Cross ventilation possible	Yes
SAP Region	North East England
Front of dwelling faces	South
Overshading	Average or unknown
Thermal mass parameter	118.3 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	6.00 (Windows fully open)

Overheating Calculation

Summer ventilation heat loss coefficient	214.30	(P1)
Transmission heat loss coefficient	56.85	(37)
Summer heat loss coefficient	271.15	(P2)

Overhangs

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

Solar shading

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

[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	4.3300	74.6426	0.7200	0.7000	0.9000	131.9443
East	9.1400	111.2086	0.7200	0.7000	0.9000	414.9541
South	3.1200	110.4126	0.7200	0.7000	0.9000	140.6335
total:						687.5319

	Jun	Jul	Aug	
Solar gains	710	688	592	(P3)
Internal gains	284	274	280	
Total summer gains	994	962	871	(P5)
Summer gain/loss ratio	3.67	3.55	3.21	(P6)
Summer external temperature	13.80	15.80	15.60	
Thermal mass temperature increment (TMP = 118.3)	1.17	1.17	1.17	
Threshold temperature	18.64	20.52	19.99	(P7)
Likelihood of high internal temperature	Not significant	Slight	Not significant	

Assessment of likelihood of high internal temperature: Slight

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

Anderson Goddard Ltd

Property Reference	73940-WR02	**Issued on Date**	07/10/2020
Assessment Reference	001	**Prop Type Ref**	Det
Property	Woodlands Room 2, Raithwaite Bay, WHITBY, YO21 3ST		

SAP Rating	76 C	**DER**	38.61	**TER**	43.57
Environmental	78 C	**% DER<TER**	11.39		
CO_2 Emissions (t/year)	1.44	**DFEE**	84.35	**TFEE**	85.87
General Requirements Compliance	Pass	**% DFEE<TFEE**	1.77		

Assessor Details	Mr. Paul Goddard, Anderson Goddard Limited, Tel: 0161 7757770, paul.goddard@andersongoddard.com	**Assessor ID**	B342-0001
Client			

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

Detached Bungalow, total floor area 35 m²

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

1a TER and DER
Fuel for main heating:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 43.57 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 38.61 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)85.9 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)84.3 kWh/m²/yrOK

---
2 Fabric U-values

Element	Average	Highest	
External wall	0.23 (max. 0.30)	0.23 (max. 0.70)	OK
Floor	0.22 (max. 0.25)	0.22 (max. 0.70)	OK
Roof	0.18 (max. 0.20)	0.18 (max. 0.35)	OK
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated using user-specified y-value of 0.051

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

---
4 Heating efficiency
Main heating system: Heat pump with radiators or underfloor - Electric
Air-to-water heat pump

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage Measured cylinder loss: 1.05 kWh/day
Permitted by DBSCG 1.70 OK
Primary pipework insulated: Yes OK

---
6 Controls
Space heating controls: Programmer and room thermostat OK

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

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

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (North East England): Slight OK
Based on:
Overshading: Average
Windows facing North: 4.33 m², No overhang
Windows facing East: 9.14 m², No overhang
Windows facing South: 3.12 m², No overhang
Air change rate: 8.00 ach
Blinds/curtains: None

---
10 Key features
None

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3424	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2910	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3711	0.3638	0.3565	0.3201	0.3129	0.2765	0.2765	0.2692	0.2910	0.3129	0.3274	0.3420	(22b)
Effective ac	0.5688	0.5662	0.5636	0.5512	0.5489	0.5382	0.5382	0.5362	0.5424	0.5489	0.5536	0.5585	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	74.4500	16.5900	57.8600	0.2300	13.3078	9.0000	520.7400	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			145.1900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.4501			(33)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		4183.9200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							118.2901	(35)
Thermal bridges (User defined value 0.051 * total exposed area)							7.4047	(36)
Total fabric heat loss					(33) + (36) =		56.8548	(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	20.3173	20.2218	20.1282	19.6886	19.6063	19.2235	19.2235	19.1526	19.3709	19.6063	19.7727	19.9467	(38)
Heat transfer coeff	77.1721	77.0766	76.9830	76.5434	76.4611	76.0783	76.0783	76.0074	76.2257	76.4611	76.6275	76.8015	(39)
Average = Sum(39)m / 12 =												76.5430	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1819	2.1792	2.1765	2.1641	2.1618	2.1509	2.1509	2.1489	2.1551	2.1618	2.1665	2.1714	(40)
HLP (average)												2.1641	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.2895	(42)
Average daily hot water use (litres/day)												64.8244	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)

Water storage loss:	
Store volume	125.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):	1.0500 (48)
Temperature factor from Table 2b	0.5400 (49)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Enter (49) or (54) in (55)												0.5670	(55)
Total storage loss													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(56)
If cylinder contains dedicated solar storage													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(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													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(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													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
									Total per year (kWh/year) = Sum(64)m =			1500.7919	(64)
Heat gains from water heating, kWh/month													
	67.8321	60.2614	64.4045	59.2832	59.2173	54.5246	53.8982	57.0294	56.2664	61.3974	62.9741	66.7226	(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	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	9.8146	8.7172	7.0893	5.3671	4.0119	3.3871	3.6598	4.7572	6.3851	8.1073	9.4625	10.0874	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	110.0897	111.2321	108.3533	102.2247	94.4885	87.2176	82.3601	81.2177	84.0965	90.2251	97.9613	105.2323	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	91.1722	89.6747	86.5651	82.3377	79.5931	75.7286	72.4438	76.6525	78.1478	82.5233	87.4640	89.6810	(72)
Total internal gains													
	256.4182	254.9658	247.3495	235.2713	223.4353	211.6749	203.8055	207.9691	213.9712	226.1975	240.2295	250.3424	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.3300	10.6334	0.7200	0.7000	0.7700	16.0814	(74)
East	9.1400	19.6403	0.7200	0.7000	0.7700	62.6985	(76)
South	3.1200	46.7521	0.7200	0.7000	0.7700	50.9471	(78)

Solar gains	129.7270	236.8221	360.4969	498.5971	599.2055	611.0124	582.4954	506.1457	408.7376	272.1152	158.4058	108.9894	(83)
Total gains	386.1452	491.7879	607.8465	733.8684	822.6409	822.6873	786.3009	714.1148	622.7087	498.3127	398.6353	359.3318	(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	15.0599	15.0785	15.0968	15.1835	15.1999	15.2764	15.2764	15.2906	15.2468	15.1999	15.1669	15.1325	
alpha	2.0040	2.0052	2.0065	2.0122	2.0133	2.0184	2.0184	2.0194	2.0165	2.0133	2.0111	2.0088	
util living area													
	0.9357	0.8994	0.8397	0.7420	0.6184	0.4864	0.3785	0.4228	0.6107	0.8071	0.9086	0.9435	(86)
MIT	17.8096	18.2510	18.9132	19.6816	20.3006	20.6993	20.8714	20.8345	20.4956	19.6415	18.5728	17.7194	(87)
Th 2	19.9091	19.9104	19.9117	19.9180	19.9191	19.9245	19.9245	19.9255	19.9225	19.9191	19.9168	19.9143	(88)
util rest of house													
	0.9281	0.8880	0.8217	0.7132	0.5752	0.4246	0.2988	0.3411	0.5511	0.7781	0.8962	0.9368	(89)
MIT 2	16.9982	17.4312	18.0758	18.8126	19.3825	19.7312	19.8623	19.8409	19.5740	18.7963	17.7592	16.9129	(90)
Living area fraction									fLA = Living area / (4) =			0.5900	(91)
MIT	17.4770	17.9149	18.5699	19.3253	19.9242	20.3024	20.4577	20.4272	20.1178	19.2950	18.2393	17.3888	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.4770	17.9149	18.5699	19.3253	19.9242	20.3024	20.4577	20.4272	20.1178	19.2950	18.2393	17.3888	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9058	0.8617	0.7952	0.6956	0.5755	0.4472	0.3395	0.3807	0.5627	0.7585	0.8718	0.9158	(94)
Useful gains	349.7569	423.7775	483.3873	510.4586	473.3983	367.9258	266.9662	271.8334	350.4139	377.9911	347.5240	329.0807	(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													
	1016.8948	1003.1464	929.1760	797.9909	628.8324	433.8312	293.4849	306.0982	458.7117	664.8300	853.5758	1012.9169	(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													
	496.3506	389.3359	331.6668	207.0233	115.6430	0.0000	0.0000	0.0000	0.0000	213.4082	364.3573	508.7742	(98)
Space heating												2626.5593	(98)
Space heating per m2											(98) / (4) =	74.2595	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	170.0000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1545.0349	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	496.3506	389.3359	331.6668	207.0233	115.6430	0.0000	0.0000	0.0000	0.0000	213.4082	364.3573	508.7742	(98)
Space heating efficiency (main heating system 1)													
	170.0000	170.0000	170.0000	170.0000	170.0000	0.0000	0.0000	0.0000	0.0000	170.0000	170.0000	170.0000	(210)
Space heating fuel (main heating system)													
	291.9709	229.0211	195.0981	121.7784	68.0253	0.0000	0.0000	0.0000	0.0000	125.5342	214.3278	299.2789	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
Efficiency of water heater												170.0000	(216)
(217)m	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	(217)
Fuel for water heating, kWh/month													
	86.2267	76.1020	80.1629	72.1922	70.9860	63.7736	61.5759	67.1155	66.8552	74.8429	78.7219	84.2640	(219)
Water heating fuel used												882.8188	(219)
Annual totals kWh/year													
Space heating fuel - main system												1545.0349	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
Total electricity for the above, kWh/year												30.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Total delivered energy for all uses												2631.1821	(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	1545.0349	0.5190	801.8731	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	882.8188	0.5190	458.1829	(264)
Space and water heating			1260.0560	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Total CO2, kg/year			1365.5835	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			38.6100	(273)

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

DER		38.6100	ZC1
Total Floor Area	TFA	35.3700	
Assumed number of occupants	N	1.2895	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		18.4441	ZC2
CO2 emissions from cooking, equation (L16)		4.2394	ZC3
Total CO2 emissions		61.2935	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		61.2935	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000	/ (5) =	0.1848	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.4348	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3696	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4712	0.4620	0.4527	0.4065	0.3973	0.3511	0.3511	0.3419	0.3696	0.3973	0.4158	0.4342	(22b)
Effective ac	0.6110	0.6067	0.6025	0.5826	0.5789	0.5616	0.5616	0.5584	0.5683	0.5789	0.5864	0.5943	(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 Opening Type (Uw = 1.40)			8.8400	1.3258	11.7197			(27)
GF			35.3700	0.1300	4.5981			(28b)
Main	74.4500	8.8400	65.6100	0.1800	11.8098			(29a)
Flat	35.3700		35.3700	0.1300	4.5981			(30)
Total net area of external elements Aum(A, m2)			145.1900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		32.7257			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.5255	(36)
Total fabric heat loss					(33) + (36) =		41.2512	(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	21.8234	21.6694	21.5185	20.8096	20.6770	20.0596	20.0596	19.9453	20.2974	20.6770	20.9453	21.2258	(38)
Heat transfer coeff	63.0746	62.9206	62.7697	62.0608	61.9282	61.3108	61.3108	61.1965	61.5486	61.9282	62.1965	62.4770	(39)
Average = Sum(39)m / 12 =												62.0602	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.7833	1.7789	1.7747	1.7546	1.7509	1.7334	1.7334	1.7302	1.7401	1.7509	1.7585	1.7664	(40)
HLP (average)												1.7546	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.2895	(42)
Average daily hot water use (litres/day)												64.8244	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.2538	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.6770	(55)
Total storage loss													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	20.9878	18.9567	20.9878	20.3108	20.9878	20.3108	20.9878	20.9878	20.3108	20.9878	20.3108	20.9878	(56)
If cylinder contains dedicated solar storage													
	20.9878	18.9567	20.9878	20.3108	20.9878	20.3108	20.9878	20.9878	20.3108	20.9878	20.3108	20.9878	(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													
	149.9962	132.4541	139.6876	126.0274	124.0870	111.7159	108.0898	117.5071	116.9546	130.6437	137.1280	146.6596	(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													
	149.9962	132.4541	139.6876	126.0274	124.0870	111.7159	108.0898	117.5071	116.9546	130.6437	137.1280	146.6596	(64)
								Total per year (kWh/year) = Sum(64)m =				1540.9510	(64)
Heat gains from water heating, kWh/month													
	70.5607	62.7260	67.1331	61.9238	61.9459	57.1652	56.6268	59.7581	58.9070	64.1260	65.6147	69.4513	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	9.8146	8.7172	7.0893	5.3671	4.0119	3.3871	3.6598	4.7572	6.3851	8.1073	9.4625	10.0874	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	110.0897	111.2321	108.3533	102.2247	94.4885	87.2176	82.3601	81.2177	84.0965	90.2251	97.9613	105.2323	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	94.8397	93.3422	90.2326	86.0052	83.2606	79.3961	76.1113	80.3200	81.8153	86.1908	91.1315	93.3485	(72)
Total internal gains													
	260.0857	258.6333	251.0170	238.9388	227.1028	215.3424	207.4730	211.6366	217.6387	229.8650	243.8970	254.0099	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.3100	10.6334	0.6300	0.7000	0.7700	7.5068	(74)
East	4.8700	19.6403	0.6300	0.7000	0.7700	29.2313	(76)
South	1.6600	46.7521	0.6300	0.7000	0.7700	23.7181	(78)

Solar gains	60.4563	110.3727	168.0295	232.4236	279.3427	284.8551	271.5572	235.9501	190.5232	126.8260	73.8227	50.7911	(83)
Total gains	320.5420	369.0060	419.0465	471.3624	506.4456	500.1976	479.0302	447.5868	408.1618	356.6910	317.7197	304.8010	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	38.9420	39.0373	39.1311	39.5781	39.6629	40.0623	40.0623	40.1371	39.9075	39.6629	39.4918	39.3145	
alpha	3.5961	3.6025	3.6087	3.6385	3.6442	3.6708	3.6708	3.6758	3.6605	3.6442	3.6328	3.6210	
util living area													
	0.9903	0.9831	0.9662	0.9227	0.8320	0.6822	0.5311	0.5810	0.8007	0.9446	0.9832	0.9919	(86)
MIT	19.2481	19.4509	19.7954	20.2441	20.6301	20.8772	20.9631	20.9485	20.7654	20.2650	19.6802	19.2161	(87)
Th 2	19.4817	19.4848	19.4878	19.5019	19.5046	19.5170	19.5170	19.5193	19.5122	19.5046	19.4992	19.4936	(88)
util rest of house													
	0.9869	0.9772	0.9538	0.8929	0.7660	0.5615	0.3670	0.4156	0.6996	0.9168	0.9761	0.9891	(89)
MIT 2	17.2459	17.5409	18.0368	18.6714	19.1702	19.4445	19.5063	19.5022	19.3452	18.7179	17.8851	17.2068	(90)
Living area fraction									fLA = Living area / (4) =			0.5900	(91)
MIT	18.4273	18.6679	19.0745	19.5994	20.0316	20.2899	20.3659	20.3556	20.1832	19.6308	18.9443	18.3924	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4273	18.6679	19.0745	19.5994	20.0316	20.2899	20.3659	20.3556	20.1832	19.6308	18.9443	18.3924	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9836	0.9729	0.9495	0.8952	0.7919	0.6284	0.4643	0.5133	0.7503	0.9197	0.9726	0.9862	(94)
Useful gains	315.3006	359.0192	397.8962	421.9821	401.0646	314.3180	222.4004	229.7662	306.2519	328.0568	309.0292	300.5843	(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													
	891.0713	866.2852	789.2973	664.0146	515.9620	348.8520	230.8892	242.0669	374.4105	559.2589	736.6723	886.6977	(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													
	428.3734	340.8828	291.2024	174.2634	85.4837	0.0000	0.0000	0.0000	0.0000	172.0143	307.9031	436.0684	(98)
Space heating												2236.1914	(98)
Space heating per m2											(98) / (4) =	63.2228	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2391.6486	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	428.3734	340.8828	291.2024	174.2634	85.4837	0.0000	0.0000	0.0000	0.0000	172.0143	307.9031	436.0684	(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)	458.1534	364.5805	311.4465	186.3780	91.4264	0.0000	0.0000	0.0000	0.0000	183.9725	329.3081	466.3833	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	149.9962	132.4541	139.6876	126.0274	124.0870	111.7159	108.0898	117.5071	116.9546	130.6437	137.1280	146.6596	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.4587	87.2271	86.7300	85.6786	83.8435	79.8000	79.8000	79.8000	79.8000	85.5486	86.9093	87.5457	(217)
Fuel for water heating, kWh/month	171.5052	151.8496	161.0603	147.0933	147.9984	139.9949	135.4509	147.2520	146.5596	152.7129	157.7829	167.5235	(219)
Water heating fuel used												1826.7835	(219)
Annual totals kWh/year													
Space heating fuel - main system												2391.6486	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Total delivered energy for all uses												4466.7607	(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	2391.6486	0.2160	516.5961	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1826.7835	0.2160	394.5852	(264)
Space and water heating			911.1813	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Total CO2, kg/m2/year			1040.0638	(272)
Emissions per m2 for space and water heating			25.7614	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			2.5433	(272b)
Emissions per m2 for pumps and fans			1.1005	(272c)
Target Carbon Dioxide Emission Rate (TER) = (25.7614 * 1.55) + 2.5433 + 1.1005, rounded to 2 d.p.			43.5700	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1848	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4348	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3696	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4712	0.4620	0.4527	0.4065	0.3973	0.3511	0.3511	0.3419	0.3696	0.3973	0.4158	0.4342	(22b)
Effective ac	0.6110	0.6067	0.6025	0.5826	0.5789	0.5616	0.5616	0.5584	0.5683	0.5789	0.5864	0.5943	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	74.4500	16.5900	57.8600	0.2300	13.3078	9.0000	520.7400	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			145.1900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.4501			(33)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		4183.9200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							118.2901	(35)
Thermal bridges (User defined value 0.051 * total exposed area)							7.4047	(36)
Total fabric heat loss					(33) + (36) =		56.8548	(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	21.8234	21.6694	21.5185	20.8096	20.6770	20.0596	20.0596	19.9453	20.2974	20.6770	20.9453	21.2258	(38)
Heat transfer coeff	78.6782	78.5242	78.3733	77.6645	77.5318	76.9144	76.9144	76.8001	77.1522	77.5318	77.8001	78.0806	(39)
Average = Sum(39)m / 12 =												77.6638	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.2244	2.2201	2.2158	2.1958	2.1920	2.1746	2.1746	2.1713	2.1813	2.1920	2.1996	2.2075	(40)
HLP (average)												2.1958	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.2895	(42)
Average daily hot water use (litres/day)												64.8244	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(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													

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	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													
	22.4710	19.6533	20.2805	17.6810	16.9653	14.6398	13.5659	15.5671	15.7530	18.3586	20.0399	21.7620	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	9.8146	8.7172	7.0893	5.3671	4.0119	3.3871	3.6598	4.7572	6.3851	8.1073	9.4625	10.0874	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	110.0897	111.2321	108.3533	102.2247	94.4885	87.2176	82.3601	81.2177	84.0965	90.2251	97.9613	105.2323	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	30.2030	29.2460	27.2587	24.5569	22.8029	20.3330	18.2338	20.9235	21.8792	24.6756	27.8331	29.2500	(72)
Total internal gains													
	192.4491	191.5371	185.0431	174.4905	163.6451	153.2794	146.5955	149.2402	154.7025	165.3497	177.5987	186.9114	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.3300	10.6334	0.7200	0.7000	0.7700	16.0814	(74)
East	9.1400	19.6403	0.7200	0.7000	0.7700	62.6985	(76)
South	3.1200	46.7521	0.7200	0.7000	0.7700	50.9471	(78)

Solar gains	129.7270	236.8221	360.4969	498.5971	599.2055	611.0124	582.4954	506.1457	408.7376	272.1152	158.4058	108.9894	(83)
Total gains	322.1760	428.3592	545.5400	673.0876	762.8506	764.2918	729.0909	655.3859	563.4401	437.4649	336.0045	295.9008	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	14.7716	14.8005	14.8290	14.9644	14.9900	15.1103	15.1103	15.1328	15.0637	14.9900	14.9383	14.8846	
alpha	1.9848	1.9867	1.9886	1.9976	1.9993	2.0074	2.0074	2.0089	2.0042	1.9993	1.9959	1.9923	
util living area													
	0.9529	0.9198	0.8640	0.7696	0.6476	0.5149	0.4050	0.4540	0.6480	0.8397	0.9311	0.9597	(86)
MIT	17.5721	18.0343	18.7311	19.5542	20.2211	20.6597	20.8513	20.8078	20.4247	19.4936	18.3676	17.4866	(87)
Th 2	19.1879	19.1906	19.1933	19.2060	19.2084	19.2195	19.2195	19.2216	19.2152	19.2084	19.2036	19.1986	(88)
util rest of house													
	0.9429	0.9033	0.8360	0.7222	0.5736	0.4055	0.2609	0.3058	0.5440	0.7939	0.9138	0.9510	(89)
MIT 2	16.2343	16.6850	17.3554	18.1285	18.7123	19.0631	19.1807	19.1654	18.9119	18.1099	17.0300	16.1572	(90)
Living area fraction										fLA = Living area / (4) =		0.5900	(91)
MIT	17.0237	17.4812	18.1671	18.9697	19.6025	20.0052	20.1664	20.1345	19.8045	18.9263	17.8192	16.9416	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.0237	17.4812	18.1671	18.9697	19.6025	20.0052	20.1664	20.1345	19.8045	18.9263	17.8192	16.9416	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9260	0.8827	0.8163	0.7150	0.5915	0.4569	0.3414	0.3866	0.5822	0.7850	0.8959	0.9356	(94)
Useful gains	298.3437	378.0914	445.3423	481.2396	451.2118	349.2330	248.9214	253.3604	328.0417	343.4177	301.0175	276.8314	(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													
	1001.0757	987.9257	914.3929	782.0570	612.6991	415.7358	274.3111	286.8072	440.1160	645.5570	833.9573	994.8713	(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													
	522.8326	409.8086	348.9736	216.5885	120.1466	0.0000	0.0000	0.0000	0.0000	224.7917	383.7166	534.2217	(98)
Space heating												2761.0799	(98)
Space heating per m2											(98) / (4) =	78.0628	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	722.9956	569.1668	583.6807	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7512	0.8044	0.7711	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	543.1257	457.8209	450.0935	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	942.9616	900.9628	815.4510	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	287.8818	329.6976	271.8260	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												889.4054	(104)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Cooled fraction										fC = cooled area / (4) =		1.0000 (105)
Intermittency factor (Table 10b)												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	71.9705	82.4244	67.9565	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												222.3513 (107)
Space cooling per m2												6.2864 (108)
Energy for space heating												78.0628 (99)
Energy for space cooling												6.2864 (108)
Total												84.3492 (109)
Dwelling Fabric Energy Efficiency (DFEE)												84.3 (109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000	/ (5) =	0.1848	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.4348	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3696	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4712	0.4620	0.4527	0.4065	0.3973	0.3511	0.3511	0.3419	0.3696	0.3973	0.4158	0.4342	(22b)
Effective ac	0.6110	0.6067	0.6025	0.5826	0.5789	0.5616	0.5616	0.5584	0.5683	0.5789	0.5864	0.5943	(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 Opening Type (Uw = 1.40)			8.8400	1.3258	11.7197			(27)
GF			35.3700	0.1300	4.5981			(28b)
Main	74.4500	8.8400	65.6100	0.1800	11.8098			(29a)
Flat	35.3700		35.3700	0.1300	4.5981			(30)
Total net area of external elements Aum(A, m2)			145.1900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		32.7257			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.5255	(36)
Total fabric heat loss					(33) + (36) =		41.2512	(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	21.8234	21.6694	21.5185	20.8096	20.6770	20.0596	20.0596	19.9453	20.2974	20.6770	20.9453	21.2258	(38)
Heat transfer coeff	63.0746	62.9206	62.7697	62.0608	61.9282	61.3108	61.3108	61.1965	61.5486	61.9282	62.1965	62.4770	(39)
Average = Sum(39)m / 12 =												62.0602	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.7833	1.7789	1.7747	1.7546	1.7509	1.7334	1.7334	1.7302	1.7401	1.7509	1.7585	1.7664	(40)
HLP (average)												1.7546	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895	(42)
Average daily hot water use (litres/day)	64.8244	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(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)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Heat gains from water heating, kWh/month

	22.4710	19.6533	20.2805	17.6810	16.9653	14.6398	13.5659	15.5671	15.7530	18.3586	20.0399	21.7620 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	9.8146	8.7172	7.0893	5.3671	4.0119	3.3871	3.6598	4.7572	6.3851	8.1073	9.4625	10.0874	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	110.0897	111.2321	108.3533	102.2247	94.4885	87.2176	82.3601	81.2177	84.0965	90.2251	97.9613	105.2323	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	30.2030	29.2460	27.2587	24.5569	22.8029	20.3330	18.2338	20.9235	21.8792	24.6756	27.8331	29.2500	(72)
Total internal gains													
	192.4491	191.5371	185.0431	174.4905	163.6451	153.2794	146.5955	149.2402	154.7025	165.3497	177.5987	186.9114	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.3100	10.6334	0.6300	0.7000	0.7700	7.5068	(74)
East	4.8700	19.6403	0.6300	0.7000	0.7700	29.2313	(76)
South	1.6600	46.7521	0.6300	0.7000	0.7700	23.7181	(78)

Solar gains	60.4563	110.3727	168.0295	232.4236	279.3427	284.8551	271.5572	235.9501	190.5232	126.8260	73.8227	50.7911	(83)
Total gains	252.9053	301.9098	353.0725	406.9141	442.9878	438.1346	418.1526	385.1903	345.2257	292.1758	251.4214	237.7025	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	38.9420	39.0373	39.1311	39.5781	39.6629	40.0623	40.0623	40.1371	39.9075	39.6629	39.4918	39.3145	
alpha	3.5961	3.6025	3.6087	3.6385	3.6442	3.6708	3.6708	3.6758	3.6605	3.6442	3.6328	3.6210	
util living area													
	0.9955	0.9910	0.9797	0.9477	0.8741	0.7406	0.5925	0.6501	0.8584	0.9685	0.9920	0.9964	(86)
MIT	19.0917	19.2994	19.6548	20.1262	20.5483	20.8370	20.9472	20.9253	20.6923	20.1358	19.5296	19.0597	(87)
Th 2	19.4817	19.4848	19.4878	19.5019	19.5046	19.5170	19.5170	19.5193	19.5122	19.5046	19.4992	19.4936	(88)
util rest of house													
	0.9939	0.9877	0.9717	0.9256	0.8175	0.6222	0.4167	0.4759	0.7712	0.9510	0.9884	0.9951	(89)
MIT 2	17.8004	18.0090	18.3622	18.8290	19.2145	19.4477	19.5059	19.5011	19.3519	18.8498	18.2499	17.7773	(90)
Living area fraction									fLA = Living area / (4) =			0.5900	(91)
MIT	18.5624	18.7704	19.1249	19.5944	20.0015	20.2675	20.3563	20.3414	20.1428	19.6086	19.0050	18.5340	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5624	18.7704	19.1249	19.5944	20.0015	20.2675	20.3563	20.3414	20.1428	19.6086	19.0050	18.5340	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9925	0.9856	0.9693	0.9272	0.8389	0.6871	0.5212	0.5790	0.8137	0.9525	0.9869	0.9940	(94)
Useful gains	251.0038	297.5644	342.2271	377.3061	371.6272	301.0574	217.9573	223.0312	280.9010	278.3103	248.1173	236.2665	(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													
	899.5928	872.7338	792.4602	663.7055	514.0994	347.4768	230.3041	241.2021	371.9258	557.8886	740.4493	895.5461	(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													
	482.5502	386.5138	334.9734	206.2076	105.9993	0.0000	0.0000	0.0000	0.0000	208.0063	354.4790	490.5040	(98)
Space heating												2569.2335	(98)
Space heating per m2											(98) / (4) =	72.6388	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	576.3217	453.7000	465.0933	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7757	0.8470	0.8134	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	447.0648	384.2839	378.2852	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	561.7389	537.5285	499.6380	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	82.5653	114.0140	90.2865	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												286.8658	(104)
Cooled fraction									fC = cooled area / (4) =			1.0000	(105)
Intermittency factor (Table 10b)													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	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	20.6413	28.5035	22.5716	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												71.7165 (107)
Space cooling per m2												2.0276 (108)
Energy for space heating												72.6388 (99)
Energy for space cooling												2.0276 (108)
Total												74.6664 (109)
Target Fabric Energy Efficiency (TFEE)												85.9 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3424	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2910	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	6.6000	6.2000	5.9000	5.1000	4.9000	4.6000	4.2000	4.3000	4.9000	5.4000	5.9000	5.7000	(22)
Wind factor	1.6500	1.5500	1.4750	1.2750	1.2250	1.1500	1.0500	1.0750	1.2250	1.3500	1.4750	1.4250	(22a)
Adj infilt rate	0.4802	0.4511	0.4293	0.3711	0.3565	0.3347	0.3056	0.3129	0.3565	0.3929	0.4293	0.4147	(22b)
Effective ac	0.6153	0.6017	0.5921	0.5688	0.5636	0.5560	0.5467	0.5489	0.5636	0.5772	0.5921	0.5860	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	74.4500	16.5900	57.8600	0.2300	13.3078	9.0000	520.7400	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			145.1900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.4501			(33)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		4183.9200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							118.2901	(35)
Thermal bridges (User defined value 0.051 * total exposed area)							7.4047	(36)
Total fabric heat loss					(33) + (36) =		56.8548	(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	21.9764	21.4924	21.1492	20.3173	20.1282	19.8588	19.5260	19.6063	20.1282	20.6151	21.1492	20.9299	(38)
Heat transfer coeff	78.8312	78.3472	78.0040	77.1721	76.9830	76.7136	76.3808	76.4611	76.9830	77.4699	78.0040	77.7847	(39)
Average = Sum(39)m / 12 =												77.4279	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.2288	2.2151	2.2054	2.1819	2.1765	2.1689	2.1595	2.1618	2.1765	2.1903	2.2054	2.1992	(40)
HLP (average)												2.1891	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.2895	(42)
Average daily hot water use (litres/day)												64.8244	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)

Water storage loss:	
Store volume	125.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):	1.0500 (48)
Temperature factor from Table 2b	0.5400 (49)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Enter (49) or (54) in (55) 0.5670 (55)
Total storage loss
17.5770 15.8760 17.5770 17.0100 17.5770 17.0100 17.5770 17.5770 17.0100 17.5770 17.0100 17.5770 (56)
If cylinder contains dedicated solar storage
17.5770 15.8760 17.5770 17.0100 17.5770 17.0100 17.5770 17.5770 17.0100 17.5770 17.0100 17.5770 (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
146.5855 129.3734 136.2768 122.7267 120.6763 108.4151 104.6790 114.0963 113.6538 127.2329 133.8273 143.2488 (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
146.5855 129.3734 136.2768 122.7267 120.6763 108.4151 104.6790 114.0963 113.6538 127.2329 133.8273 143.2488 (64)
Total per year (kWh/year) = Sum(64)m = 1500.7919 (64)
RHI water heating demand 1501 (64)
Heat gains from water heating, kWh/month
67.8321 60.2614 64.4045 59.2832 59.2173 54.5246 53.8982 57.0294 56.2664 61.3974 62.9741 66.7226 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
24.5364 21.7931 17.7233 13.4177 10.0299 8.4676 9.1496 11.8930 15.9627 20.2684 23.6562 25.2184 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
164.3130 166.0181 161.7214 152.5743 141.0276 130.1755 122.9255 121.2205 125.5172 134.6643 146.2109 157.0631 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
44.0262 44.0262 44.0262 44.0262 44.0262 44.0262 44.0262 44.0262 44.0262 44.0262 44.0262 44.0262 (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)
-51.5780 -51.5780 -51.5780 -51.5780 -51.5780 -51.5780 -51.5780 -51.5780 -51.5780 -51.5780 -51.5780 -51.5780 (71)
Water heating gains (Table 5)
91.1722 89.6747 86.5651 82.3377 79.5931 75.7286 72.4438 76.6525 78.1478 82.5233 87.4640 89.6810 (72)
Total internal gains
352.8368 350.3010 338.8250 321.1448 303.4658 287.1868 277.3341 282.5811 292.4429 310.2711 330.1462 344.7776 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.3300	10.3621	0.7200	0.7000	0.7700	15.6711	(74)
East	9.1400	19.0327	0.7200	0.7000	0.7700	60.7588	(76)
South	3.1200	46.2981	0.7200	0.7000	0.7700	50.4524	(78)

Solar gains	126.8823	231.6520	368.8859	516.3558	621.4785	610.6966	588.5247	516.3760	413.2903	267.7693	151.3147	105.6121	(83)
Total gains	479.7191	581.9529	707.7109	837.5006	924.9443	897.8835	865.8588	798.9571	705.7331	578.0404	481.4610	450.3897	(84)

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7. Mean internal temperature (heating season)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	14.7429	14.8340	14.8992	15.0599	15.0968	15.1499	15.2159	15.1999	15.0968	15.0020	14.8992	14.9412	
alpha	1.9829	1.9889	1.9933	2.0040	2.0065	2.0100	2.0144	2.0133	2.0065	2.0001	1.9933	1.9961	
util living area	0.9191	0.8856	0.8289	0.7433	0.6437	0.5488	0.4646	0.4979	0.6458	0.8054	0.8954	0.9277	(86)
MIT	17.7006	18.1069	18.7378	19.4780	20.0809	20.5031	20.7271	20.6834	20.2896	19.4335	18.3925	17.6086	(87)
Th 2	19.8856	19.8925	19.8973	19.9091	19.9117	19.9156	19.9203	19.9191	19.9117	19.9049	19.8973	19.9004	(88)
util rest of house	0.9104	0.8739	0.8119	0.7182	0.6085	0.4999	0.4028	0.4352	0.5992	0.7800	0.8829	0.9200	(89)
MIT 2	16.8709	17.2722	17.8880	18.6043	19.1690	19.5542	19.7476	19.7152	19.3764	18.5791	17.5634	16.7901	(90)
Living area fraction									fLA = Living area / (4) =			0.5900	(91)
MIT	17.3604	17.7647	18.3894	19.1198	19.7071	20.1141	20.3255	20.2865	19.9152	19.0832	18.0527	17.2730	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.3604	17.7647	18.3894	19.1198	19.7071	20.1141	20.3255	20.2865	19.9152	19.0832	18.0527	17.2730	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8850	0.8459	0.7843	0.6979	0.6013	0.5093	0.4269	0.4575	0.5993	0.7578	0.8565	0.8959	(94)
Useful gains	424.5539	492.2709	555.0582	584.4641	556.2127	457.2835	369.6502	365.4995	422.9563	438.0247	412.3785	403.5104	(95)
Ext temp.	3.1000	3.6000	5.0000	7.2000	9.8000	12.7000	14.7000	14.6000	12.4000	9.1000	5.7000	2.9000	(96)
Heat loss rate W	1124.1684	1109.7672	1044.4286	919.8777	762.6764	568.7645	429.6830	434.7961	578.5422	773.3995	963.5566	1118.0028	(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	520.5132	414.9575	364.0916	241.4978	153.6090	0.0000	0.0000	0.0000	0.0000	249.5189	396.8482	531.5823	(98)

Space heating 2872.6185 (98)
RHI space heating demand 2873 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3424	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2910	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3711	0.3638	0.3565	0.3201	0.3129	0.2765	0.2765	0.2692	0.2910	0.3129	0.3274	0.3420	(22b)
Effective ac	0.5688	0.5662	0.5636	0.5512	0.5489	0.5382	0.5382	0.5362	0.5424	0.5489	0.5536	0.5585	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	74.4500	16.5900	57.8600	0.2300	13.3078	9.0000	520.7400	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			145.1900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.4501			(33)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		4183.9200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							118.2901	(35)
Thermal bridges (User defined value 0.051 * total exposed area)							7.4047	(36)
Total fabric heat loss					(33) + (36) =		56.8548	(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	20.3173	20.2218	20.1282	19.6886	19.6063	19.2235	19.2235	19.1526	19.3709	19.6063	19.7727	19.9467	(38)
Heat transfer coeff	77.1721	77.0766	76.9830	76.5434	76.4611	76.0783	76.0783	76.0074	76.2257	76.4611	76.6275	76.8015	(39)
Average = Sum(39)m / 12 =												76.5430	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1819	2.1792	2.1765	2.1641	2.1618	2.1509	2.1509	2.1489	2.1551	2.1618	2.1665	2.1714	(40)
HLP (average)												2.1641	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895 (42)
Average daily hot water use (litres/day)	64.8244 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)

Water storage loss:	
Store volume	125.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):	1.0500 (48)
Temperature factor from Table 2b	0.5400 (49)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Enter (49) or (54) in (55)												0.5670	(55)
Total storage loss													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(56)
If cylinder contains dedicated solar storage													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(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													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(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													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
									Total per year (kWh/year) = Sum(64)m =			1500.7919	(64)
Heat gains from water heating, kWh/month													
	67.8321	60.2614	64.4045	59.2832	59.2173	54.5246	53.8982	57.0294	56.2664	61.3974	62.9741	66.7226	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.5364	21.7931	17.7233	13.4177	10.0299	8.4676	9.1496	11.8930	15.9627	20.2684	23.6562	25.2184	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	164.3130	166.0181	161.7214	152.5743	141.0276	130.1755	122.9255	121.2205	125.5172	134.6643	146.2109	157.0631	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	91.1722	89.6747	86.5651	82.3377	79.5931	75.7286	72.4438	76.6525	78.1478	82.5233	87.4640	89.6810	(72)
Total internal gains													
	352.8368	350.3010	338.8250	321.1448	303.4658	287.1868	277.3341	282.5811	292.4429	310.2711	330.1462	344.7776	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.3300	10.6334	0.7200	0.7000	0.7700	16.0814	(74)
East	9.1400	19.6403	0.7200	0.7000	0.7700	62.6985	(76)
South	3.1200	46.7521	0.7200	0.7000	0.7700	50.9471	(78)

Solar gains	129.7270	236.8221	360.4969	498.5971	599.2055	611.0124	582.4954	506.1457	408.7376	272.1152	158.4058	108.9894	(83)
Total gains	482.5637	587.1231	699.3219	819.7419	902.6713	898.1992	859.8295	788.7268	701.1804	582.3863	488.5520	453.7670	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	15.0599	15.0785	15.0968	15.1835	15.1999	15.2764	15.2764	15.2906	15.2468	15.1999	15.1669	15.1325	
alpha	2.0040	2.0052	2.0065	2.0122	2.0133	2.0184	2.0184	2.0194	2.0165	2.0133	2.0111	2.0088	
util living area													
	0.9078	0.8687	0.8064	0.7079	0.5860	0.4565	0.3517	0.3911	0.5691	0.7652	0.8752	0.9170	(86)
MIT	18.0737	18.4840	19.0975	19.8049	20.3705	20.7335	20.8880	20.8572	20.5606	19.7916	18.7985	17.9852	(87)
Th 2	19.9091	19.9104	19.9117	19.9180	19.9191	19.9245	19.9245	19.9255	19.9225	19.9191	19.9168	19.9143	(88)
util rest of house													
	0.8976	0.8547	0.7860	0.6775	0.5426	0.3964	0.2761	0.3134	0.5095	0.7328	0.8594	0.9077	(89)
MIT 2	17.2554	17.6553	18.2488	18.9229	19.4398	19.7547	19.8709	19.8534	19.6227	18.9312	17.9754	17.1725	(90)
Living area fraction										fLA = Living area / (4) =		0.5900	(91)
MIT	17.7382	18.1443	18.7496	19.4433	19.9890	20.3322	20.4710	20.4457	20.1761	19.4389	18.4611	17.6520	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.7382	18.1443	18.7496	19.4433	19.9890	20.3322	20.4710	20.4457	20.1761	19.4389	18.4611	17.6520	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8717	0.8271	0.7608	0.6628	0.5456	0.4200	0.3155	0.3522	0.5244	0.7164	0.8334	0.8827	(94)
Useful gains	420.6480	485.5859	532.0361	543.3114	492.4699	377.2624	271.3142	277.7704	367.7005	417.2376	407.1800	400.5582	(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													
	1037.0537	1020.8230	943.0081	807.0214	633.7840	436.0975	294.4987	307.5024	463.1547	675.8318	870.5729	1033.1360	(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													
	458.6059	359.6793	305.7632	189.8712	105.1377	0.0000	0.0000	0.0000	0.0000	192.3941	333.6429	470.6378	(98)
Space heating												2415.7321	(98)
Space heating per m2											(98) / (4) =	68.2989	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												170.0000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												1421.0189	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	458.6059	359.6793	305.7632	189.8712	105.1377	0.0000	0.0000	0.0000	0.0000	192.3941	333.6429	470.6378	(98)
Space heating efficiency (main heating system 1)													
	170.0000	170.0000	170.0000	170.0000	170.0000	0.0000	0.0000	0.0000	0.0000	170.0000	170.0000	170.0000	(210)
Space heating fuel (main heating system)													
	269.7682	211.5761	179.8607	111.6890	61.8457	0.0000	0.0000	0.0000	0.0000	113.1730	196.2605	276.8458	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
Efficiency of water heater												170.0000	(216)
(217)m	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	(217)
Fuel for water heating, kWh/month													
	86.2267	76.1020	80.1629	72.1922	70.9860	63.7736	61.5759	67.1155	66.8552	74.8429	78.7219	84.2640	(219)
Water heating fuel used												882.8188	(219)
Annual totals kWh/year													
Space heating fuel - main system												1421.0189	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
Total electricity for the above, kWh/year												30.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Total delivered energy for all uses												2507.1661	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1421.0189	13.1900	187.4324	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	882.8188	13.1900	116.4438	(247)
Pumps and fans for heating	30.0000	13.1900	3.9570	(249)
Energy for lighting	173.3285	13.1900	22.8620	(250)
Additional standing charges			0.0000	(251)
Total energy cost			330.6952	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.7282	(257)
SAP value		75.8922	
SAP rating (Section 12)		76	(258)
SAP band		C	

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	1421.0189	0.5190	737.5088	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	882.8188	0.5190	458.1829	(264)
Space and water heating			1195.6917	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Total kg/year			1301.2192	(272)
CO2 emissions per m2			36.7900	(273)
EI value			78.3049	
EI rating			78	(274)
EI band			C	

Calculation of stars for heating and DHW

Main heating energy efficiency	13.19 × (1 + 0.29 × 0.00) / 1.7000 = 7.759, stars = 2
Main heating environmental impact	0.519 × (1 + 0.29 × 0.00) / 1.7000 = 0.3053, stars = 4
Water heating energy efficiency	13.19 / 1.7000 = 7.759, stars = 2
Water heating environmental impact	0.519 / 1.7000 = 0.3053, stars = 4

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3424	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2910	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	6.6000	6.2000	5.9000	5.1000	4.9000	4.6000	4.2000	4.3000	4.9000	5.4000	5.9000	5.7000	(22)
Wind factor	1.6500	1.5500	1.4750	1.2750	1.2250	1.1500	1.0500	1.0750	1.2250	1.3500	1.4750	1.4250	(22a)
Adj infilt rate	0.4802	0.4511	0.4293	0.3711	0.3565	0.3347	0.3056	0.3129	0.3565	0.3929	0.4293	0.4147	(22b)
Effective ac	0.6153	0.6017	0.5921	0.5688	0.5636	0.5560	0.5467	0.5489	0.5636	0.5772	0.5921	0.5860	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	74.4500	16.5900	57.8600	0.2300	13.3078	9.0000	520.7400	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			145.1900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.4501			(33)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		4183.9200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							118.2901	(35)
Thermal bridges (User defined value 0.051 * total exposed area)							7.4047	(36)
Total fabric heat loss					(33) + (36) =		56.8548	(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	21.9764	21.4924	21.1492	20.3173	20.1282	19.8588	19.5260	19.6063	20.1282	20.6151	21.1492	20.9299	(38)
Heat transfer coeff	78.8312	78.3472	78.0040	77.1721	76.9830	76.7136	76.3808	76.4611	76.9830	77.4699	78.0040	77.7847	(39)
Average = Sum(39)m / 12 =												77.4279	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.2288	2.2151	2.2054	2.1819	2.1765	2.1689	2.1595	2.1618	2.1765	2.1903	2.2054	2.1992	(40)
HLP (average)												2.1891	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.2895	(42)
Average daily hot water use (litres/day)												64.8244	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)

Water storage loss:	
Store volume	125.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):	1.0500 (48)
Temperature factor from Table 2b	0.5400 (49)

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

Enter (49) or (54) in (55) 0.5670 (55)

Total storage loss

	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770 (56)

If cylinder contains dedicated solar storage

	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770 (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

	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488 (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

	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488 (64)

Total per year (kWh/year) = Sum(64)m = 1500.7919 (64)

Heat gains from water heating, kWh/month

	67.8321	60.2614	64.4045	59.2832	59.2173	54.5246	53.8982	57.0294	56.2664	61.3974	62.9741	66.7226 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	(66)

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

	24.5364	21.7931	17.7233	13.4177	10.0299	8.4676	9.1496	11.8930	15.9627	20.2684	23.6562	25.2184	(67)

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

	164.3130	166.0181	161.7214	152.5743	141.0276	130.1755	122.9255	121.2205	125.5172	134.6643	146.2109	157.0631	(68)

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

	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	(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)

	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)

Water heating gains (Table 5)

	91.1722	89.6747	86.5651	82.3377	79.5931	75.7286	72.4438	76.6525	78.1478	82.5233	87.4640	89.6810	(72)

Total internal gains

	352.8368	350.3010	338.8250	321.1448	303.4658	287.1868	277.3341	282.5811	292.4429	310.2711	330.1462	344.7776	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.3300	10.3621	0.7200	0.7000	0.7700	15.6711	(74)
East	9.1400	19.0327	0.7200	0.7000	0.7700	60.7588	(76)
South	3.1200	46.2981	0.7200	0.7000	0.7700	50.4524	(78)

Solar gains	126.8823	231.6520	368.8859	516.3558	621.4785	610.6966	588.5247	516.3760	413.2903	267.7693	151.3147	105.6121	(83)
Total gains	479.7191	581.9529	707.7109	837.5006	924.9443	897.8835	865.8588	798.9571	705.7331	578.0404	481.4610	450.3897	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	14.7429	14.8340	14.8992	15.0599	15.0968	15.1499	15.2159	15.1999	15.0968	15.0020	14.8992	14.9412	
alpha	1.9829	1.9889	1.9933	2.0040	2.0065	2.0100	2.0144	2.0133	2.0065	2.0001	1.9933	1.9961	
util living area	0.9191	0.8856	0.8289	0.7433	0.6437	0.5488	0.4646	0.4979	0.6458	0.8054	0.8954	0.9277	(86)
MIT	17.7006	18.1069	18.7378	19.4780	20.0809	20.5031	20.7271	20.6834	20.2896	19.4335	18.3925	17.6086	(87)
Th 2	19.8856	19.8925	19.8973	19.9091	19.9117	19.9156	19.9203	19.9191	19.9117	19.9049	19.8973	19.9004	(88)
util rest of house	0.9104	0.8739	0.8119	0.7182	0.6085	0.4999	0.4028	0.4352	0.5992	0.7800	0.8829	0.9200	(89)
MIT 2	16.8709	17.2722	17.8880	18.6043	19.1690	19.5542	19.7476	19.7152	19.3764	18.5791	17.5634	16.7901	(90)

Living area fraction fLA = Living area / (4) = 0.5900 (91)

MIT	17.3604	17.7647	18.3894	19.1198	19.7071	20.1141	20.3255	20.2865	19.9152	19.0832	18.0527	17.2730	(92)

Temperature adjustment 0.0000

adjusted MIT	17.3604	17.7647	18.3894	19.1198	19.7071	20.1141	20.3255	20.2865	19.9152	19.0832	18.0527	17.2730	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8850	0.8459	0.7843	0.6979	0.6013	0.5093	0.4269	0.4575	0.5993	0.7578	0.8565	0.8959	(94)
Useful gains	424.5539	492.2709	555.0582	584.4641	556.2127	457.2835	369.6502	365.4995	422.9563	438.0247	412.3785	403.5104	(95)
Ext temp.	3.1000	3.6000	5.0000	7.2000	9.8000	12.7000	14.7000	14.6000	12.4000	9.1000	5.7000	2.9000	(96)
Heat loss rate W	1124.1684	1109.7672	1044.4286	919.8777	762.6764	568.7645	429.6830	434.7961	578.5422	773.3995	963.5566	1118.0028	(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	520.5132	414.9575	364.0916	241.4978	153.6090	0.0000	0.0000	0.0000	0.0000	249.5189	396.8482	531.5823	(98)

Space heating 2872.6185 (98)

Space heating per m2 (98) / (4) = 81.2162 (99)

8c. Space cooling requirement

Not applicable

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

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												170.0000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												1689.7756	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	520.5132	414.9575	364.0916	241.4978	153.6090	0.0000	0.0000	0.0000	0.0000	249.5189	396.8482	531.5823	(98)
Space heating efficiency (main heating system 1)													
	170.0000	170.0000	170.0000	170.0000	170.0000	0.0000	0.0000	0.0000	0.0000	170.0000	170.0000	170.0000	(210)
Space heating fuel (main heating system)													
	306.1842	244.0926	214.1715	142.0576	90.3582	0.0000	0.0000	0.0000	0.0000	146.7758	233.4401	312.6955	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
Efficiency of water heater												170.0000	(216)
(217)m	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	(217)
Fuel for water heating, kWh/month													
	86.2267	76.1020	80.1629	72.1922	70.9860	63.7736	61.5759	67.1155	66.8552	74.8429	78.7219	84.2640	(219)
Water heating fuel used												882.8188	(219)
Annual totals kWh/year													
Space heating fuel - main system												1689.7756	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
Total electricity for the above, kWh/year												30.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Total delivered energy for all uses												2775.9229	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1689.7756	18.7000	315.9880	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	882.8188	18.7000	165.0871	(247)
Pumps and fans for heating	30.0000	18.7000	5.6100	(249)
Energy for lighting	173.3285	18.7000	32.4124	(250)
Additional standing charges			0.0000	(251)
Total energy cost			519.0976	(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	1689.7756	0.5190	876.9935	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	882.8188	0.5190	458.1829	(264)
Space and water heating			1335.1765	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Total kg/year			1440.7040	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	1689.7756	3.0700	5187.6110	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	882.8188	3.0700	2710.2536	(264)
Space and water heating			7897.8646	(265)
Pumps and fans	30.0000	3.0700	92.1000	(267)
Energy for lighting	173.3285	3.0700	532.1186	(268)
Primary energy kWh/year			8522.0832	(272)
Primary energy kWh/m2/year			240.9410	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating:	C 76
Current environmental impact rating:	C 78

(For testing purposes):

A Not considered

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

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 3.7	-£ 73	-203 kg (14.1%)
U Solar photovoltaic panels	+ 16.6	-£ 326	-906 kg (73.2%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£73	5.73 kg/m²	C 80	B 82
Solar photovoltaic panels	£326	25.62 kg/m²	A 96	A 97
Total Savings	£399	31.34 kg/m²		

Potential energy efficiency rating: A 96
Potential environmental impact rating: A 97

Fuel prices for cost data on this page from database revision number 465 TEST (04 Sep 2020)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£519	£446	£73
Space heating	£322	£322	-£1
Water heating	£165	£92	£74
Lighting	£32	£32	£0
Generated (PV)	-£0	-£326	£326
Total cost of fuels	£519	£120	£399
Total cost of uses	£519	£120	£399
Delivered energy	78 kWh/m²	18 kWh/m²	60 kWh/m²
Carbon dioxide emissions	1.4 tonnes	0.3 tonnes	1.1 tonnes
CO2 emissions per m²	41 kg/m²	9 kg/m²	31 kg/m²
Primary energy	241 kWh/m²	56 kWh/m²	185 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000	/ (5) =	0.0924	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3424	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.2910	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3711	0.3638	0.3565	0.3201	0.3129	0.2765	0.2765	0.2692	0.2910	0.3129	0.3274	0.3420	(22b)
Effective ac	0.5688	0.5662	0.5636	0.5512	0.5489	0.5382	0.5382	0.5362	0.5424	0.5489	0.5536	0.5585	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	74.4500	16.5900	57.8600	0.2300	13.3078	9.0000	520.7400	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			145.1900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.4501			(33)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		4183.9200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							118.2901	(35)
Thermal bridges (User defined value 0.051 * total exposed area)							7.4047	(36)
Total fabric heat loss					(33) + (36) =		56.8548	(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	20.3173	20.2218	20.1282	19.6886	19.6063	19.2235	19.2235	19.1526	19.3709	19.6063	19.7727	19.9467	(38)
Heat transfer coeff	77.1721	77.0766	76.9830	76.5434	76.4611	76.0783	76.0783	76.0074	76.2257	76.4611	76.6275	76.8015	(39)
Average = Sum(39)m / 12 =												76.5430	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1819	2.1792	2.1765	2.1641	2.1618	2.1509	2.1509	2.1489	2.1551	2.1618	2.1665	2.1714	(40)
HLP (average)												2.1641	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.2895	(42)
Average daily hot water use (litres/day)												64.8244	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)

Water storage loss:	
Store volume	125.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):	1.0500 (48)
Temperature factor from Table 2b	0.5400 (49)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Enter (49) or (54) in (55)												0.5670	(55)
Total storage loss													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(56)
If cylinder contains dedicated solar storage													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(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													
	146.5855	129.3734	134.8811	115.9731	107.8819	95.8084	91.6521	101.9999	108.2509	125.8372	133.8273	143.2488	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.7781	(H8)
Utilisation factor												0.4302	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												64.8244	(H14)
Volume ratio Veff/V												1.1570	(H15)
Solar storage volume factor												1.0000	(H16)
Solar input												-685.9569	(H17)
Solar input	-19.8914	-33.1930	-56.5315	-75.7633	-93.5992	-92.0229	-90.8068	-79.3384	-62.1378	-42.4328	-23.5940	-16.6457	(63)
								Solar input (sum of months) = Sum(63)m =				-685.9569	(63)
Output from w/h													
	126.6941	96.1804	78.3496	40.2098	14.2827	3.7855	0.8453	22.6615	46.1131	83.4043	110.2332	126.6031	(64)
									Total per year (kWh/year) = Sum(64)m =			749.3626	(64)
Heat gains from water heating, kWh/month													
	67.8321	60.2614	63.2879	53.8803	48.9818	44.4392	43.4766	47.3523	51.9441	60.2808	62.9741	66.7226	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.5364	21.7931	17.7233	13.4177	10.0299	8.4676	9.1496	11.8930	15.9627	20.2684	23.6562	25.2184	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	164.3130	166.0181	161.7214	152.5743	141.0276	130.1755	122.9255	121.2205	125.5172	134.6643	146.2109	157.0631	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	91.1722	89.6747	85.0643	74.8337	65.8358	61.7211	58.4363	63.6455	72.1446	81.0225	87.4640	89.6810	(72)
Total internal gains													
	352.8368	350.3010	337.3242	313.6408	289.7085	273.1794	263.3266	269.5742	286.4397	308.7703	330.1462	344.7776	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.3300	10.6334	0.7200	0.7000	0.7700	16.0814	(74)
East	9.1400	19.6403	0.7200	0.7000	0.7700	62.6985	(76)
South	3.1200	46.7521	0.7200	0.7000	0.7700	50.9471	(78)

Solar gains	129.7270	236.8221	360.4969	498.5971	599.2055	611.0124	582.4954	506.1457	408.7376	272.1152	158.4058	108.9894	(83)
Total gains	482.5637	587.1231	697.8211	812.2379	888.9140	884.1917	845.8220	775.7199	695.1772	580.8855	488.5520	453.7670	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	15.0599	15.0785	15.0968	15.1835	15.1999	15.2764	15.2764	15.2906	15.2468	15.1999	15.1669	15.1325	
alpha	2.0040	2.0052	2.0065	2.0122	2.0133	2.0184	2.0184	2.0194	2.0165	2.0133	2.0111	2.0088	
util living area													
	0.9078	0.8687	0.8069	0.7108	0.5914	0.4618	0.3566	0.3963	0.5721	0.7659	0.8752	0.9170	(86)
MIT	18.0737	18.4840	19.0946	19.7947	20.3592	20.7276	20.8850	20.8536	20.5560	19.7891	18.7985	17.9852	(87)
Th 2	19.9091	19.9104	19.9117	19.9180	19.9191	19.9245	19.9245	19.9255	19.9225	19.9191	19.9168	19.9143	(88)
util rest of house													
	0.8976	0.8547	0.7866	0.6805	0.5480	0.4014	0.2802	0.3179	0.5125	0.7336	0.8594	0.9077	(89)
MIT 2	17.2554	17.6553	18.2461	18.9139	19.4306	19.7507	19.8694	19.8514	19.6194	18.9290	17.9754	17.1725	(90)
Living area fraction										fLA = Living area / (4) =		0.5900	(91)
MIT	17.7382	18.1443	18.7468	19.4336	19.9785	20.3271	20.4687	20.4428	20.1720	19.4365	18.4611	17.6520	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.7382	18.1443	18.7468	19.4336	19.9785	20.3271	20.4687	20.4428	20.1720	19.4365	18.4611	17.6520	(93)

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8. Space heating requirement

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8717	0.8271	0.7613	0.6656	0.5505	0.4248	0.3199	0.3569	0.5272	0.7172	0.8334	0.8827	(94)
Useful gains	420.6480	485.5859	531.2790	540.5914	489.3692	375.6428	270.5498	276.8208	366.4830	416.5833	407.1800	400.5582	(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													
	1037.0537	1020.8230	942.7936	806.2784	632.9842	435.7066	294.3212	307.2790	462.8447	675.6495	870.5729	1033.1360	(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													
	458.6059	359.6793	306.1669	191.2946	106.8496	0.0000	0.0000	0.0000	0.0000	192.7453	333.6429	470.6378	(98)
Space heating												2419.6223	(98)
Space heating per m2											(98) / (4) =	68.4089	(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 %)												170.0000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												1423.3072	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	458.6059	359.6793	306.1669	191.2946	106.8496	0.0000	0.0000	0.0000	0.0000	192.7453	333.6429	470.6378	(98)
Space heating efficiency (main heating system 1)													
	170.0000	170.0000	170.0000	170.0000	170.0000	0.0000	0.0000	0.0000	0.0000	170.0000	170.0000	170.0000	(210)
Space heating fuel (main heating system)													
	269.7682	211.5761	180.0982	112.5263	62.8527	0.0000	0.0000	0.0000	0.0000	113.3796	196.2605	276.8458	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	126.6941	96.1804	78.3496	40.2098	14.2827	3.7855	0.8453	22.6615	46.1131	83.4043	110.2332	126.6031	(64)
Efficiency of water heater												170.0000	(216)
(217)m	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	(217)
Fuel for water heating, kWh/month													
	74.5259	56.5767	46.0880	23.6528	8.4016	2.2268	0.4972	13.3303	27.1254	49.0614	64.8431	74.4724	(219)
Water heating fuel used												440.8015	(219)
Annual totals kWh/year													
Space heating fuel - main system												1423.3072	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												80.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												390.1979	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1423.3072	13.1900	187.7342	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	440.8015	13.1900	58.1417	(247)
Pumps and fans for heating	30.0000	13.1900	3.9570	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	173.3285	13.1900	22.8620	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			51.4671	(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] =	0.2690	(257)
SAP value		96.2480	
SAP rating (Section 12)		96	(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	1423.3072	0.5190	738.6965	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Water heating (other fuel)	440.8015	0.5190	228.7760 (264)
Space and water heating			967.4724 (265)
Pumps and fans	80.0000	0.5190	41.5200 (267)
Energy for lighting	173.3285	0.5190	89.9575 (268)
Energy saving/generation technologies			
PV Unit	-1727.2394	0.5190	-896.4372 (269)
Total kg/year			202.5127 (272)
CO2 emissions per m2			5.7300 (273)
EI value			96.6235
EI rating			97 (274)
EI band			A

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3424	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2910	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	6.6000	6.2000	5.9000	5.1000	4.9000	4.6000	4.2000	4.3000	4.9000	5.4000	5.9000	5.7000	(22)
Wind factor	1.6500	1.5500	1.4750	1.2750	1.2250	1.1500	1.0500	1.0750	1.2250	1.3500	1.4750	1.4250	(22a)
Adj infilt rate	0.4802	0.4511	0.4293	0.3711	0.3565	0.3347	0.3056	0.3129	0.3565	0.3929	0.4293	0.4147	(22b)
Effective ac	0.6153	0.6017	0.5921	0.5688	0.5636	0.5560	0.5467	0.5489	0.5636	0.5772	0.5921	0.5860	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	74.4500	16.5900	57.8600	0.2300	13.3078	9.0000	520.7400	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			145.1900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.4501			(33)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	4183.9200 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		118.2901 (35)
Thermal bridges (User defined value 0.051 * total exposed area)		7.4047 (36)
Total fabric heat loss	(33) + (36) =	56.8548 (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	21.9764	21.4924	21.1492	20.3173	20.1282	19.8588	19.5260	19.6063	20.1282	20.6151	21.1492	20.9299	(38)
Heat transfer coeff	78.8312	78.3472	78.0040	77.1721	76.9830	76.7136	76.3808	76.4611	76.9830	77.4699	78.0040	77.7847	(39)
Average = Sum(39)m / 12 =												77.4279	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.2288	2.2151	2.2054	2.1819	2.1765	2.1689	2.1595	2.1618	2.1765	2.1903	2.2054	2.1992	(40)
HLP (average)												2.1891	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895 (42)
Average daily hot water use (litres/day)	64.8244 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)

Water storage loss:	
Store volume	125.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):	1.0500 (48)
Temperature factor from Table 2b	0.5400 (49)

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

Enter (49) or (54) in (55)												0.5670	(55)
Total storage loss													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(56)
If cylinder contains dedicated solar storage													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(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													
	146.5855	129.3734	134.8811	115.9731	107.8819	95.8084	91.6521	101.9999	108.2509	125.8372	133.8273	143.2488	(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												1091.0709	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1832.9992	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.7972	(H8)
Utilisation factor												0.4267	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												64.8244	(H14)
Volume ratio Veff/V												1.1570	(H15)
Solar storage volume factor												1.0000	(H16)
Solar input												-687.8113	(H17)
Solar input	-19.2686	-32.1683	-57.3554	-77.8632	-96.3853	-91.3308	-91.0993	-80.3442	-62.3188	-41.3797	-22.3236	-15.9741	(63)
								Solar input (sum of months) = Sum(63)m =				-687.8113	(63)
Output from w/h													
	127.3169	97.2050	77.5257	38.1099	11.4966	4.4776	0.5528	21.6557	45.9322	84.4575	111.5037	127.2747	(64)
									Total per year (kWh/year) = Sum(64)m =			747.5082	(64)
Heat gains from water heating, kWh/month													
	67.8321	60.2614	63.2879	53.8803	48.9818	44.4392	43.4766	47.3523	51.9441	60.2808	62.9741	66.7226	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.5364	21.7931	17.7233	13.4177	10.0299	8.4676	9.1496	11.8930	15.9627	20.2684	23.6562	25.2184	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	164.3130	166.0181	161.7214	152.5743	141.0276	130.1755	122.9255	121.2205	125.5172	134.6643	146.2109	157.0631	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	91.1722	89.6747	85.0643	74.8337	65.8358	61.7211	58.4363	63.6455	72.1446	81.0225	87.4640	89.6810	(72)
Total internal gains													
	352.8368	350.3010	337.3242	313.6408	289.7085	273.1794	263.3266	269.5742	286.4397	308.7703	330.1462	344.7776	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.3300	10.3621	0.7200	0.7000	0.7700	15.6711	(74)
East	9.1400	19.0327	0.7200	0.7000	0.7700	60.7588	(76)
South	3.1200	46.2981	0.7200	0.7000	0.7700	50.4524	(78)

Solar gains	126.8823	231.6520	368.8859	516.3558	621.4785	610.6966	588.5247	516.3760	413.2903	267.7693	151.3147	105.6121	(83)
Total gains	479.7191	581.9529	706.2101	829.9966	911.1869	883.8760	851.8513	785.9502	699.7299	576.5396	481.4610	450.3897	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	14.7429	14.8340	14.8992	15.0599	15.0968	15.1499	15.2159	15.1999	15.0968	15.0020	14.8992	14.9412	
alpha	1.9829	1.9889	1.9933	2.0040	2.0065	2.0100	2.0144	2.0133	2.0065	2.0001	1.9933	1.9961	
util living area													
	0.9191	0.8856	0.8294	0.7460	0.6488	0.5543	0.4702	0.5036	0.6488	0.8061	0.8954	0.9277	(86)
MIT	17.7006	18.1069	18.7348	19.4665	20.0664	20.4935	20.7209	20.6765	20.2832	19.4306	18.3925	17.6086	(87)
Th 2	19.8856	19.8925	19.8973	19.9091	19.9117	19.9156	19.9203	19.9191	19.9117	19.9049	19.8973	19.9004	(88)
util rest of house													
	0.9104	0.8739	0.8124	0.7210	0.6137	0.5053	0.4080	0.4406	0.6021	0.7807	0.8829	0.9200	(89)
MIT 2	16.8709	17.2722	17.8851	18.5937	19.1565	19.5467	19.7433	19.7104	19.3712	18.5765	17.5634	16.7901	(90)
Living area fraction									fLA = Living area / (4) =			0.5900	(91)
MIT	17.3604	17.7647	18.3864	19.1087	19.6934	20.1053	20.3202	20.2804	19.9093	19.0805	18.0527	17.2730	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.3604	17.7647	18.3864	19.1087	19.6934	20.1053	20.3202	20.2804	19.9093	19.0805	18.0527	17.2730	(93)

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8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8850	0.8459	0.7848	0.7005	0.6061	0.5144	0.4319	0.4626	0.6020	0.7584	0.8565	0.8959	(94)
Useful gains	424.5539	492.2709	554.2419	581.3768	552.2587	454.6217	367.9556	363.6187	421.2523	437.2738	412.3785	403.5104	(95)
Ext temp.	3.1000	3.6000	5.0000	7.2000	9.8000	12.7000	14.7000	14.6000	12.4000	9.1000	5.7000	2.9000	(96)
Heat loss rate W	1124.1684	1109.7672	1044.1946	919.0184	761.6230	568.0896	429.2716	434.3322	578.0890	773.1862	963.5566	1118.0028	(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	520.5132	414.9575	364.5247	243.1019	155.7670	0.0000	0.0000	0.0000	0.0000	249.9188	396.8482	531.5823	(98)
Space heating												2877.2138	(98)
Space heating per m2											(98) / (4) =	81.3462	(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 %)	170.0000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1692.4787	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	520.5132	414.9575	364.5247	243.1019	155.7670	0.0000	0.0000	0.0000	0.0000	249.9188	396.8482	531.5823	(98)
Space heating efficiency (main heating system 1)													
	170.0000	170.0000	170.0000	170.0000	170.0000	0.0000	0.0000	0.0000	0.0000	170.0000	170.0000	170.0000	(210)
Space heating fuel (main heating system)													
	306.1842	244.0926	214.4263	143.0011	91.6277	0.0000	0.0000	0.0000	0.0000	147.0111	233.4401	312.6955	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	127.3169	97.2050	77.5257	38.1099	11.4966	4.4776	0.5528	21.6557	45.9322	84.4575	111.5037	127.2747	(64)
Efficiency of water heater												170.0000	(216)
(217)m	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	(217)
Fuel for water heating, kWh/month													
	74.8923	57.1794	45.6033	22.4176	6.7627	2.6339	0.3252	12.7386	27.0189	49.6809	65.5904	74.8675	(219)
Water heating fuel used												439.7107	(219)
Annual totals kWh/year													
Space heating fuel - main system												1692.4787	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												80.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1091 * 0.80) =										-1745.7135		-1745.7135	(233)
Total delivered energy for all uses												639.8044	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1692.4787	18.7000	316.4935	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	439.7107	18.7000	82.2259	(247)
Pumps and fans for heating	30.0000	18.7000	5.6100	(249)
Pump for solar water heating	50.0000	18.7000	9.3500	(249)
Energy for lighting	173.3285	18.7000	32.4124	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-1745.7135	18.7000	-326.4484	(252)
Total energy cost			119.6434	(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	1692.4787	0.5190	878.3964	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	439.7107	0.5190	228.2098	(264)
Space and water heating			1106.6063	(265)
Pumps and fans	80.0000	0.5190	41.5200	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Energy saving/generation technologies				
PV Unit	-1745.7135	0.5190	-906.0253	(269)
Total kg/year			332.0585	(272)

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

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	1692.4787	3.0700	5195.9096	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	439.7107	3.0700	1349.9118	(264)
Space and water heating			6545.8214	(265)
Pumps and fans	80.0000	3.0700	245.6000	(267)
Energy for lighting	173.3285	3.0700	532.1186	(268)
Energy saving/generation technologies				
PV Unit	-1745.7135	3.0700	-5359.3404	(269)
Primary energy kWh/year			1964.1995	(272)
Primary energy kWh/m2/year			55.5329	(273)

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

Overheating Calculation Input Data

Dwelling type	Detached Bungalow
Number of storeys	1
Cross ventilation possible	Yes
SAP Region	North East England
Front of dwelling faces	South
Overshading	Average or unknown
Thermal mass parameter	118.3 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	6.00 (Windows fully open)

Overheating Calculation

Summer ventilation heat loss coefficient	214.30	(P1)
Transmission heat loss coefficient	56.85	(37)
Summer heat loss coefficient	271.15	(P2)

Overhangs

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

Solar shading

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

[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	4.3300	74.6426	0.7200	0.7000	0.9000	131.9443
East	9.1400	111.2086	0.7200	0.7000	0.9000	414.9541
South	3.1200	110.4126	0.7200	0.7000	0.9000	140.6335
total:						687.5319

	Jun	Jul	Aug	
Solar gains	710	688	592	(P3)
Internal gains	284	274	280	
Total summer gains	994	962	871	(P5)
Summer gain/loss ratio	3.67	3.55	3.21	(P6)
Summer external temperature	13.80	15.80	15.60	
Thermal mass temperature increment (TMP = 118.3)	1.17	1.17	1.17	
Threshold temperature	18.64	20.52	19.99	(P7)
Likelihood of high internal temperature	Not significant	Slight	Not significant	

Assessment of likelihood of high internal temperature: Slight

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

Anderson Goddard Ltd

Property Reference	73940-WR03	**Issued on Date**	07/10/2020
Assessment Reference	001	**Prop Type Ref**	Det
Property	Woodlands Room 3, Raithwaite Bay, WHITBY, YO21 3ST		

SAP Rating	76 C	**DER**	38.61	**TER**	43.57
Environmental	78 C	**% DER<TER**	11.39		
CO_2 Emissions (t/year)	1.44	**DFEE**	84.35	**TFEE**	85.87
General Requirements Compliance	Pass	**% DFEE<TFEE**	1.77		

Assessor Details	Mr. Paul Goddard, Anderson Goddard Limited, Tel: 0161 7757770, paul.goddard@andersongoddard.com	**Assessor ID**	B342-0001
Client			

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DWELLING AS DESIGNED

Detached Bungalow, total floor area 35 m²

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

1a TER and DER
Fuel for main heating:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 43.57 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 38.61 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)85.9 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)84.3 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.23 (max. 0.30)	0.23 (max. 0.70)	OK
Floor	0.22 (max. 0.25)	0.22 (max. 0.70)	OK
Roof	0.18 (max. 0.20)	0.18 (max. 0.35)	OK
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated using user-specified y-value of 0.051

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

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4 Heating efficiency
Main heating system: Heat pump with radiators or underfloor - Electric
Air-to-water heat pump

Secondary heating system: None

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5 Cylinder insulation
Hot water storage Measured cylinder loss: 1.05 kWh/day
Permitted by DBSCG 1.70 OK
Primary pipework insulated: Yes OK

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6 Controls
Space heating controls: Programmer and room thermostat OK

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

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

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8 Mechanical ventilation
Not applicable

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9 Summertime temperature
Overheating risk (North East England): Slight OK
Based on:
Overshading: Average
Windows facing North: 4.33 m², No overhang
Windows facing East: 9.14 m², No overhang
Windows facing South: 3.12 m², No overhang
Air change rate: 8.00 ach
Blinds/curtains: None

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10 Key features
None

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3424	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2910	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3711	0.3638	0.3565	0.3201	0.3129	0.2765	0.2765	0.2692	0.2910	0.3129	0.3274	0.3420	(22b)
Effective ac	0.5688	0.5662	0.5636	0.5512	0.5489	0.5382	0.5382	0.5362	0.5424	0.5489	0.5536	0.5585	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	74.4500	16.5900	57.8600	0.2300	13.3078	9.0000	520.7400	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			145.1900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.4501			(33)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		4183.9200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							118.2901	(35)
Thermal bridges (User defined value 0.051 * total exposed area)							7.4047	(36)
Total fabric heat loss					(33) + (36) =		56.8548	(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	20.3173	20.2218	20.1282	19.6886	19.6063	19.2235	19.2235	19.1526	19.3709	19.6063	19.7727	19.9467	(38)
Heat transfer coeff	77.1721	77.0766	76.9830	76.5434	76.4611	76.0783	76.0783	76.0074	76.2257	76.4611	76.6275	76.8015	(39)
Average = Sum(39)m / 12 =												76.5430	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1819	2.1792	2.1765	2.1641	2.1618	2.1509	2.1509	2.1489	2.1551	2.1618	2.1665	2.1714	(40)
HLP (average)												2.1641	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.2895	(42)
Average daily hot water use (litres/day)												64.8244	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)

Water storage loss:	
Store volume	125.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):	1.0500 (48)
Temperature factor from Table 2b	0.5400 (49)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Enter (49) or (54) in (55)												0.5670	(55)
Total storage loss													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(56)
If cylinder contains dedicated solar storage													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(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													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(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													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
									Total per year (kWh/year) = Sum(64)m =			1500.7919	(64)
Heat gains from water heating, kWh/month													
	67.8321	60.2614	64.4045	59.2832	59.2173	54.5246	53.8982	57.0294	56.2664	61.3974	62.9741	66.7226	(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	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	9.8146	8.7172	7.0893	5.3671	4.0119	3.3871	3.6598	4.7572	6.3851	8.1073	9.4625	10.0874	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	110.0897	111.2321	108.3533	102.2247	94.4885	87.2176	82.3601	81.2177	84.0965	90.2251	97.9613	105.2323	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	91.1722	89.6747	86.5651	82.3377	79.5931	75.7286	72.4438	76.6525	78.1478	82.5233	87.4640	89.6810	(72)
Total internal gains													
	256.4182	254.9658	247.3495	235.2713	223.4353	211.6749	203.8055	207.9691	213.9712	226.1975	240.2295	250.3424	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.3300	10.6334	0.7200	0.7000	0.7700	16.0814	(74)
East	9.1400	19.6403	0.7200	0.7000	0.7700	62.6985	(76)
South	3.1200	46.7521	0.7200	0.7000	0.7700	50.9471	(78)

Solar gains	129.7270	236.8221	360.4969	498.5971	599.2055	611.0124	582.4954	506.1457	408.7376	272.1152	158.4058	108.9894	(83)
Total gains	386.1452	491.7879	607.8465	733.8684	822.6409	822.6873	786.3009	714.1148	622.7087	498.3127	398.6353	359.3318	(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	15.0599	15.0785	15.0968	15.1835	15.1999	15.2764	15.2764	15.2906	15.2468	15.1999	15.1669	15.1325	
alpha	2.0040	2.0052	2.0065	2.0122	2.0133	2.0184	2.0184	2.0194	2.0165	2.0133	2.0111	2.0088	
util living area													
	0.9357	0.8994	0.8397	0.7420	0.6184	0.4864	0.3785	0.4228	0.6107	0.8071	0.9086	0.9435	(86)
MIT	17.8096	18.2510	18.9132	19.6816	20.3006	20.6993	20.8714	20.8345	20.4956	19.6415	18.5728	17.7194	(87)
Th 2	19.9091	19.9104	19.9117	19.9180	19.9191	19.9245	19.9245	19.9255	19.9225	19.9191	19.9168	19.9143	(88)
util rest of house													
	0.9281	0.8880	0.8217	0.7132	0.5752	0.4246	0.2988	0.3411	0.5511	0.7781	0.8962	0.9368	(89)
MIT 2	16.9982	17.4312	18.0758	18.8126	19.3825	19.7312	19.8623	19.8409	19.5740	18.7963	17.7592	16.9129	(90)
Living area fraction									fLA = Living area / (4) =			0.5900	(91)
MIT	17.4770	17.9149	18.5699	19.3253	19.9242	20.3024	20.4577	20.4272	20.1178	19.2950	18.2393	17.3888	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.4770	17.9149	18.5699	19.3253	19.9242	20.3024	20.4577	20.4272	20.1178	19.2950	18.2393	17.3888	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9058	0.8617	0.7952	0.6956	0.5755	0.4472	0.3395	0.3807	0.5627	0.7585	0.8718	0.9158	(94)
Useful gains	349.7569	423.7775	483.3873	510.4586	473.3983	367.9258	266.9662	271.8334	350.4139	377.9911	347.5240	329.0807	(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													
	1016.8948	1003.1464	929.1760	797.9909	628.8324	433.8312	293.4849	306.0982	458.7117	664.8300	853.5758	1012.9169	(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													
	496.3506	389.3359	331.6668	207.0233	115.6430	0.0000	0.0000	0.0000	0.0000	213.4082	364.3573	508.7742	(98)
Space heating												2626.5593	(98)
Space heating per m2											(98) / (4) =	74.2595	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	170.0000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1545.0349	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	496.3506	389.3359	331.6668	207.0233	115.6430	0.0000	0.0000	0.0000	0.0000	213.4082	364.3573	508.7742	(98)
Space heating efficiency (main heating system 1)													
	170.0000	170.0000	170.0000	170.0000	170.0000	0.0000	0.0000	0.0000	0.0000	170.0000	170.0000	170.0000	(210)
Space heating fuel (main heating system)													
	291.9709	229.0211	195.0981	121.7784	68.0253	0.0000	0.0000	0.0000	0.0000	125.5342	214.3278	299.2789	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
Efficiency of water heater												170.0000	(216)
(217)m	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	(217)
Fuel for water heating, kWh/month													
	86.2267	76.1020	80.1629	72.1922	70.9860	63.7736	61.5759	67.1155	66.8552	74.8429	78.7219	84.2640	(219)
Water heating fuel used												882.8188	(219)
Annual totals kWh/year													
Space heating fuel - main system												1545.0349	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
Total electricity for the above, kWh/year												30.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Total delivered energy for all uses												2631.1821	(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	1545.0349	0.5190	801.8731	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	882.8188	0.5190	458.1829	(264)
Space and water heating			1260.0560	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Total CO2, kg/year			1365.5835	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			38.6100	(273)

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

DER		38.6100	ZC1
Total Floor Area	TFA	35.3700	
Assumed number of occupants	N	1.2895	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		18.4441	ZC2
CO2 emissions from cooking, equation (L16)		4.2394	ZC3
Total CO2 emissions		61.2935	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		61.2935	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000	/ (5) =	0.1848	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.4348	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3696	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4712	0.4620	0.4527	0.4065	0.3973	0.3511	0.3511	0.3419	0.3696	0.3973	0.4158	0.4342	(22b)
Effective ac	0.6110	0.6067	0.6025	0.5826	0.5789	0.5616	0.5616	0.5584	0.5683	0.5789	0.5864	0.5943	(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 Opening Type (Uw = 1.40)			8.8400	1.3258	11.7197			(27)
GF			35.3700	0.1300	4.5981			(28b)
Main	74.4500	8.8400	65.6100	0.1800	11.8098			(29a)
Flat	35.3700		35.3700	0.1300	4.5981			(30)
Total net area of external elements Aum(A, m2)			145.1900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		32.7257			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.5255	(36)
Total fabric heat loss					(33) + (36) =		41.2512	(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	21.8234	21.6694	21.5185	20.8096	20.6770	20.0596	20.0596	19.9453	20.2974	20.6770	20.9453	21.2258	(38)
Heat transfer coeff	63.0746	62.9206	62.7697	62.0608	61.9282	61.3108	61.3108	61.1965	61.5486	61.9282	62.1965	62.4770	(39)
Average = Sum(39)m / 12 =												62.0602	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.7833	1.7789	1.7747	1.7546	1.7509	1.7334	1.7334	1.7302	1.7401	1.7509	1.7585	1.7664	(40)
HLP (average)												1.7546	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.2895	(42)
Average daily hot water use (litres/day)												64.8244	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.2538	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.6770	(55)
Total storage loss													

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	20.9878	18.9567	20.9878	20.3108	20.9878	20.3108	20.9878	20.9878	20.3108	20.9878	20.3108	20.9878	(56)
If cylinder contains dedicated solar storage													
	20.9878	18.9567	20.9878	20.3108	20.9878	20.3108	20.9878	20.9878	20.3108	20.9878	20.3108	20.9878	(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													
	149.9962	132.4541	139.6876	126.0274	124.0870	111.7159	108.0898	117.5071	116.9546	130.6437	137.1280	146.6596	(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													
	149.9962	132.4541	139.6876	126.0274	124.0870	111.7159	108.0898	117.5071	116.9546	130.6437	137.1280	146.6596	(64)
								Total per year (kWh/year) = Sum(64)m =				1540.9510	(64)
Heat gains from water heating, kWh/month													
	70.5607	62.7260	67.1331	61.9238	61.9459	57.1652	56.6268	59.7581	58.9070	64.1260	65.6147	69.4513	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	9.8146	8.7172	7.0893	5.3671	4.0119	3.3871	3.6598	4.7572	6.3851	8.1073	9.4625	10.0874	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	110.0897	111.2321	108.3533	102.2247	94.4885	87.2176	82.3601	81.2177	84.0965	90.2251	97.9613	105.2323	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	94.8397	93.3422	90.2326	86.0052	83.2606	79.3961	76.1113	80.3200	81.8153	86.1908	91.1315	93.3485	(72)
Total internal gains													
	260.0857	258.6333	251.0170	238.9388	227.1028	215.3424	207.4730	211.6366	217.6387	229.8650	243.8970	254.0099	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.3100	10.6334	0.6300	0.7000	0.7700	7.5068	(74)
East	4.8700	19.6403	0.6300	0.7000	0.7700	29.2313	(76)
South	1.6600	46.7521	0.6300	0.7000	0.7700	23.7181	(78)

Solar gains	60.4563	110.3727	168.0295	232.4236	279.3427	284.8551	271.5572	235.9501	190.5232	126.8260	73.8227	50.7911	(83)
Total gains	320.5420	369.0060	419.0465	471.3624	506.4456	500.1976	479.0302	447.5868	408.1618	356.6910	317.7197	304.8010	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	38.9420	39.0373	39.1311	39.5781	39.6629	40.0623	40.0623	40.1371	39.9075	39.6629	39.4918	39.3145	
alpha	3.5961	3.6025	3.6087	3.6385	3.6442	3.6708	3.6708	3.6758	3.6605	3.6442	3.6328	3.6210	
util living area													
	0.9903	0.9831	0.9662	0.9227	0.8320	0.6822	0.5311	0.5810	0.8007	0.9446	0.9832	0.9919	(86)
MIT	19.2481	19.4509	19.7954	20.2441	20.6301	20.8772	20.9631	20.9485	20.7654	20.2650	19.6802	19.2161	(87)
Th 2	19.4817	19.4848	19.4878	19.5019	19.5046	19.5170	19.5170	19.5193	19.5122	19.5046	19.4992	19.4936	(88)
util rest of house													
	0.9869	0.9772	0.9538	0.8929	0.7660	0.5615	0.3670	0.4156	0.6996	0.9168	0.9761	0.9891	(89)
MIT 2	17.2459	17.5409	18.0368	18.6714	19.1702	19.4445	19.5063	19.5022	19.3452	18.7179	17.8851	17.2068	(90)
Living area fraction									fLA = Living area / (4) =			0.5900	(91)
MIT	18.4273	18.6679	19.0745	19.5994	20.0316	20.2899	20.3659	20.3556	20.1832	19.6308	18.9443	18.3924	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4273	18.6679	19.0745	19.5994	20.0316	20.2899	20.3659	20.3556	20.1832	19.6308	18.9443	18.3924	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9836	0.9729	0.9495	0.8952	0.7919	0.6284	0.4643	0.5133	0.7503	0.9197	0.9726	0.9862	(94)
Useful gains	315.3006	359.0192	397.8962	421.9821	401.0646	314.3180	222.4004	229.7662	306.2519	328.0568	309.0292	300.5843	(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													
	891.0713	866.2852	789.2973	664.0146	515.9620	348.8520	230.8892	242.0669	374.4105	559.2589	736.6723	886.6977	(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													
	428.3734	340.8828	291.2024	174.2634	85.4837	0.0000	0.0000	0.0000	0.0000	172.0143	307.9031	436.0684	(98)
Space heating												2236.1914	(98)
Space heating per m2											(98) / (4) =	63.2228	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2391.6486	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	428.3734	340.8828	291.2024	174.2634	85.4837	0.0000	0.0000	0.0000	0.0000	172.0143	307.9031	436.0684	(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)	458.1534	364.5805	311.4465	186.3780	91.4264	0.0000	0.0000	0.0000	0.0000	183.9725	329.3081	466.3833	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	149.9962	132.4541	139.6876	126.0274	124.0870	111.7159	108.0898	117.5071	116.9546	130.6437	137.1280	146.6596	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.4587	87.2271	86.7300	85.6786	83.8435	79.8000	79.8000	79.8000	79.8000	85.5486	86.9093	87.5457	(217)
Fuel for water heating, kWh/month	171.5052	151.8496	161.0603	147.0933	147.9984	139.9949	135.4509	147.2520	146.5596	152.7129	157.7829	167.5235	(219)
Water heating fuel used												1826.7835	(219)
Annual totals kWh/year													
Space heating fuel - main system												2391.6486	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Total delivered energy for all uses												4466.7607	(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	2391.6486	0.2160	516.5961	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1826.7835	0.2160	394.5852	(264)
Space and water heating			911.1813	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Total CO2, kg/m2/year			1040.0638	(272)
Emissions per m2 for space and water heating			25.7614	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			2.5433	(272b)
Emissions per m2 for pumps and fans			1.1005	(272c)
Target Carbon Dioxide Emission Rate (TER) = (25.7614 * 1.55) + 2.5433 + 1.1005, rounded to 2 d.p.			43.5700	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1848	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4348	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3696	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4712	0.4620	0.4527	0.4065	0.3973	0.3511	0.3511	0.3419	0.3696	0.3973	0.4158	0.4342	(22b)
Effective ac	0.6110	0.6067	0.6025	0.5826	0.5789	0.5616	0.5616	0.5584	0.5683	0.5789	0.5864	0.5943	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	74.4500	16.5900	57.8600	0.2300	13.3078	9.0000	520.7400	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			145.1900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.4501			(33)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		4183.9200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							118.2901	(35)
Thermal bridges (User defined value 0.051 * total exposed area)							7.4047	(36)
Total fabric heat loss					(33) + (36) =		56.8548	(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	21.8234	21.6694	21.5185	20.8096	20.6770	20.0596	20.0596	19.9453	20.2974	20.6770	20.9453	21.2258	(38)
Heat transfer coeff	78.6782	78.5242	78.3733	77.6645	77.5318	76.9144	76.9144	76.8001	77.1522	77.5318	77.8001	78.0806	(39)
Average = Sum(39)m / 12 =												77.6638	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.2244	2.2201	2.2158	2.1958	2.1920	2.1746	2.1746	2.1713	2.1813	2.1920	2.1996	2.2075	(40)
HLP (average)												2.1958	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.2895	(42)
Average daily hot water use (litres/day)												64.8244	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(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													

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	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													
	22.4710	19.6533	20.2805	17.6810	16.9653	14.6398	13.5659	15.5671	15.7530	18.3586	20.0399	21.7620	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	9.8146	8.7172	7.0893	5.3671	4.0119	3.3871	3.6598	4.7572	6.3851	8.1073	9.4625	10.0874	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	110.0897	111.2321	108.3533	102.2247	94.4885	87.2176	82.3601	81.2177	84.0965	90.2251	97.9613	105.2323	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	30.2030	29.2460	27.2587	24.5569	22.8029	20.3330	18.2338	20.9235	21.8792	24.6756	27.8331	29.2500	(72)
Total internal gains													
	192.4491	191.5371	185.0431	174.4905	163.6451	153.2794	146.5955	149.2402	154.7025	165.3497	177.5987	186.9114	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.3300	10.6334	0.7200	0.7000	0.7700	16.0814	(74)
East	9.1400	19.6403	0.7200	0.7000	0.7700	62.6985	(76)
South	3.1200	46.7521	0.7200	0.7000	0.7700	50.9471	(78)

Solar gains	129.7270	236.8221	360.4969	498.5971	599.2055	611.0124	582.4954	506.1457	408.7376	272.1152	158.4058	108.9894	(83)
Total gains	322.1760	428.3592	545.5400	673.0876	762.8506	764.2918	729.0909	655.3859	563.4401	437.4649	336.0045	295.9008	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	14.7716	14.8005	14.8290	14.9644	14.9900	15.1103	15.1103	15.1328	15.0637	14.9900	14.9383	14.8846	
alpha	1.9848	1.9867	1.9886	1.9976	1.9993	2.0074	2.0074	2.0089	2.0042	1.9993	1.9959	1.9923	
util living area													
	0.9529	0.9198	0.8640	0.7696	0.6476	0.5149	0.4050	0.4540	0.6480	0.8397	0.9311	0.9597	(86)
MIT	17.5721	18.0343	18.7311	19.5542	20.2211	20.6597	20.8513	20.8078	20.4247	19.4936	18.3676	17.4866	(87)
Th 2	19.1879	19.1906	19.1933	19.2060	19.2084	19.2195	19.2195	19.2216	19.2152	19.2084	19.2036	19.1986	(88)
util rest of house													
	0.9429	0.9033	0.8360	0.7222	0.5736	0.4055	0.2609	0.3058	0.5440	0.7939	0.9138	0.9510	(89)
MIT 2	16.2343	16.6850	17.3554	18.1285	18.7123	19.0631	19.1807	19.1654	18.9119	18.1099	17.0300	16.1572	(90)
Living area fraction										fLA = Living area / (4) =		0.5900	(91)
MIT	17.0237	17.4812	18.1671	18.9697	19.6025	20.0052	20.1664	20.1345	19.8045	18.9263	17.8192	16.9416	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.0237	17.4812	18.1671	18.9697	19.6025	20.0052	20.1664	20.1345	19.8045	18.9263	17.8192	16.9416	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9260	0.8827	0.8163	0.7150	0.5915	0.4569	0.3414	0.3866	0.5822	0.7850	0.8959	0.9356	(94)
Useful gains	298.3437	378.0914	445.3423	481.2396	451.2118	349.2330	248.9214	253.3604	328.0417	343.4177	301.0175	276.8314	(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													
	1001.0757	987.9257	914.3929	782.0570	612.6991	415.7358	274.3111	286.8072	440.1160	645.5570	833.9573	994.8713	(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													
	522.8326	409.8086	348.9736	216.5885	120.1466	0.0000	0.0000	0.0000	0.0000	224.7917	383.7166	534.2217	(98)
Space heating												2761.0799	(98)
Space heating per m2											(98) / (4) =	78.0628	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	722.9956	569.1668	583.6807	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7512	0.8044	0.7711	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	543.1257	457.8209	450.0935	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	942.9616	900.9628	815.4510	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	287.8818	329.6976	271.8260	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												889.4054	(104)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Cooled fraction										fC = cooled area / (4) =		1.0000 (105)
Intermittency factor (Table 10b)												
	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000 (106)
Space cooling kWh												
	0.0000	0.0000	0.0000	0.0000	0.0000	71.9705	82.4244	67.9565	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												222.3513 (107)
Space cooling per m2												6.2864 (108)
Energy for space heating												78.0628 (99)
Energy for space cooling												6.2864 (108)
Total												84.3492 (109)
Dwelling Fabric Energy Efficiency (DFEE)												84.3 (109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000	/ (5) =	0.1848	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.4348	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3696	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4712	0.4620	0.4527	0.4065	0.3973	0.3511	0.3511	0.3419	0.3696	0.3973	0.4158	0.4342	(22b)
Effective ac	0.6110	0.6067	0.6025	0.5826	0.5789	0.5616	0.5616	0.5584	0.5683	0.5789	0.5864	0.5943	(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 Opening Type (Uw = 1.40)			8.8400	1.3258	11.7197			(27)
GF			35.3700	0.1300	4.5981			(28b)
Main	74.4500	8.8400	65.6100	0.1800	11.8098			(29a)
Flat	35.3700		35.3700	0.1300	4.5981			(30)
Total net area of external elements Aum(A, m2)			145.1900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		32.7257			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.5255	(36)
Total fabric heat loss					(33) + (36) =		41.2512	(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	21.8234	21.6694	21.5185	20.8096	20.6770	20.0596	20.0596	19.9453	20.2974	20.6770	20.9453	21.2258	(38)
Heat transfer coeff	63.0746	62.9206	62.7697	62.0608	61.9282	61.3108	61.3108	61.1965	61.5486	61.9282	62.1965	62.4770	(39)
Average = Sum(39)m / 12 =												62.0602	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.7833	1.7789	1.7747	1.7546	1.7509	1.7334	1.7334	1.7302	1.7401	1.7509	1.7585	1.7664	(40)
HLP (average)												1.7546	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895	(42)
Average daily hot water use (litres/day)	64.8244	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(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)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Heat gains from water heating, kWh/month

	22.4710	19.6533	20.2805	17.6810	16.9653	14.6398	13.5659	15.5671	15.7530	18.3586	20.0399	21.7620 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	9.8146	8.7172	7.0893	5.3671	4.0119	3.3871	3.6598	4.7572	6.3851	8.1073	9.4625	10.0874	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	110.0897	111.2321	108.3533	102.2247	94.4885	87.2176	82.3601	81.2177	84.0965	90.2251	97.9613	105.2323	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	30.2030	29.2460	27.2587	24.5569	22.8029	20.3330	18.2338	20.9235	21.8792	24.6756	27.8331	29.2500	(72)
Total internal gains													
	192.4491	191.5371	185.0431	174.4905	163.6451	153.2794	146.5955	149.2402	154.7025	165.3497	177.5987	186.9114	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	2.3100	10.6334	0.6300	0.7000	0.7700	7.5068	(74)
East	4.8700	19.6403	0.6300	0.7000	0.7700	29.2313	(76)
South	1.6600	46.7521	0.6300	0.7000	0.7700	23.7181	(78)

Solar gains	60.4563	110.3727	168.0295	232.4236	279.3427	284.8551	271.5572	235.9501	190.5232	126.8260	73.8227	50.7911	(83)
Total gains	252.9053	301.9098	353.0725	406.9141	442.9878	438.1346	418.1526	385.1903	345.2257	292.1758	251.4214	237.7025	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	38.9420	39.0373	39.1311	39.5781	39.6629	40.0623	40.0623	40.1371	39.9075	39.6629	39.4918	39.3145	
alpha	3.5961	3.6025	3.6087	3.6385	3.6442	3.6708	3.6708	3.6758	3.6605	3.6442	3.6328	3.6210	
util living area													
	0.9955	0.9910	0.9797	0.9477	0.8741	0.7406	0.5925	0.6501	0.8584	0.9685	0.9920	0.9964	(86)
MIT	19.0917	19.2994	19.6548	20.1262	20.5483	20.8370	20.9472	20.9253	20.6923	20.1358	19.5296	19.0597	(87)
Th 2	19.4817	19.4848	19.4878	19.5019	19.5046	19.5170	19.5170	19.5193	19.5122	19.5046	19.4992	19.4936	(88)
util rest of house													
	0.9939	0.9877	0.9717	0.9256	0.8175	0.6222	0.4167	0.4759	0.7712	0.9510	0.9884	0.9951	(89)
MIT 2	17.8004	18.0090	18.3622	18.8290	19.2145	19.4477	19.5059	19.5011	19.3519	18.8498	18.2499	17.7773	(90)
Living area fraction									fLA = Living area / (4) =			0.5900	(91)
MIT	18.5624	18.7704	19.1249	19.5944	20.0015	20.2675	20.3563	20.3414	20.1428	19.6086	19.0050	18.5340	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5624	18.7704	19.1249	19.5944	20.0015	20.2675	20.3563	20.3414	20.1428	19.6086	19.0050	18.5340	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9925	0.9856	0.9693	0.9272	0.8389	0.6871	0.5212	0.5790	0.8137	0.9525	0.9869	0.9940	(94)
Useful gains	251.0038	297.5644	342.2271	377.3061	371.6272	301.0574	217.9573	223.0312	280.9010	278.3103	248.1173	236.2665	(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													
	899.5928	872.7338	792.4602	663.7055	514.0994	347.4768	230.3041	241.2021	371.9258	557.8886	740.4493	895.5461	(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													
	482.5502	386.5138	334.9734	206.2076	105.9993	0.0000	0.0000	0.0000	0.0000	208.0063	354.4790	490.5040	(98)
Space heating												2569.2335	(98)
Space heating per m2											(98) / (4) =	72.6388	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	576.3217	453.7000	465.0933	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7757	0.8470	0.8134	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	447.0648	384.2839	378.2852	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	561.7389	537.5285	499.6380	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	82.5653	114.0140	90.2865	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												286.8658	(104)
Cooled fraction									fC = cooled area / (4) =			1.0000	(105)
Intermittency factor (Table 10b)													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	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	20.6413	28.5035	22.5716	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												71.7165 (107)
Space cooling per m2												2.0276 (108)
Energy for space heating												72.6388 (99)
Energy for space cooling												2.0276 (108)
Total												74.6664 (109)
Target Fabric Energy Efficiency (TFEE)												85.9 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3424	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2910	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	6.6000	6.2000	5.9000	5.1000	4.9000	4.6000	4.2000	4.3000	4.9000	5.4000	5.9000	5.7000	(22)
Wind factor	1.6500	1.5500	1.4750	1.2750	1.2250	1.1500	1.0500	1.0750	1.2250	1.3500	1.4750	1.4250	(22a)
Adj infilt rate	0.4802	0.4511	0.4293	0.3711	0.3565	0.3347	0.3056	0.3129	0.3565	0.3929	0.4293	0.4147	(22b)
Effective ac	0.6153	0.6017	0.5921	0.5688	0.5636	0.5560	0.5467	0.5489	0.5636	0.5772	0.5921	0.5860	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	74.4500	16.5900	57.8600	0.2300	13.3078	9.0000	520.7400	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			145.1900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.4501			(33)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		4183.9200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							118.2901	(35)
Thermal bridges (User defined value 0.051 * total exposed area)							7.4047	(36)
Total fabric heat loss					(33) + (36) =		56.8548	(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	21.9764	21.4924	21.1492	20.3173	20.1282	19.8588	19.5260	19.6063	20.1282	20.6151	21.1492	20.9299	(38)
Heat transfer coeff	78.8312	78.3472	78.0040	77.1721	76.9830	76.7136	76.3808	76.4611	76.9830	77.4699	78.0040	77.7847	(39)
Average = Sum(39)m / 12 =												77.4279	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.2288	2.2151	2.2054	2.1819	2.1765	2.1689	2.1595	2.1618	2.1765	2.1903	2.2054	2.1992	(40)
HLP (average)												2.1891	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.2895	(42)
Average daily hot water use (litres/day)												64.8244	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)

Water storage loss:	
Store volume	125.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):	1.0500 (48)
Temperature factor from Table 2b	0.5400 (49)

CALCULATION OF HEAT DEMAND 09 Jan 2014

Enter (49) or (54) in (55) 0.5670 (55)
Total storage loss
17.5770 15.8760 17.5770 17.0100 17.5770 17.0100 17.5770 17.5770 17.0100 17.5770 17.0100 17.5770 (56)
If cylinder contains dedicated solar storage
17.5770 15.8760 17.5770 17.0100 17.5770 17.0100 17.5770 17.5770 17.0100 17.5770 17.0100 17.5770 (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
146.5855 129.3734 136.2768 122.7267 120.6763 108.4151 104.6790 114.0963 113.6538 127.2329 133.8273 143.2488 (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
146.5855 129.3734 136.2768 122.7267 120.6763 108.4151 104.6790 114.0963 113.6538 127.2329 133.8273 143.2488 (64)
Total per year (kWh/year) = Sum(64)m = 1500.7919 (64)
RHI water heating demand 1501 (64)
Heat gains from water heating, kWh/month
67.8321 60.2614 64.4045 59.2832 59.2173 54.5246 53.8982 57.0294 56.2664 61.3974 62.9741 66.7226 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	(66)

Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
24.5364 21.7931 17.7233 13.4177 10.0299 8.4676 9.1496 11.8930 15.9627 20.2684 23.6562 25.2184 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
164.3130 166.0181 161.7214 152.5743 141.0276 130.1755 122.9255 121.2205 125.5172 134.6643 146.2109 157.0631 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
44.0262 44.0262 44.0262 44.0262 44.0262 44.0262 44.0262 44.0262 44.0262 44.0262 44.0262 44.0262 (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)
-51.5780 -51.5780 -51.5780 -51.5780 -51.5780 -51.5780 -51.5780 -51.5780 -51.5780 -51.5780 -51.5780 -51.5780 (71)
Water heating gains (Table 5)
91.1722 89.6747 86.5651 82.3377 79.5931 75.7286 72.4438 76.6525 78.1478 82.5233 87.4640 89.6810 (72)
Total internal gains
352.8368 350.3010 338.8250 321.1448 303.4658 287.1868 277.3341 282.5811 292.4429 310.2711 330.1462 344.7776 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.3300	10.3621	0.7200	0.7000	0.7700	15.6711	(74)
East	9.1400	19.0327	0.7200	0.7000	0.7700	60.7588	(76)
South	3.1200	46.2981	0.7200	0.7000	0.7700	50.4524	(78)

Solar gains	126.8823	231.6520	368.8859	516.3558	621.4785	610.6966	588.5247	516.3760	413.2903	267.7693	151.3147	105.6121	(83)
Total gains	479.7191	581.9529	707.7109	837.5006	924.9443	897.8835	865.8588	798.9571	705.7331	578.0404	481.4610	450.3897	(84)

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7. Mean internal temperature (heating season)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	14.7429	14.8340	14.8992	15.0599	15.0968	15.1499	15.2159	15.1999	15.0968	15.0020	14.8992	14.9412	
alpha	1.9829	1.9889	1.9933	2.0040	2.0065	2.0100	2.0144	2.0133	2.0065	2.0001	1.9933	1.9961	
util living area	0.9191	0.8856	0.8289	0.7433	0.6437	0.5488	0.4646	0.4979	0.6458	0.8054	0.8954	0.9277	(86)
MIT	17.7006	18.1069	18.7378	19.4780	20.0809	20.5031	20.7271	20.6834	20.2896	19.4335	18.3925	17.6086	(87)
Th 2	19.8856	19.8925	19.8973	19.9091	19.9117	19.9156	19.9203	19.9191	19.9117	19.9049	19.8973	19.9004	(88)
util rest of house	0.9104	0.8739	0.8119	0.7182	0.6085	0.4999	0.4028	0.4352	0.5992	0.7800	0.8829	0.9200	(89)
MIT 2	16.8709	17.2722	17.8880	18.6043	19.1690	19.5542	19.7476	19.7152	19.3764	18.5791	17.5634	16.7901	(90)
Living area fraction									fLA = Living area / (4) =			0.5900	(91)
MIT	17.3604	17.7647	18.3894	19.1198	19.7071	20.1141	20.3255	20.2865	19.9152	19.0832	18.0527	17.2730	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.3604	17.7647	18.3894	19.1198	19.7071	20.1141	20.3255	20.2865	19.9152	19.0832	18.0527	17.2730	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8850	0.8459	0.7843	0.6979	0.6013	0.5093	0.4269	0.4575	0.5993	0.7578	0.8565	0.8959	(94)
Useful gains	424.5539	492.2709	555.0582	584.4641	556.2127	457.2835	369.6502	365.4995	422.9563	438.0247	412.3785	403.5104	(95)
Ext temp.	3.1000	3.6000	5.0000	7.2000	9.8000	12.7000	14.7000	14.6000	12.4000	9.1000	5.7000	2.9000	(96)
Heat loss rate W	1124.1684	1109.7672	1044.4286	919.8777	762.6764	568.7645	429.6830	434.7961	578.5422	773.3995	963.5566	1118.0028	(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	520.5132	414.9575	364.0916	241.4978	153.6090	0.0000	0.0000	0.0000	0.0000	249.5189	396.8482	531.5823	(98)

Space heating 2872.6185 (98)
RHI space heating demand 2873 (98)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3424	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2910	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3711	0.3638	0.3565	0.3201	0.3129	0.2765	0.2765	0.2692	0.2910	0.3129	0.3274	0.3420	(22b)
Effective ac	0.5688	0.5662	0.5636	0.5512	0.5489	0.5382	0.5382	0.5362	0.5424	0.5489	0.5536	0.5585	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	74.4500	16.5900	57.8600	0.2300	13.3078	9.0000	520.7400	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			145.1900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.4501			(33)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		4183.9200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							118.2901	(35)
Thermal bridges (User defined value 0.051 * total exposed area)							7.4047	(36)
Total fabric heat loss					(33) + (36) =		56.8548	(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	20.3173	20.2218	20.1282	19.6886	19.6063	19.2235	19.2235	19.1526	19.3709	19.6063	19.7727	19.9467	(38)
Heat transfer coeff	77.1721	77.0766	76.9830	76.5434	76.4611	76.0783	76.0783	76.0074	76.2257	76.4611	76.6275	76.8015	(39)
Average = Sum(39)m / 12 =												76.5430	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1819	2.1792	2.1765	2.1641	2.1618	2.1509	2.1509	2.1489	2.1551	2.1618	2.1665	2.1714	(40)
HLP (average)												2.1641	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895 (42)
Average daily hot water use (litres/day)	64.8244 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)

Water storage loss:	
Store volume	125.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):	1.0500 (48)
Temperature factor from Table 2b	0.5400 (49)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Enter (49) or (54) in (55)												0.5670	(55)
Total storage loss													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(56)
If cylinder contains dedicated solar storage													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(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													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(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													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
									Total per year (kWh/year) = Sum(64)m =			1500.7919	(64)
Heat gains from water heating, kWh/month													
	67.8321	60.2614	64.4045	59.2832	59.2173	54.5246	53.8982	57.0294	56.2664	61.3974	62.9741	66.7226	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.5364	21.7931	17.7233	13.4177	10.0299	8.4676	9.1496	11.8930	15.9627	20.2684	23.6562	25.2184	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	164.3130	166.0181	161.7214	152.5743	141.0276	130.1755	122.9255	121.2205	125.5172	134.6643	146.2109	157.0631	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	91.1722	89.6747	86.5651	82.3377	79.5931	75.7286	72.4438	76.6525	78.1478	82.5233	87.4640	89.6810	(72)
Total internal gains													
	352.8368	350.3010	338.8250	321.1448	303.4658	287.1868	277.3341	282.5811	292.4429	310.2711	330.1462	344.7776	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.3300	10.6334	0.7200	0.7000	0.7700	16.0814	(74)
East	9.1400	19.6403	0.7200	0.7000	0.7700	62.6985	(76)
South	3.1200	46.7521	0.7200	0.7000	0.7700	50.9471	(78)

Solar gains	129.7270	236.8221	360.4969	498.5971	599.2055	611.0124	582.4954	506.1457	408.7376	272.1152	158.4058	108.9894	(83)
Total gains	482.5637	587.1231	699.3219	819.7419	902.6713	898.1992	859.8295	788.7268	701.1804	582.3863	488.5520	453.7670	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	15.0599	15.0785	15.0968	15.1835	15.1999	15.2764	15.2764	15.2906	15.2468	15.1999	15.1669	15.1325	
alpha	2.0040	2.0052	2.0065	2.0122	2.0133	2.0184	2.0184	2.0194	2.0165	2.0133	2.0111	2.0088	
util living area													
	0.9078	0.8687	0.8064	0.7079	0.5860	0.4565	0.3517	0.3911	0.5691	0.7652	0.8752	0.9170	(86)
MIT	18.0737	18.4840	19.0975	19.8049	20.3705	20.7335	20.8880	20.8572	20.5606	19.7916	18.7985	17.9852	(87)
Th 2	19.9091	19.9104	19.9117	19.9180	19.9191	19.9245	19.9245	19.9255	19.9225	19.9191	19.9168	19.9143	(88)
util rest of house													
	0.8976	0.8547	0.7860	0.6775	0.5426	0.3964	0.2761	0.3134	0.5095	0.7328	0.8594	0.9077	(89)
MIT 2	17.2554	17.6553	18.2488	18.9229	19.4398	19.7547	19.8709	19.8534	19.6227	18.9312	17.9754	17.1725	(90)
Living area fraction										fLA = Living area / (4) =		0.5900	(91)
MIT	17.7382	18.1443	18.7496	19.4433	19.9890	20.3322	20.4710	20.4457	20.1761	19.4389	18.4611	17.6520	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.7382	18.1443	18.7496	19.4433	19.9890	20.3322	20.4710	20.4457	20.1761	19.4389	18.4611	17.6520	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8717	0.8271	0.7608	0.6628	0.5456	0.4200	0.3155	0.3522	0.5244	0.7164	0.8334	0.8827	(94)
Useful gains	420.6480	485.5859	532.0361	543.3114	492.4699	377.2624	271.3142	277.7704	367.7005	417.2376	407.1800	400.5582	(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													
	1037.0537	1020.8230	943.0081	807.0214	633.7840	436.0975	294.4987	307.5024	463.1547	675.8318	870.5729	1033.1360	(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													
	458.6059	359.6793	305.7632	189.8712	105.1377	0.0000	0.0000	0.0000	0.0000	192.3941	333.6429	470.6378	(98)
Space heating												2415.7321	(98)
Space heating per m2											(98) / (4) =	68.2989	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												170.0000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												1421.0189	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	458.6059	359.6793	305.7632	189.8712	105.1377	0.0000	0.0000	0.0000	0.0000	192.3941	333.6429	470.6378	(98)
Space heating efficiency (main heating system 1)													
	170.0000	170.0000	170.0000	170.0000	170.0000	0.0000	0.0000	0.0000	0.0000	170.0000	170.0000	170.0000	(210)
Space heating fuel (main heating system)													
	269.7682	211.5761	179.8607	111.6890	61.8457	0.0000	0.0000	0.0000	0.0000	113.1730	196.2605	276.8458	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
Efficiency of water heater												170.0000	(216)
(217)m	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	(217)
Fuel for water heating, kWh/month													
	86.2267	76.1020	80.1629	72.1922	70.9860	63.7736	61.5759	67.1155	66.8552	74.8429	78.7219	84.2640	(219)
Water heating fuel used												882.8188	(219)
Annual totals kWh/year													
Space heating fuel - main system												1421.0189	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
Total electricity for the above, kWh/year												30.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Total delivered energy for all uses												2507.1661	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1421.0189	13.1900	187.4324	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	882.8188	13.1900	116.4438	(247)
Pumps and fans for heating	30.0000	13.1900	3.9570	(249)
Energy for lighting	173.3285	13.1900	22.8620	(250)
Additional standing charges			0.0000	(251)
Total energy cost			330.6952	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.7282	(257)
SAP value		75.8922	
SAP rating (Section 12)		76	(258)
SAP band		C	

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	1421.0189	0.5190	737.5088	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	882.8188	0.5190	458.1829	(264)
Space and water heating			1195.6917	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Total kg/year			1301.2192	(272)
CO2 emissions per m2			36.7900	(273)
EI value			78.3049	
EI rating			78	(274)
EI band			C	

Calculation of stars for heating and DHW

Main heating energy efficiency	13.19 × (1 + 0.29 × 0.00) / 1.7000 = 7.759, stars = 2
Main heating environmental impact	0.519 × (1 + 0.29 × 0.00) / 1.7000 = 0.3053, stars = 4
Water heating energy efficiency	13.19 / 1.7000 = 7.759, stars = 2
Water heating environmental impact	0.519 / 1.7000 = 0.3053, stars = 4

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3424	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2910	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	6.6000	6.2000	5.9000	5.1000	4.9000	4.6000	4.2000	4.3000	4.9000	5.4000	5.9000	5.7000	(22)
Wind factor	1.6500	1.5500	1.4750	1.2750	1.2250	1.1500	1.0500	1.0750	1.2250	1.3500	1.4750	1.4250	(22a)
Adj infilt rate	0.4802	0.4511	0.4293	0.3711	0.3565	0.3347	0.3056	0.3129	0.3565	0.3929	0.4293	0.4147	(22b)
Effective ac	0.6153	0.6017	0.5921	0.5688	0.5636	0.5560	0.5467	0.5489	0.5636	0.5772	0.5921	0.5860	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	74.4500	16.5900	57.8600	0.2300	13.3078	9.0000	520.7400	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			145.1900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.4501			(33)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		4183.9200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							118.2901	(35)
Thermal bridges (User defined value 0.051 * total exposed area)							7.4047	(36)
Total fabric heat loss					(33) + (36) =		56.8548	(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	21.9764	21.4924	21.1492	20.3173	20.1282	19.8588	19.5260	19.6063	20.1282	20.6151	21.1492	20.9299	(38)
Heat transfer coeff	78.8312	78.3472	78.0040	77.1721	76.9830	76.7136	76.3808	76.4611	76.9830	77.4699	78.0040	77.7847	(39)
Average = Sum(39)m / 12 =												77.4279	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.2288	2.2151	2.2054	2.1819	2.1765	2.1689	2.1595	2.1618	2.1765	2.1903	2.2054	2.1992	(40)
HLP (average)												2.1891	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.2895	(42)
Average daily hot water use (litres/day)												64.8244	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)

Water storage loss:	
Store volume	125.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):	1.0500 (48)
Temperature factor from Table 2b	0.5400 (49)

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

Enter (49) or (54) in (55) 0.5670 (55)

Total storage loss

	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770 (56)

If cylinder contains dedicated solar storage

	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770 (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

	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488 (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

	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488 (64)

Total per year (kWh/year) = Sum(64)m = 1500.7919 (64)

Heat gains from water heating, kWh/month

	67.8321	60.2614	64.4045	59.2832	59.2173	54.5246	53.8982	57.0294	56.2664	61.3974	62.9741	66.7226 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	(66)

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

	24.5364	21.7931	17.7233	13.4177	10.0299	8.4676	9.1496	11.8930	15.9627	20.2684	23.6562	25.2184	(67)

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

	164.3130	166.0181	161.7214	152.5743	141.0276	130.1755	122.9255	121.2205	125.5172	134.6643	146.2109	157.0631	(68)

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

	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	(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)

	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)

Water heating gains (Table 5)

	91.1722	89.6747	86.5651	82.3377	79.5931	75.7286	72.4438	76.6525	78.1478	82.5233	87.4640	89.6810	(72)

Total internal gains

	352.8368	350.3010	338.8250	321.1448	303.4658	287.1868	277.3341	282.5811	292.4429	310.2711	330.1462	344.7776	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.3300	10.3621	0.7200	0.7000	0.7700	15.6711	(74)
East	9.1400	19.0327	0.7200	0.7000	0.7700	60.7588	(76)
South	3.1200	46.2981	0.7200	0.7000	0.7700	50.4524	(78)

Solar gains	126.8823	231.6520	368.8859	516.3558	621.4785	610.6966	588.5247	516.3760	413.2903	267.7693	151.3147	105.6121	(83)
Total gains	479.7191	581.9529	707.7109	837.5006	924.9443	897.8835	865.8588	798.9571	705.7331	578.0404	481.4610	450.3897	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	14.7429	14.8340	14.8992	15.0599	15.0968	15.1499	15.2159	15.1999	15.0968	15.0020	14.8992	14.9412	
alpha	1.9829	1.9889	1.9933	2.0040	2.0065	2.0100	2.0144	2.0133	2.0065	2.0001	1.9933	1.9961	
util living area	0.9191	0.8856	0.8289	0.7433	0.6437	0.5488	0.4646	0.4979	0.6458	0.8054	0.8954	0.9277	(86)
MIT	17.7006	18.1069	18.7378	19.4780	20.0809	20.5031	20.7271	20.6834	20.2896	19.4335	18.3925	17.6086	(87)
Th 2	19.8856	19.8925	19.8973	19.9091	19.9117	19.9156	19.9203	19.9191	19.9117	19.9049	19.8973	19.9004	(88)
util rest of house	0.9104	0.8739	0.8119	0.7182	0.6085	0.4999	0.4028	0.4352	0.5992	0.7800	0.8829	0.9200	(89)
MIT 2	16.8709	17.2722	17.8880	18.6043	19.1690	19.5542	19.7476	19.7152	19.3764	18.5791	17.5634	16.7901	(90)

Living area fraction fLA = Living area / (4) = 0.5900 (91)

MIT	17.3604	17.7647	18.3894	19.1198	19.7071	20.1141	20.3255	20.2865	19.9152	19.0832	18.0527	17.2730	(92)

Temperature adjustment 0.0000

adjusted MIT	17.3604	17.7647	18.3894	19.1198	19.7071	20.1141	20.3255	20.2865	19.9152	19.0832	18.0527	17.2730	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8850	0.8459	0.7843	0.6979	0.6013	0.5093	0.4269	0.4575	0.5993	0.7578	0.8565	0.8959	(94)
Useful gains	424.5539	492.2709	555.0582	584.4641	556.2127	457.2835	369.6502	365.4995	422.9563	438.0247	412.3785	403.5104	(95)
Ext temp.	3.1000	3.6000	5.0000	7.2000	9.8000	12.7000	14.7000	14.6000	12.4000	9.1000	5.7000	2.9000	(96)
Heat loss rate W	1124.1684	1109.7672	1044.4286	919.8777	762.6764	568.7645	429.6830	434.7961	578.5422	773.3995	963.5566	1118.0028	(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	520.5132	414.9575	364.0916	241.4978	153.6090	0.0000	0.0000	0.0000	0.0000	249.5189	396.8482	531.5823	(98)

Space heating 2872.6185 (98)

Space heating per m2 (98) / (4) = 81.2162 (99)

8c. Space cooling requirement

Not applicable

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

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												170.0000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												1689.7756	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	520.5132	414.9575	364.0916	241.4978	153.6090	0.0000	0.0000	0.0000	0.0000	249.5189	396.8482	531.5823	(98)
Space heating efficiency (main heating system 1)													
	170.0000	170.0000	170.0000	170.0000	170.0000	0.0000	0.0000	0.0000	0.0000	170.0000	170.0000	170.0000	(210)
Space heating fuel (main heating system)													
	306.1842	244.0926	214.1715	142.0576	90.3582	0.0000	0.0000	0.0000	0.0000	146.7758	233.4401	312.6955	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
Efficiency of water heater												170.0000	(216)
(217)m	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	(217)
Fuel for water heating, kWh/month													
	86.2267	76.1020	80.1629	72.1922	70.9860	63.7736	61.5759	67.1155	66.8552	74.8429	78.7219	84.2640	(219)
Water heating fuel used												882.8188	(219)
Annual totals kWh/year													
Space heating fuel - main system												1689.7756	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
Total electricity for the above, kWh/year												30.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Total delivered energy for all uses												2775.9229	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1689.7756	18.7000	315.9880	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	882.8188	18.7000	165.0871	(247)
Pumps and fans for heating	30.0000	18.7000	5.6100	(249)
Energy for lighting	173.3285	18.7000	32.4124	(250)
Additional standing charges			0.0000	(251)
Total energy cost			519.0976	(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	1689.7756	0.5190	876.9935	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	882.8188	0.5190	458.1829	(264)
Space and water heating			1335.1765	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Total kg/year			1440.7040	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	1689.7756	3.0700	5187.6110	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	882.8188	3.0700	2710.2536	(264)
Space and water heating			7897.8646	(265)
Pumps and fans	30.0000	3.0700	92.1000	(267)
Energy for lighting	173.3285	3.0700	532.1186	(268)
Primary energy kWh/year			8522.0832	(272)
Primary energy kWh/m2/year			240.9410	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating:	C 76
Current environmental impact rating:	C 78

(For testing purposes):

A Not considered

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

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 3.7	-£ 73	-203 kg (14.1%)
U Solar photovoltaic panels	+ 16.6	-£ 326	-906 kg (73.2%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£73	5.73 kg/m²	C 80	B 82
Solar photovoltaic panels	£326	25.62 kg/m²	A 96	A 97
Total Savings	£399	31.34 kg/m²		

Potential energy efficiency rating: A 96
Potential environmental impact rating: A 97

Fuel prices for cost data on this page from database revision number 465 TEST (04 Sep 2020)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£519	£446	£73
Space heating	£322	£322	-£1
Water heating	£165	£92	£74
Lighting	£32	£32	£0
Generated (PV)	-£0	-£326	£326
Total cost of fuels	£519	£120	£399
Total cost of uses	£519	£120	£399
Delivered energy	78 kWh/m²	18 kWh/m²	60 kWh/m²
Carbon dioxide emissions	1.4 tonnes	0.3 tonnes	1.1 tonnes
CO2 emissions per m²	41 kg/m²	9 kg/m²	31 kg/m²
Primary energy	241 kWh/m²	56 kWh/m²	185 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000	/ (5) =	0.0924	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.3424	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.2910	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3711	0.3638	0.3565	0.3201	0.3129	0.2765	0.2765	0.2692	0.2910	0.3129	0.3274	0.3420	(22b)
Effective ac	0.5688	0.5662	0.5636	0.5512	0.5489	0.5382	0.5382	0.5362	0.5424	0.5489	0.5536	0.5585	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	74.4500	16.5900	57.8600	0.2300	13.3078	9.0000	520.7400	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			145.1900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.4501			(33)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		4183.9200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							118.2901	(35)
Thermal bridges (User defined value 0.051 * total exposed area)							7.4047	(36)
Total fabric heat loss					(33) + (36) =		56.8548	(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	20.3173	20.2218	20.1282	19.6886	19.6063	19.2235	19.2235	19.1526	19.3709	19.6063	19.7727	19.9467	(38)
Heat transfer coeff	77.1721	77.0766	76.9830	76.5434	76.4611	76.0783	76.0783	76.0074	76.2257	76.4611	76.6275	76.8015	(39)
Average = Sum(39)m / 12 =												76.5430	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1819	2.1792	2.1765	2.1641	2.1618	2.1509	2.1509	2.1489	2.1551	2.1618	2.1665	2.1714	(40)
HLP (average)												2.1641	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.2895	(42)
Average daily hot water use (litres/day)												64.8244	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)

Water storage loss:	
Store volume	125.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):	1.0500 (48)
Temperature factor from Table 2b	0.5400 (49)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Enter (49) or (54) in (55)												0.5670	(55)
Total storage loss													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(56)
If cylinder contains dedicated solar storage													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(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													
	146.5855	129.3734	134.8811	115.9731	107.8819	95.8084	91.6521	101.9999	108.2509	125.8372	133.8273	143.2488	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.7781	(H8)
Utilisation factor												0.4302	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												64.8244	(H14)
Volume ratio Veff/V												1.1570	(H15)
Solar storage volume factor												1.0000	(H16)
Solar input												-685.9569	(H17)
Solar input	-19.8914	-33.1930	-56.5315	-75.7633	-93.5992	-92.0229	-90.8068	-79.3384	-62.1378	-42.4328	-23.5940	-16.6457	(63)
								Solar input (sum of months) = Sum(63)m =				-685.9569	(63)
Output from w/h													
	126.6941	96.1804	78.3496	40.2098	14.2827	3.7855	0.8453	22.6615	46.1131	83.4043	110.2332	126.6031	(64)
									Total per year (kWh/year) = Sum(64)m =			749.3626	(64)
Heat gains from water heating, kWh/month													
	67.8321	60.2614	63.2879	53.8803	48.9818	44.4392	43.4766	47.3523	51.9441	60.2808	62.9741	66.7226	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.5364	21.7931	17.7233	13.4177	10.0299	8.4676	9.1496	11.8930	15.9627	20.2684	23.6562	25.2184	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	164.3130	166.0181	161.7214	152.5743	141.0276	130.1755	122.9255	121.2205	125.5172	134.6643	146.2109	157.0631	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	91.1722	89.6747	85.0643	74.8337	65.8358	61.7211	58.4363	63.6455	72.1446	81.0225	87.4640	89.6810	(72)
Total internal gains													
	352.8368	350.3010	337.3242	313.6408	289.7085	273.1794	263.3266	269.5742	286.4397	308.7703	330.1462	344.7776	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.3300	10.6334	0.7200	0.7000	0.7700	16.0814	(74)
East	9.1400	19.6403	0.7200	0.7000	0.7700	62.6985	(76)
South	3.1200	46.7521	0.7200	0.7000	0.7700	50.9471	(78)

Solar gains	129.7270	236.8221	360.4969	498.5971	599.2055	611.0124	582.4954	506.1457	408.7376	272.1152	158.4058	108.9894	(83)
Total gains	482.5637	587.1231	697.8211	812.2379	888.9140	884.1917	845.8220	775.7199	695.1772	580.8855	488.5520	453.7670	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	15.0599	15.0785	15.0968	15.1835	15.1999	15.2764	15.2764	15.2906	15.2468	15.1999	15.1669	15.1325	
alpha	2.0040	2.0052	2.0065	2.0122	2.0133	2.0184	2.0184	2.0194	2.0165	2.0133	2.0111	2.0088	
util living area													
	0.9078	0.8687	0.8069	0.7108	0.5914	0.4618	0.3566	0.3963	0.5721	0.7659	0.8752	0.9170	(86)
MIT	18.0737	18.4840	19.0946	19.7947	20.3592	20.7276	20.8850	20.8536	20.5560	19.7891	18.7985	17.9852	(87)
Th 2	19.9091	19.9104	19.9117	19.9180	19.9191	19.9245	19.9245	19.9255	19.9225	19.9191	19.9168	19.9143	(88)
util rest of house													
	0.8976	0.8547	0.7866	0.6805	0.5480	0.4014	0.2802	0.3179	0.5125	0.7336	0.8594	0.9077	(89)
MIT 2	17.2554	17.6553	18.2461	18.9139	19.4306	19.7507	19.8694	19.8514	19.6194	18.9290	17.9754	17.1725	(90)
Living area fraction										fLA = Living area / (4) =		0.5900	(91)
MIT	17.7382	18.1443	18.7468	19.4336	19.9785	20.3271	20.4687	20.4428	20.1720	19.4365	18.4611	17.6520	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.7382	18.1443	18.7468	19.4336	19.9785	20.3271	20.4687	20.4428	20.1720	19.4365	18.4611	17.6520	(93)

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8. Space heating requirement

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8717	0.8271	0.7613	0.6656	0.5505	0.4248	0.3199	0.3569	0.5272	0.7172	0.8334	0.8827	(94)
Useful gains	420.6480	485.5859	531.2790	540.5914	489.3692	375.6428	270.5498	276.8208	366.4830	416.5833	407.1800	400.5582	(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													
	1037.0537	1020.8230	942.7936	806.2784	632.9842	435.7066	294.3212	307.2790	462.8447	675.6495	870.5729	1033.1360	(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													
	458.6059	359.6793	306.1669	191.2946	106.8496	0.0000	0.0000	0.0000	0.0000	192.7453	333.6429	470.6378	(98)
Space heating												2419.6223	(98)
Space heating per m2											(98) / (4) =	68.4089	(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 %)												170.0000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												1423.3072	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	458.6059	359.6793	306.1669	191.2946	106.8496	0.0000	0.0000	0.0000	0.0000	192.7453	333.6429	470.6378	(98)
Space heating efficiency (main heating system 1)													
	170.0000	170.0000	170.0000	170.0000	170.0000	0.0000	0.0000	0.0000	0.0000	170.0000	170.0000	170.0000	(210)
Space heating fuel (main heating system)													
	269.7682	211.5761	180.0982	112.5263	62.8527	0.0000	0.0000	0.0000	0.0000	113.3796	196.2605	276.8458	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	126.6941	96.1804	78.3496	40.2098	14.2827	3.7855	0.8453	22.6615	46.1131	83.4043	110.2332	126.6031	(64)
Efficiency of water heater												170.0000	(216)
(217)m	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	(217)
Fuel for water heating, kWh/month													
	74.5259	56.5767	46.0880	23.6528	8.4016	2.2268	0.4972	13.3303	27.1254	49.0614	64.8431	74.4724	(219)
Water heating fuel used												440.8015	(219)
Annual totals kWh/year													
Space heating fuel - main system												1423.3072	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												80.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												390.1979	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1423.3072	13.1900	187.7342	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	440.8015	13.1900	58.1417	(247)
Pumps and fans for heating	30.0000	13.1900	3.9570	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	173.3285	13.1900	22.8620	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			51.4671	(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] =	0.2690	(257)
SAP value		96.2480	
SAP rating (Section 12)		96	(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	1423.3072	0.5190	738.6965	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Water heating (other fuel)	440.8015	0.5190	228.7760 (264)
Space and water heating			967.4724 (265)
Pumps and fans	80.0000	0.5190	41.5200 (267)
Energy for lighting	173.3285	0.5190	89.9575 (268)
Energy saving/generation technologies			
PV Unit	-1727.2394	0.5190	-896.4372 (269)
Total kg/year			202.5127 (272)
CO2 emissions per m2			5.7300 (273)
EI value			96.6235
EI rating			97 (274)
EI band			A

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3424	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2910	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	6.6000	6.2000	5.9000	5.1000	4.9000	4.6000	4.2000	4.3000	4.9000	5.4000	5.9000	5.7000	(22)
Wind factor	1.6500	1.5500	1.4750	1.2750	1.2250	1.1500	1.0500	1.0750	1.2250	1.3500	1.4750	1.4250	(22a)
Adj infilt rate	0.4802	0.4511	0.4293	0.3711	0.3565	0.3347	0.3056	0.3129	0.3565	0.3929	0.4293	0.4147	(22b)
Effective ac	0.6153	0.6017	0.5921	0.5688	0.5636	0.5560	0.5467	0.5489	0.5636	0.5772	0.5921	0.5860	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	74.4500	16.5900	57.8600	0.2300	13.3078	9.0000	520.7400	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			145.1900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.4501			(33)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	4183.9200 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		118.2901 (35)
Thermal bridges (User defined value 0.051 * total exposed area)		7.4047 (36)
Total fabric heat loss	(33) + (36) =	56.8548 (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	21.9764	21.4924	21.1492	20.3173	20.1282	19.8588	19.5260	19.6063	20.1282	20.6151	21.1492	20.9299	(38)
Heat transfer coeff	78.8312	78.3472	78.0040	77.1721	76.9830	76.7136	76.3808	76.4611	76.9830	77.4699	78.0040	77.7847	(39)
Average = Sum(39)m / 12 =												77.4279	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.2288	2.2151	2.2054	2.1819	2.1765	2.1689	2.1595	2.1618	2.1765	2.1903	2.2054	2.1992	(40)
HLP (average)												2.1891	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895 (42)
Average daily hot water use (litres/day)	64.8244 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)

Water storage loss:	
Store volume	125.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):	1.0500 (48)
Temperature factor from Table 2b	0.5400 (49)

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

Enter (49) or (54) in (55)												0.5670	(55)
Total storage loss													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(56)
If cylinder contains dedicated solar storage													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(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													
	146.5855	129.3734	134.8811	115.9731	107.8819	95.8084	91.6521	101.9999	108.2509	125.8372	133.8273	143.2488	(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												1091.0709	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1832.9992	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.7972	(H8)
Utilisation factor												0.4267	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												64.8244	(H14)
Volume ratio Veff/V												1.1570	(H15)
Solar storage volume factor												1.0000	(H16)
Solar input												-687.8113	(H17)
Solar input	-19.2686	-32.1683	-57.3554	-77.8632	-96.3853	-91.3308	-91.0993	-80.3442	-62.3188	-41.3797	-22.3236	-15.9741	(63)
								Solar input (sum of months) = Sum(63)m =				-687.8113	(63)
Output from w/h													
	127.3169	97.2050	77.5257	38.1099	11.4966	4.4776	0.5528	21.6557	45.9322	84.4575	111.5037	127.2747	(64)
									Total per year (kWh/year) = Sum(64)m =			747.5082	(64)
Heat gains from water heating, kWh/month													
	67.8321	60.2614	63.2879	53.8803	48.9818	44.4392	43.4766	47.3523	51.9441	60.2808	62.9741	66.7226	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.5364	21.7931	17.7233	13.4177	10.0299	8.4676	9.1496	11.8930	15.9627	20.2684	23.6562	25.2184	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	164.3130	166.0181	161.7214	152.5743	141.0276	130.1755	122.9255	121.2205	125.5172	134.6643	146.2109	157.0631	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	91.1722	89.6747	85.0643	74.8337	65.8358	61.7211	58.4363	63.6455	72.1446	81.0225	87.4640	89.6810	(72)
Total internal gains													
	352.8368	350.3010	337.3242	313.6408	289.7085	273.1794	263.3266	269.5742	286.4397	308.7703	330.1462	344.7776	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.3300	10.3621	0.7200	0.7000	0.7700	15.6711	(74)
East	9.1400	19.0327	0.7200	0.7000	0.7700	60.7588	(76)
South	3.1200	46.2981	0.7200	0.7000	0.7700	50.4524	(78)

Solar gains	126.8823	231.6520	368.8859	516.3558	621.4785	610.6966	588.5247	516.3760	413.2903	267.7693	151.3147	105.6121	(83)
Total gains	479.7191	581.9529	706.2101	829.9966	911.1869	883.8760	851.8513	785.9502	699.7299	576.5396	481.4610	450.3897	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	14.7429	14.8340	14.8992	15.0599	15.0968	15.1499	15.2159	15.1999	15.0968	15.0020	14.8992	14.9412	
alpha	1.9829	1.9889	1.9933	2.0040	2.0065	2.0100	2.0144	2.0133	2.0065	2.0001	1.9933	1.9961	
util living area													
	0.9191	0.8856	0.8294	0.7460	0.6488	0.5543	0.4702	0.5036	0.6488	0.8061	0.8954	0.9277	(86)
MIT	17.7006	18.1069	18.7348	19.4665	20.0664	20.4935	20.7209	20.6765	20.2832	19.4306	18.3925	17.6086	(87)
Th 2	19.8856	19.8925	19.8973	19.9091	19.9117	19.9156	19.9203	19.9191	19.9117	19.9049	19.8973	19.9004	(88)
util rest of house													
	0.9104	0.8739	0.8124	0.7210	0.6137	0.5053	0.4080	0.4406	0.6021	0.7807	0.8829	0.9200	(89)
MIT 2	16.8709	17.2722	17.8851	18.5937	19.1565	19.5467	19.7433	19.7104	19.3712	18.5765	17.5634	16.7901	(90)
Living area fraction									fLA = Living area / (4) =			0.5900	(91)
MIT	17.3604	17.7647	18.3864	19.1087	19.6934	20.1053	20.3202	20.2804	19.9093	19.0805	18.0527	17.2730	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.3604	17.7647	18.3864	19.1087	19.6934	20.1053	20.3202	20.2804	19.9093	19.0805	18.0527	17.2730	(93)

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8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8850	0.8459	0.7848	0.7005	0.6061	0.5144	0.4319	0.4626	0.6020	0.7584	0.8565	0.8959	(94)
Useful gains	424.5539	492.2709	554.2419	581.3768	552.2587	454.6217	367.9556	363.6187	421.2523	437.2738	412.3785	403.5104	(95)
Ext temp.	3.1000	3.6000	5.0000	7.2000	9.8000	12.7000	14.7000	14.6000	12.4000	9.1000	5.7000	2.9000	(96)
Heat loss rate W	1124.1684	1109.7672	1044.1946	919.0184	761.6230	568.0896	429.2716	434.3322	578.0890	773.1862	963.5566	1118.0028	(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	520.5132	414.9575	364.5247	243.1019	155.7670	0.0000	0.0000	0.0000	0.0000	249.9188	396.8482	531.5823	(98)
Space heating												2877.2138	(98)
Space heating per m2											(98) / (4) =	81.3462	(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 %)	170.0000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1692.4787	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	520.5132	414.9575	364.5247	243.1019	155.7670	0.0000	0.0000	0.0000	0.0000	249.9188	396.8482	531.5823	(98)
Space heating efficiency (main heating system 1)													
	170.0000	170.0000	170.0000	170.0000	170.0000	0.0000	0.0000	0.0000	0.0000	170.0000	170.0000	170.0000	(210)
Space heating fuel (main heating system)													
	306.1842	244.0926	214.4263	143.0011	91.6277	0.0000	0.0000	0.0000	0.0000	147.0111	233.4401	312.6955	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	127.3169	97.2050	77.5257	38.1099	11.4966	4.4776	0.5528	21.6557	45.9322	84.4575	111.5037	127.2747	(64)
Efficiency of water heater												170.0000	(216)
(217)m	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	(217)
Fuel for water heating, kWh/month													
	74.8923	57.1794	45.6033	22.4176	6.7627	2.6339	0.3252	12.7386	27.0189	49.6809	65.5904	74.8675	(219)
Water heating fuel used												439.7107	(219)
Annual totals kWh/year													
Space heating fuel - main system												1692.4787	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												80.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1091 * 0.80) =										-1745.7135		-1745.7135	(233)
Total delivered energy for all uses												639.8044	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1692.4787	18.7000	316.4935	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	439.7107	18.7000	82.2259	(247)
Pumps and fans for heating	30.0000	18.7000	5.6100	(249)
Pump for solar water heating	50.0000	18.7000	9.3500	(249)
Energy for lighting	173.3285	18.7000	32.4124	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-1745.7135	18.7000	-326.4484	(252)
Total energy cost			119.6434	(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	1692.4787	0.5190	878.3964	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	439.7107	0.5190	228.2098	(264)
Space and water heating			1106.6063	(265)
Pumps and fans	80.0000	0.5190	41.5200	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Energy saving/generation technologies				
PV Unit	-1745.7135	0.5190	-906.0253	(269)
Total kg/year			332.0585	(272)

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

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	1692.4787	3.0700	5195.9096	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	439.7107	3.0700	1349.9118	(264)
Space and water heating			6545.8214	(265)
Pumps and fans	80.0000	3.0700	245.6000	(267)
Energy for lighting	173.3285	3.0700	532.1186	(268)
Energy saving/generation technologies				
PV Unit	-1745.7135	3.0700	-5359.3404	(269)
Primary energy kWh/year			1964.1995	(272)
Primary energy kWh/m2/year			55.5329	(273)

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

Overheating Calculation Input Data

Dwelling type	Detached Bungalow
Number of storeys	1
Cross ventilation possible	Yes
SAP Region	North East England
Front of dwelling faces	South
Overshading	Average or unknown
Thermal mass parameter	118.3 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	6.00 (Windows fully open)

Overheating Calculation

Summer ventilation heat loss coefficient	214.30	(P1)
Transmission heat loss coefficient	56.85	(37)
Summer heat loss coefficient	271.15	(P2)

Overhangs

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

Solar shading

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

[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	4.3300	74.6426	0.7200	0.7000	0.9000	131.9443
East	9.1400	111.2086	0.7200	0.7000	0.9000	414.9541
South	3.1200	110.4126	0.7200	0.7000	0.9000	140.6335
total:						687.5319

	Jun	Jul	Aug	
Solar gains	710	688	592	(P3)
Internal gains	284	274	280	
Total summer gains	994	962	871	(P5)
Summer gain/loss ratio	3.67	3.55	3.21	(P6)
Summer external temperature	13.80	15.80	15.60	
Thermal mass temperature increment (TMP = 118.3)	1.17	1.17	1.17	
Threshold temperature	18.64	20.52	19.99	(P7)
Likelihood of high internal temperature	Not significant	Slight	Not significant	

Assessment of likelihood of high internal temperature: Slight

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

Anderson Goddard Ltd

Property Reference	73940-WR04	**Issued on Date**	07/10/2020
Assessment Reference	001	**Prop Type Ref**	Det
Property	Woodlands Room 4, Raithwaite Bay, WHITBY, YO21 3ST		

SAP Rating	75 C	**DER**	39.94	**TER**	44.70
Environmental	78 C	**% DER<TER**	10.65		
CO_2 Emissions (t/year)	1.49	**DFEE**	88.13	**TFEE**	89.61
General Requirements Compliance	Pass	**% DFEE<TFEE**	1.65		

Assessor Details	Mr. Paul Goddard, Anderson Goddard Limited, Tel: 0161 7757770, paul.goddard@andersongoddard.com	**Assessor ID**	B342-0001
Client			

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

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

Detached Bungalow, total floor area 35 m²

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

1a TER and DER
Fuel for main heating:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 44.70 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 39.94 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)89.6 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)88.1 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.23 (max. 0.30)	0.23 (max. 0.70)	OK
Floor	0.22 (max. 0.25)	0.22 (max. 0.70)	OK
Roof	0.18 (max. 0.20)	0.18 (max. 0.35)	OK
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated using user-specified y-value of 0.051

---
3 Air permeability
Air permeability at 50 pascals: 4.95 (design value)
Maximum 10.0 OK

---
4 Heating efficiency
Main heating system: Heat pump with radiators or underfloor - Electric
Air-to-water heat pump

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage Measured cylinder loss: 1.05 kWh/day
Permitted by DBSCG 1.70 OK
Primary pipework insulated: Yes OK

---
6 Controls
Space heating controls: Programmer and room thermostat OK

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

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

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (North East England): Not significant OK
Based on:
Overshading: Average
Windows facing North: 9.14 m², No overhang
Windows facing East: 3.12 m², No overhang
Windows facing West: 4.33 m², No overhang
Air change rate: 8.00 ach
Blinds/curtains: None

---
10 Key features
None

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		4.9500	
Infiltration rate		0.3399	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2889	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3684	0.3611	0.3539	0.3178	0.3106	0.2745	0.2745	0.2672	0.2889	0.3106	0.3250	0.3395	(22b)
Effective ac	0.5678	0.5652	0.5626	0.5505	0.5482	0.5377	0.5377	0.5357	0.5417	0.5482	0.5528	0.5576	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	74.4500	16.5900	57.8600	0.2300	13.3078	9.0000	520.7400	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			145.1900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.4501			(33)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		4183.9200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							118.2901	(35)
Thermal bridges (User defined value 0.051 * total exposed area)							7.4047	(36)
Total fabric heat loss					(33) + (36) =		56.8548	(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	20.2815	20.1874	20.0952	19.6620	19.5809	19.2036	19.2036	19.1337	19.3489	19.5809	19.7449	19.9163	(38)
Heat transfer coeff	77.1363	77.0422	76.9500	76.5168	76.4357	76.0584	76.0584	75.9885	76.2037	76.4357	76.5997	76.7711	(39)
Average = Sum(39)m / 12 =												76.5164	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1808	2.1782	2.1756	2.1633	2.1610	2.1504	2.1504	2.1484	2.1545	2.1610	2.1657	2.1705	(40)
HLP (average)												2.1633	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.2895	(42)
Average daily hot water use (litres/day)												64.8244	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0500	(48)
Temperature factor from Table 2b												0.5400	(49)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Enter (49) or (54) in (55)												0.5670	(55)
Total storage loss													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(56)
If cylinder contains dedicated solar storage													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(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													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(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													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
									Total per year (kWh/year) = Sum(64)m =			1500.7919	(64)
Heat gains from water heating, kWh/month													
	67.8321	60.2614	64.4045	59.2832	59.2173	54.5246	53.8982	57.0294	56.2664	61.3974	62.9741	66.7226	(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	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	9.8146	8.7172	7.0893	5.3671	4.0119	3.3871	3.6598	4.7572	6.3851	8.1073	9.4625	10.0874	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	110.0897	111.2321	108.3533	102.2247	94.4885	87.2176	82.3601	81.2177	84.0965	90.2251	97.9613	105.2323	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	91.1722	89.6747	86.5651	82.3377	79.5931	75.7286	72.4438	76.6525	78.1478	82.5233	87.4640	89.6810	(72)
Total internal gains													
	256.4182	254.9658	247.3495	235.2713	223.4353	211.6749	203.8055	207.9691	213.9712	226.1975	240.2295	250.3424	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	9.1400	10.6334	0.7200	0.7000	0.7700	33.9455	(74)
East	3.1200	19.6403	0.7200	0.7000	0.7700	21.4026	(76)
West	4.3300	19.6403	0.7200	0.7000	0.7700	29.7029	(80)

Solar gains	85.0509	164.8447	274.8741	417.1816	532.7943	556.5848	525.1898	435.4886	324.0202	195.8476	105.5986	70.3253	(83)
Total gains	341.4691	419.8105	522.2236	652.4529	756.2296	768.2597	728.9953	643.4578	537.9913	422.0451	345.8282	320.6676	(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	15.0668	15.0852	15.1033	15.1888	15.2049	15.2804	15.2804	15.2944	15.2512	15.2049	15.1724	15.1385	
alpha	2.0045	2.0057	2.0069	2.0126	2.0137	2.0187	2.0187	2.0196	2.0167	2.0137	2.0115	2.0092	
util living area													
	0.9477	0.9217	0.8709	0.7759	0.6473	0.5100	0.4021	0.4573	0.6608	0.8461	0.9272	0.9534	(86)
MIT	17.6811	18.0615	18.7228	19.5501	20.2347	20.6709	20.8559	20.8081	20.4103	19.4861	18.4303	17.6056	(87)
Th 2	19.9096	19.9109	19.9122	19.9183	19.9195	19.9248	19.9248	19.9258	19.9228	19.9195	19.9172	19.9147	(88)
util rest of house													
	0.9414	0.9124	0.8555	0.7491	0.6047	0.4471	0.3190	0.3718	0.6024	0.8210	0.9170	0.9478	(89)
MIT 2	16.8727	17.2479	17.8957	18.6939	19.3283	19.7117	19.8544	19.8263	19.5085	18.6546	17.6217	16.8015	(90)
Living area fraction										fLA = Living area / (4) =		0.5900	(91)
MIT	17.3497	17.7280	18.3837	19.1991	19.8631	20.2777	20.4453	20.4056	20.0406	19.1453	18.0988	17.2760	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.3497	17.7280	18.3837	19.1991	19.8631	20.2777	20.4453	20.4056	20.0406	19.1453	18.0988	17.2760	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9213	0.8882	0.8289	0.7288	0.6023	0.4688	0.3606	0.4117	0.6094	0.7993	0.8945	0.9290	(94)
Useful gains	314.5845	372.8683	432.8779	475.4860	455.4552	360.1293	262.8803	264.8960	327.8681	337.3519	309.3283	297.8982	(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													
	1006.6053	988.2956	914.4522	788.0527	623.9537	431.8345	292.4708	304.3834	452.6976	653.1623	842.5043	1003.8588	(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													
	514.8635	413.5672	358.2913	225.0481	125.3630	0.0000	0.0000	0.0000	0.0000	234.9629	383.8867	525.2347	(98)
Space heating												2781.2173	(98)
Space heating per m2											(98) / (4) =	78.6321	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												170.0000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												1636.0102	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	514.8635	413.5672	358.2913	225.0481	125.3630	0.0000	0.0000	0.0000	0.0000	234.9629	383.8867	525.2347	(98)
Space heating efficiency (main heating system 1)													
	170.0000	170.0000	170.0000	170.0000	170.0000	0.0000	0.0000	0.0000	0.0000	170.0000	170.0000	170.0000	(210)
Space heating fuel (main heating system)													
	302.8609	243.2748	210.7596	132.3812	73.7429	0.0000	0.0000	0.0000	0.0000	138.2135	225.8157	308.9616	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
Efficiency of water heater												170.0000	(216)
(217)m	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	(217)
Fuel for water heating, kWh/month													
	86.2267	76.1020	80.1629	72.1922	70.9860	63.7736	61.5759	67.1155	66.8552	74.8429	78.7219	84.2640	(219)
Water heating fuel used												882.8188	(219)
Annual totals kWh/year													
Space heating fuel - main system												1636.0102	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
Total electricity for the above, kWh/year												30.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Total delivered energy for all uses												2722.1574	(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	1636.0102	0.5190	849.0893	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	882.8188	0.5190	458.1829	(264)
Space and water heating			1307.2722	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Total CO2, kg/year			1412.7997	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			39.9400	(273)

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

DER		39.9400	ZC1
Total Floor Area	TFA	35.3700	
Assumed number of occupants	N	1.2895	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		18.4441	ZC2
CO2 emissions from cooking, equation (L16)		4.2394	ZC3
Total CO2 emissions		62.6235	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		62.6235	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000	/ (5) =	0.1848	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.4348	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3696	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4712	0.4620	0.4527	0.4065	0.3973	0.3511	0.3511	0.3419	0.3696	0.3973	0.4158	0.4342	(22b)
Effective ac	0.6110	0.6067	0.6025	0.5826	0.5789	0.5616	0.5616	0.5584	0.5683	0.5789	0.5864	0.5943	(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 Opening Type (Uw = 1.40)			8.8400	1.3258	11.7197			(27)
GF			35.3700	0.1300	4.5981			(28b)
Main	74.4500	8.8400	65.6100	0.1800	11.8098			(29a)
Flat	35.3700		35.3700	0.1300	4.5981			(30)
Total net area of external elements Aum(A, m2)			145.1900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		32.7257			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.5255	(36)
Total fabric heat loss					(33) + (36) =		41.2512	(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	21.8234	21.6694	21.5185	20.8096	20.6770	20.0596	20.0596	19.9453	20.2974	20.6770	20.9453	21.2258	(38)
Heat transfer coeff	63.0746	62.9206	62.7697	62.0608	61.9282	61.3108	61.3108	61.1965	61.5486	61.9282	62.1965	62.4770	(39)
Average = Sum(39)m / 12 =												62.0602	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.7833	1.7789	1.7747	1.7546	1.7509	1.7334	1.7334	1.7302	1.7401	1.7509	1.7585	1.7664	(40)
HLP (average)												1.7546	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.2895	(42)
Average daily hot water use (litres/day)												64.8244	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.2538	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.6770	(55)
Total storage loss													

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	20.9878	18.9567	20.9878	20.3108	20.9878	20.3108	20.9878	20.9878	20.3108	20.9878	20.3108	20.9878	(56)
If cylinder contains dedicated solar storage													
	20.9878	18.9567	20.9878	20.3108	20.9878	20.3108	20.9878	20.9878	20.3108	20.9878	20.3108	20.9878	(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													
	149.9962	132.4541	139.6876	126.0274	124.0870	111.7159	108.0898	117.5071	116.9546	130.6437	137.1280	146.6596	(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													
	149.9962	132.4541	139.6876	126.0274	124.0870	111.7159	108.0898	117.5071	116.9546	130.6437	137.1280	146.6596	(64)
								Total per year (kWh/year) = Sum(64)m =				1540.9510	(64)
Heat gains from water heating, kWh/month													
	70.5607	62.7260	67.1331	61.9238	61.9459	57.1652	56.6268	59.7581	58.9070	64.1260	65.6147	69.4513	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	9.8146	8.7172	7.0893	5.3671	4.0119	3.3871	3.6598	4.7572	6.3851	8.1073	9.4625	10.0874	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	110.0897	111.2321	108.3533	102.2247	94.4885	87.2176	82.3601	81.2177	84.0965	90.2251	97.9613	105.2323	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	94.8397	93.3422	90.2326	86.0052	83.2606	79.3961	76.1113	80.3200	81.8153	86.1908	91.1315	93.3485	(72)
Total internal gains													
	260.0857	258.6333	251.0170	238.9388	227.1028	215.3424	207.4730	211.6366	217.6387	229.8650	243.8970	254.0099	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.8700	10.6334	0.6300	0.7000	0.7700	15.8261	(74)
East	1.6600	19.6403	0.6300	0.7000	0.7700	9.9639	(76)
West	2.3100	19.6403	0.6300	0.7000	0.7700	13.8654	(80)

Solar gains	39.6553	76.8594	128.1609	194.5116	248.4156	259.5075	244.8698	203.0471	151.0752	91.3146	49.2357	32.7894	(83)
Total gains	299.7410	335.4927	379.1779	433.4504	475.5184	474.8500	452.3428	414.6837	368.7139	321.1796	293.1327	286.7992	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	38.9420	39.0373	39.1311	39.5781	39.6629	40.0623	40.0623	40.1371	39.9075	39.6629	39.4918	39.3145	
alpha	3.5961	3.6025	3.6087	3.6385	3.6442	3.6708	3.6708	3.6758	3.6605	3.6442	3.6328	3.6210	
util living area													
	0.9922	0.9874	0.9748	0.9379	0.8528	0.7055	0.5567	0.6161	0.8372	0.9587	0.9869	0.9934	(86)
MIT	19.2004	19.3759	19.7114	20.1762	20.5922	20.8623	20.9570	20.9375	20.7219	20.1955	19.6250	19.1744	(87)
Th 2	19.4817	19.4848	19.4878	19.5019	19.5046	19.5170	19.5170	19.5193	19.5122	19.5046	19.4992	19.4936	(88)
util rest of house													
	0.9894	0.9829	0.9652	0.9127	0.7910	0.5852	0.3873	0.4456	0.7439	0.9366	0.9813	0.9910	(89)
MIT 2	17.1769	17.4334	17.9191	18.5828	19.1289	19.4340	19.5042	19.4978	19.3056	18.6261	17.8064	17.1465	(90)
Living area fraction										fLA = Living area / (4) =		0.5900	(91)
MIT	18.3708	18.5795	18.9766	19.5230	19.9923	20.2768	20.3614	20.3473	20.1413	19.5521	18.8795	18.3431	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.3708	18.5795	18.9766	19.5230	19.9923	20.2768	20.3614	20.3473	20.1413	19.5521	18.8795	18.3431	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9866	0.9792	0.9610	0.9131	0.8138	0.6512	0.4878	0.5463	0.7887	0.9375	0.9782	0.9885	(94)
Useful gains	295.7098	328.5293	364.3798	395.7830	386.9642	309.2413	220.6533	226.5236	290.8138	301.1059	286.7325	283.4876	(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													
	887.5122	860.7246	783.1541	659.2731	513.5263	348.0484	230.6145	241.5605	371.8316	554.3871	732.6412	883.6180	(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													
	440.3010	357.6353	311.5681	189.7129	94.1623	0.0000	0.0000	0.0000	0.0000	188.4412	321.0543	446.4970	(98)
Space heating												2349.3719	(98)
Space heating per m2											(98) / (4) =	66.4227	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2512.6972	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	440.3010	357.6353	311.5681	189.7129	94.1623	0.0000	0.0000	0.0000	0.0000	188.4412	321.0543	446.4970	(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)													
	470.9101	382.4976	333.2279	202.9014	100.7083	0.0000	0.0000	0.0000	0.0000	201.5414	343.3736	477.5369	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	149.9962	132.4541	139.6876	126.0274	124.0870	111.7159	108.0898	117.5071	116.9546	130.6437	137.1280	146.6596	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.5181	87.3351	86.8934	85.9025	84.0894	79.8000	79.8000	79.8000	79.8000	85.7902	87.0084	87.5959	(217)
Fuel for water heating, kWh/month													
	171.3887	151.6619	160.7575	146.7098	147.5655	139.9949	135.4509	147.2520	146.5596	152.2827	157.6033	167.4274	(219)
Water heating fuel used												1824.6543	(219)
Annual totals kWh/year													
Space heating fuel - main system												2512.6972	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Total delivered energy for all uses												4585.6800	(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	2512.6972	0.2160	542.7426	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1824.6543	0.2160	394.1253	(264)
Space and water heating			936.8679	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Total CO2, kg/m2/year			1065.7504	(272)
Emissions per m2 for space and water heating			26.4876	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			2.5433	(272b)
Emissions per m2 for pumps and fans			1.1005	(272c)
Target Carbon Dioxide Emission Rate (TER) = (26.4876 * 1.55) + 2.5433 + 1.1005, rounded to 2 d.p.			44.7000	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1848	(8)
Pressure test		Yes	
Measured/design AP50		4.9500	
Infiltration rate		0.4323	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3674	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4685	0.4593	0.4501	0.4042	0.3950	0.3491	0.3491	0.3399	0.3674	0.3950	0.4134	0.4317	(22b)
Effective ac	0.6097	0.6055	0.6013	0.5817	0.5780	0.5609	0.5609	0.5578	0.5675	0.5780	0.5854	0.5932	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	74.4500	16.5900	57.8600	0.2300	13.3078	9.0000	520.7400	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			145.1900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.4501			(33)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	4183.9200 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		118.2901 (35)
Thermal bridges (User defined value 0.051 * total exposed area)		7.4047 (36)
Total fabric heat loss	(33) + (36) =	56.8548 (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	21.7779	21.6257	21.4765	20.7758	20.6447	20.0344	20.0344	19.9214	20.2695	20.6447	20.9099	21.1872	(38)
Heat transfer coeff	78.6327	78.4805	78.3314	77.6306	77.4995	76.8892	76.8892	76.7762	77.1243	77.4995	77.7647	78.0420	(39)
Average = Sum(39)m / 12 =												77.6300	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.2231	2.2188	2.2146	2.1948	2.1911	2.1739	2.1739	2.1707	2.1805	2.1911	2.1986	2.2064	(40)
HLP (average)												2.1948	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895 (42)
Average daily hot water use (litres/day)	64.8244 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(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													

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

	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													
	22.4710	19.6533	20.2805	17.6810	16.9653	14.6398	13.5659	15.5671	15.7530	18.3586	20.0399	21.7620	(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	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	9.8146	8.7172	7.0893	5.3671	4.0119	3.3871	3.6598	4.7572	6.3851	8.1073	9.4625	10.0874	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	110.0897	111.2321	108.3533	102.2247	94.4885	87.2176	82.3601	81.2177	84.0965	90.2251	97.9613	105.2323	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	30.2030	29.2460	27.2587	24.5569	22.8029	20.3330	18.2338	20.9235	21.8792	24.6756	27.8331	29.2500	(72)
Total internal gains													
	192.4491	191.5371	185.0431	174.4905	163.6451	153.2794	146.5955	149.2402	154.7025	165.3497	177.5987	186.9114	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	9.1400	10.6334	0.7200	0.7000	0.7700	33.9455	(74)
East	3.1200	19.6403	0.7200	0.7000	0.7700	21.4026	(76)
West	4.3300	19.6403	0.7200	0.7000	0.7700	29.7029	(80)

Solar gains	85.0509	164.8447	274.8741	417.1816	532.7943	556.5848	525.1898	435.4886	324.0202	195.8476	105.5986	70.3253	(83)
Total gains	277.5000	356.3817	459.9172	591.6721	696.4394	709.8642	671.7853	584.7288	478.7227	361.1974	283.1973	257.2366	(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	14.7801	14.8088	14.8370	14.9709	14.9962	15.1153	15.1153	15.1375	15.0692	14.9962	14.9451	14.8920	
alpha	1.9853	1.9873	1.9891	1.9981	1.9997	2.0077	2.0077	2.0092	2.0046	1.9997	1.9963	1.9928	
util living area													
	0.9636	0.9406	0.8944	0.8040	0.6780	0.5406	0.4314	0.4927	0.7018	0.8782	0.9482	0.9685	(86)
MIT	17.4387	17.8353	18.5278	19.4102	20.1469	20.6266	20.8327	20.7756	20.3249	19.3224	18.2168	17.3687	(87)
Th 2	19.1887	19.1914	19.1941	19.2066	19.2090	19.2199	19.2199	19.2220	19.2157	19.2090	19.2042	19.1993	(88)
util rest of house													
	0.9556	0.9278	0.8712	0.7606	0.6053	0.4293	0.2806	0.3371	0.6010	0.8402	0.9346	0.9615	(89)
MIT 2	16.1049	16.4950	17.1682	18.0061	18.6585	19.0459	19.1755	19.1546	18.8481	17.9606	16.8863	16.0424	(90)
Living area fraction										fLA = Living area / (4) =		0.5900	(91)
MIT	16.8919	17.2859	17.9704	18.8346	19.5367	19.9786	20.1533	20.1111	19.7195	18.7641	17.6713	16.8250	(92)
Temperature adjustment												0.0000	
adjusted MIT	16.8919	17.2859	17.9704	18.8346	19.5367	19.9786	20.1533	20.1111	19.7195	18.7641	17.6713	16.8250	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9411	0.9092	0.8510	0.7499	0.6201	0.4802	0.3642	0.4207	0.6335	0.8282	0.9186	0.9482	(94)
Useful gains	261.1499	324.0357	391.4101	443.7082	431.8747	340.9031	244.6793	245.9886	303.2711	299.1276	260.1342	243.9152	(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													
	990.1374	972.0498	898.4917	771.2281	607.3440	413.5567	273.2119	284.9215	433.3970	632.7156	822.0761	985.2786	(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													
	542.3668	435.4655	377.2687	235.8143	130.5491	0.0000	0.0000	0.0000	0.0000	248.1894	404.5982	551.5744	(98)
Space heating												2925.8264	(98)
Space heating per m2											(98) / (4) =	82.7206	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	722.7583	568.9800	583.4988	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7304	0.7842	0.7402	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	527.9147	446.1980	431.9276	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	879.3449	833.9823	732.8648	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	253.0298	288.5115	223.8973	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												765.4386	(104)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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Cooled fraction                                                                  fC = cooled area / (4) =      1.0000 (105)
Intermittency factor (Table 10b)
                0.0000    0.0000    0.0000    0.0000    0.0000    0.2500    0.2500    0.2500    0.0000    0.0000    0.0000    0.0000 (106)
Space cooling kWh
                0.0000    0.0000    0.0000    0.0000    0.0000   63.2574   72.1279   55.9743    0.0000    0.0000    0.0000    0.0000 (107)
Space cooling                                                                                                        191.3596 (107)
Space cooling per m2                                                                                                   5.4102 (108)
Energy for space heating                                                                                              82.7206 (99)
Energy for space cooling                                                                                               5.4102 (108)
Total                                                                                                                 88.1308 (109)
Dwelling Fabric Energy Efficiency (DFEE)                                                                              88.1 (109)


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CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000	/ (5) =	0.1848	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.4348	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3696	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4712	0.4620	0.4527	0.4065	0.3973	0.3511	0.3511	0.3419	0.3696	0.3973	0.4158	0.4342	(22b)
Effective ac	0.6110	0.6067	0.6025	0.5826	0.5789	0.5616	0.5616	0.5584	0.5683	0.5789	0.5864	0.5943	(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 Opening Type (Uw = 1.40)			8.8400	1.3258	11.7197			(27)
GF			35.3700	0.1300	4.5981			(28b)
Main	74.4500	8.8400	65.6100	0.1800	11.8098			(29a)
Flat	35.3700		35.3700	0.1300	4.5981			(30)
Total net area of external elements Aum(A, m2)			145.1900					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		32.7257			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.5255	(36)
Total fabric heat loss					(33) + (36) =		41.2512	(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	21.8234	21.6694	21.5185	20.8096	20.6770	20.0596	20.0596	19.9453	20.2974	20.6770	20.9453	21.2258	(38)
Heat transfer coeff	63.0746	62.9206	62.7697	62.0608	61.9282	61.3108	61.3108	61.1965	61.5486	61.9282	62.1965	62.4770	(39)
Average = Sum(39)m / 12 =												62.0602	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.7833	1.7789	1.7747	1.7546	1.7509	1.7334	1.7334	1.7302	1.7401	1.7509	1.7585	1.7664	(40)
HLP (average)												1.7546	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895	(42)
Average daily hot water use (litres/day)	64.8244	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(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)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Heat gains from water heating, kWh/month

	22.4710	19.6533	20.2805	17.6810	16.9653	14.6398	13.5659	15.5671	15.7530	18.3586	20.0399	21.7620 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	9.8146	8.7172	7.0893	5.3671	4.0119	3.3871	3.6598	4.7572	6.3851	8.1073	9.4625	10.0874	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	110.0897	111.2321	108.3533	102.2247	94.4885	87.2176	82.3601	81.2177	84.0965	90.2251	97.9613	105.2323	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	30.2030	29.2460	27.2587	24.5569	22.8029	20.3330	18.2338	20.9235	21.8792	24.6756	27.8331	29.2500	(72)
Total internal gains													
	192.4491	191.5371	185.0431	174.4905	163.6451	153.2794	146.5955	149.2402	154.7025	165.3497	177.5987	186.9114	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.8700	10.6334	0.6300	0.7000	0.7700	15.8261	(74)
East	1.6600	19.6403	0.6300	0.7000	0.7700	9.9639	(76)
West	2.3100	19.6403	0.6300	0.7000	0.7700	13.8654	(80)

Solar gains	39.6553	76.8594	128.1609	194.5116	248.4156	259.5075	244.8698	203.0471	151.0752	91.3146	49.2357	32.7894	(83)
Total gains	232.1043	268.3965	313.2039	369.0022	412.0607	412.7870	391.4653	352.2873	305.7778	256.6643	226.8344	219.7007	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	38.9420	39.0373	39.1311	39.5781	39.6629	40.0623	40.0623	40.1371	39.9075	39.6629	39.4918	39.3145	
alpha	3.5961	3.6025	3.6087	3.6385	3.6442	3.6708	3.6708	3.6758	3.6605	3.6442	3.6328	3.6210	
util living area													
	0.9966	0.9938	0.9859	0.9602	0.8935	0.7656	0.6229	0.6907	0.8927	0.9787	0.9943	0.9973	(86)
MIT	19.0430	19.2221	19.5664	20.0513	20.5028	20.8167	20.9377	20.9083	20.6362	20.0597	19.4726	19.0174	(87)
Th 2	19.4817	19.4848	19.4878	19.5019	19.5046	19.5170	19.5170	19.5193	19.5122	19.5046	19.4992	19.4936	(88)
util rest of house													
	0.9954	0.9915	0.9803	0.9425	0.8424	0.6496	0.4425	0.5142	0.8177	0.9661	0.9917	0.9962	(89)
MIT 2	17.7521	17.9325	18.2762	18.7601	19.1787	19.4370	19.5035	19.4959	19.3130	18.7783	18.1935	17.7351	(90)
Living area fraction									fLA = Living area / (4) =			0.5900	(91)
MIT	18.5138	18.6935	19.0374	19.5220	19.9600	20.2511	20.3498	20.3293	20.0938	19.5344	18.9482	18.4917	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5138	18.6935	19.0374	19.5220	19.9600	20.2511	20.3498	20.3293	20.0938	19.5344	18.9482	18.4917	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9942	0.9899	0.9780	0.9428	0.8604	0.7124	0.5498	0.6186	0.8523	0.9664	0.9904	0.9953	(94)
Useful gains	230.7679	265.6806	306.3218	347.9010	354.5570	294.0888	215.2318	217.9289	260.6271	248.0465	224.6524	218.6661	(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													
	896.5298	867.8928	786.9720	659.2086	511.5247	346.4719	229.9015	240.4583	368.9084	553.2914	736.9189	892.9033	(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													
	495.3268	404.6866	357.6038	224.1415	116.7840	0.0000	0.0000	0.0000	0.0000	227.1022	368.8319	501.6324	(98)
Space heating												2696.1092	(98)
Space heating per m2											(98) / (4) =	76.2259	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	576.3217	453.7000	465.0933	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7535	0.8268	0.7828	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	434.2543	375.1123	364.0747	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	532.1118	506.3355	461.1799	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	70.4574	97.6301	72.2462	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												240.3337	(104)
Cooled fraction									fC = cooled area / (4) =			1.0000	(105)
Intermittency factor (Table 10b)													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	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	17.6144	24.4075	18.0616	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												60.0834 (107)
Space cooling per m2												1.6987 (108)
Energy for space heating												76.2259 (99)
Energy for space cooling												1.6987 (108)
Total												77.9246 (109)
Target Fabric Energy Efficiency (TFEE)												89.6 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		4.9500	
Infiltration rate		0.3399	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2889	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	6.6000	6.2000	5.9000	5.1000	4.9000	4.6000	4.2000	4.3000	4.9000	5.4000	5.9000	5.7000	(22)
Wind factor	1.6500	1.5500	1.4750	1.2750	1.2250	1.1500	1.0500	1.0750	1.2250	1.3500	1.4750	1.4250	(22a)
Adj infilt rate	0.4767	0.4478	0.4261	0.3684	0.3539	0.3322	0.3034	0.3106	0.3539	0.3900	0.4261	0.4117	(22b)
Effective ac	0.6136	0.6003	0.5908	0.5678	0.5626	0.5552	0.5460	0.5482	0.5626	0.5761	0.5908	0.5847	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	74.4500	16.5900	57.8600	0.2300	13.3078	9.0000	520.7400	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			145.1900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.4501			(33)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		4183.9200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							118.2901	(35)
Thermal bridges (User defined value 0.051 * total exposed area)							7.4047	(36)
Total fabric heat loss					(33) + (36) =		56.8548	(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	21.9165	21.4395	21.1013	20.2815	20.0952	19.8296	19.5017	19.5809	20.0952	20.5750	21.1013	20.8852	(38)
Heat transfer coeff	78.7713	78.2943	77.9561	77.1363	76.9500	76.6845	76.3565	76.4357	76.9500	77.4298	77.9561	77.7400	(39)
Average = Sum(39)m / 12 =												77.3884	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.2271	2.2136	2.2040	2.1808	2.1756	2.1681	2.1588	2.1610	2.1756	2.1891	2.2040	2.1979	(40)
HLP (average)												2.1880	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895	(42)
Average daily hot water use (litres/day)	64.8244	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)

Water storage loss:		
Store volume	125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):	1.0500	(48)
Temperature factor from Table 2b	0.5400	(49)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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Enter (49) or (54) in (55)                                                                                    0.5670 (55)
Total storage loss
              17.5770    15.8760    17.5770    17.0100    17.5770    17.0100    17.5770    17.5770    17.0100    17.5770    17.0100    17.5770 (56)
If cylinder contains dedicated solar storage
              17.5770    15.8760    17.5770    17.0100    17.5770    17.0100    17.5770    17.5770    17.0100    17.5770    17.0100    17.5770 (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
             146.5855   129.3734   136.2768   122.7267   120.6763   108.4151   104.6790   114.0963   113.6538   127.2329   133.8273   143.2488 (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
             146.5855   129.3734   136.2768   122.7267   120.6763   108.4151   104.6790   114.0963   113.6538   127.2329   133.8273   143.2488 (64)
                                                                                  Total per year (kWh/year) = Sum(64)m =   1500.7919 (64)
RHI water heating demand                                                                                      1501 (64)
Heat gains from water heating, kWh/month
              67.8321    60.2614    64.4045    59.2832    59.2173    54.5246    53.8982    57.0294    56.2664    61.3974    62.9741    66.7226 (65)


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5. Internal gains (see Table 5 and 5a)
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Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m         77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              24.5364    21.7931    17.7233    13.4177    10.0299     8.4676     9.1496    11.8930    15.9627    20.2684    23.6562    25.2184 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             164.3130   166.0181   161.7214   152.5743   141.0276   130.1755   122.9255   121.2205   125.5172   134.6643   146.2109   157.0631 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262 (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)
             -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780 (71)
Water heating gains (Table 5)
              91.1722    89.6747    86.5651    82.3377    79.5931    75.7286    72.4438    76.6525    78.1478    82.5233    87.4640    89.6810 (72)
Total internal gains
             352.8368   350.3010   338.8250   321.1448   303.4658   287.1868   277.3341   282.5811   292.4429   310.2711   330.1462   344.7776 (73)


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6. Solar gains
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[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
-------------------------------------------------------------------------------------------------------------
North                                 9.1400          10.3621          0.7200         0.7000       0.7700      33.0794 (74)
East                                  3.1200          19.0327          0.7200         0.7000       0.7700      20.7404 (76)
West                                  4.3300          19.0327          0.7200         0.7000       0.7700      28.7840 (80)
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Solar gains   82.6038   159.9685   278.9235   428.8130   549.2388   553.3461   527.6267   441.2155   324.9600   191.1362   100.1345    67.6917 (83)
Total gains  435.4406   510.2695   617.7485   749.9578   852.7046   840.5329   804.9608   723.7966   617.4029   501.4073   430.2808   412.4693 (84)


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7. Mean internal temperature (heating season)
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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           14.7541    14.8440    14.9084    15.0668    15.1033    15.1556    15.2207    15.2049    15.1033    15.0097    14.9084    14.9498
alpha          1.9836     1.9896     1.9939     2.0045     2.0069     2.0104     2.0147     2.0137     2.0069     2.0006     1.9939     1.9967
util living area
               0.9307     0.9064     0.8584     0.7750     0.6710     0.5719     0.4895     0.5322     0.6903     0.8392     0.9121     0.9374 (86)

MIT           17.5817    17.9286    18.5468    19.3372    20.0019    20.4623    20.6989    20.6405    20.1884    19.2808    18.2620    17.5035 (87)
Th 2          19.8865    19.8932    19.8980    19.9096    19.9122    19.9160    19.9206    19.9195    19.9122    19.9054    19.8980    19.9010 (88)
util rest of house
               0.9231     0.8964     0.8434     0.7515     0.6365     0.5228     0.4263     0.4682     0.6452     0.8167     0.9013     0.9306 (89)
MIT 2         16.7554    17.1001    17.7070    18.4756    19.1011    19.5226    19.7286    19.6854    19.2931    18.4386    17.4379    16.6877 (90)
Living area fraction                                                                        fLA = Living area / (4) =     0.5900 (91)
MIT           17.2430    17.5889    18.2025    18.9840    19.6327    20.0771    20.3011    20.2490    19.8214    18.9356    17.9242    17.1690 (92)
Temperature adjustment                                                                                                0.0000
adjusted MIT  17.2430    17.5889    18.2025    18.9840    19.6327    20.0771    20.3011    20.2490    19.8214    18.9356    17.9242    17.1690 (93)


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8. Space heating requirement
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                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation    0.8994     0.8699     0.8155     0.7289     0.6268     0.5305     0.4495     0.4888     0.6411     0.7929     0.8762     0.9081 (94)
Useful gains 391.6336   443.8740   503.7784   546.6214   534.5032   445.8842   361.8359   353.7821   395.8082   397.5450   377.0042   374.5723 (95)
Ext temp.      3.1000     3.6000     5.0000     7.2000     9.8000    12.7000    14.7000    14.6000    12.4000     9.1000     5.7000     2.9000 (96)
Heat loss rate W
            1114.0592  1095.2548  1029.2158   908.9751   756.6230   565.7054   427.6803   431.7834   571.0742   761.5660   952.9504  1109.2756 (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
             537.4846   437.7279   390.9254   260.8946   165.2571     0.0000     0.0000     0.0000     0.0000   270.8317   414.6812   546.6193 (98)
Space heating                                                                                                3024.4218 (98)
RHI space heating demand                                                                                        3024 (98)


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CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		4.9500	
Infiltration rate		0.3399	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2889	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3684	0.3611	0.3539	0.3178	0.3106	0.2745	0.2745	0.2672	0.2889	0.3106	0.3250	0.3395	(22b)
Effective ac	0.5678	0.5652	0.5626	0.5505	0.5482	0.5377	0.5377	0.5357	0.5417	0.5482	0.5528	0.5576	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	74.4500	16.5900	57.8600	0.2300	13.3078	9.0000	520.7400	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			145.1900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.4501			(33)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		4183.9200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							118.2901	(35)
Thermal bridges (User defined value 0.051 * total exposed area)							7.4047	(36)
Total fabric heat loss					(33) + (36) =		56.8548	(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	20.2815	20.1874	20.0952	19.6620	19.5809	19.2036	19.2036	19.1337	19.3489	19.5809	19.7449	19.9163	(38)
Heat transfer coeff	77.1363	77.0422	76.9500	76.5168	76.4357	76.0584	76.0584	75.9885	76.2037	76.4357	76.5997	76.7711	(39)
Average = Sum(39)m / 12 =												76.5164	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1808	2.1782	2.1756	2.1633	2.1610	2.1504	2.1504	2.1484	2.1545	2.1610	2.1657	2.1705	(40)
HLP (average)												2.1633	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.2895	(42)
Average daily hot water use (litres/day)												64.8244	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0500	(48)
Temperature factor from Table 2b												0.5400	(49)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Enter (49) or (54) in (55)												0.5670	(55)
Total storage loss													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(56)
If cylinder contains dedicated solar storage													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(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													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(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													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
									Total per year (kWh/year) = Sum(64)m =			1500.7919	(64)
Heat gains from water heating, kWh/month													
	67.8321	60.2614	64.4045	59.2832	59.2173	54.5246	53.8982	57.0294	56.2664	61.3974	62.9741	66.7226	(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	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.5364	21.7931	17.7233	13.4177	10.0299	8.4676	9.1496	11.8930	15.9627	20.2684	23.6562	25.2184	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	164.3130	166.0181	161.7214	152.5743	141.0276	130.1755	122.9255	121.2205	125.5172	134.6643	146.2109	157.0631	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	91.1722	89.6747	86.5651	82.3377	79.5931	75.7286	72.4438	76.6525	78.1478	82.5233	87.4640	89.6810	(72)
Total internal gains													
	352.8368	350.3010	338.8250	321.1448	303.4658	287.1868	277.3341	282.5811	292.4429	310.2711	330.1462	344.7776	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	9.1400	10.6334	0.7200	0.7000	0.7700	33.9455	(74)
East	3.1200	19.6403	0.7200	0.7000	0.7700	21.4026	(76)
West	4.3300	19.6403	0.7200	0.7000	0.7700	29.7029	(80)

Solar gains	85.0509	164.8447	274.8741	417.1816	532.7943	556.5848	525.1898	435.4886	324.0202	195.8476	105.5986	70.3253	(83)
Total gains	437.8877	515.1457	613.6991	738.3264	836.2601	843.7716	802.5239	718.0697	616.4630	506.1188	435.7449	415.1029	(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	15.0668	15.0852	15.1033	15.1888	15.2049	15.2804	15.2804	15.2944	15.2512	15.2049	15.1724	15.1385	
alpha	2.0045	2.0057	2.0069	2.0126	2.0137	2.0187	2.0187	2.0196	2.0167	2.0137	2.0115	2.0092	
util living area													
	0.9210	0.8920	0.8375	0.7402	0.6127	0.4776	0.3722	0.4209	0.6141	0.8031	0.8949	0.9281	(86)
MIT	17.9553	18.3114	18.9267	19.6891	20.3136	20.7096	20.8754	20.8360	20.4902	19.6569	18.6696	17.8800	(87)
Th 2	19.9096	19.9109	19.9122	19.9183	19.9195	19.9248	19.9248	19.9258	19.9228	19.9195	19.9172	19.9147	(88)
util rest of house													
	0.9120	0.8799	0.8193	0.7113	0.5694	0.4163	0.2935	0.3395	0.5546	0.7738	0.8812	0.9199	(89)
MIT 2	17.1407	17.4898	18.0888	18.8197	19.3936	19.7386	19.8646	19.8420	19.5701	18.8106	17.8525	17.0703	(90)
Living area fraction									fLA = Living area / (4) =			0.5900	(91)
MIT	17.6214	17.9745	18.5832	19.3327	19.9365	20.3116	20.4610	20.4285	20.1130	19.3100	18.3347	17.5480	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.6214	17.9745	18.5832	19.3327	19.9365	20.3116	20.4610	20.4285	20.1130	19.3100	18.3347	17.5480	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8875	0.8531	0.7930	0.6938	0.5701	0.4393	0.3339	0.3790	0.5659	0.7545	0.8559	0.8964	(94)
Useful gains	388.6307	439.4851	486.6362	512.2257	476.7737	370.6412	267.9594	272.1439	348.8681	381.8505	372.9337	372.0814	(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													
	1027.5615	1007.2920	929.8013	798.2732	629.5609	434.4122	293.6646	306.1197	458.2153	665.7535	860.5712	1024.7442	(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													
	475.3645	381.5663	329.7148	205.9542	113.6737	0.0000	0.0000	0.0000	0.0000	211.2239	351.0990	485.5811	(98)
Space heating												2554.1775	(98)
Space heating per m2											(98) / (4) =	72.2131	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												170.0000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												1502.4573	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	475.3645	381.5663	329.7148	205.9542	113.6737	0.0000	0.0000	0.0000	0.0000	211.2239	351.0990	485.5811	(98)
Space heating efficiency (main heating system 1)													
	170.0000	170.0000	170.0000	170.0000	170.0000	0.0000	0.0000	0.0000	0.0000	170.0000	170.0000	170.0000	(210)
Space heating fuel (main heating system)													
	279.6262	224.4507	193.9499	121.1495	66.8669	0.0000	0.0000	0.0000	0.0000	124.2493	206.5288	285.6360	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
Efficiency of water heater												170.0000	(216)
(217)m	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	(217)
Fuel for water heating, kWh/month													
	86.2267	76.1020	80.1629	72.1922	70.9860	63.7736	61.5759	67.1155	66.8552	74.8429	78.7219	84.2640	(219)
Water heating fuel used												882.8188	(219)
Annual totals kWh/year													
Space heating fuel - main system												1502.4573	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
Total electricity for the above, kWh/year												30.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Total delivered energy for all uses												2588.6046	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1502.4573	13.1900	198.1741	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	882.8188	13.1900	116.4438	(247)
Pumps and fans for heating	30.0000	13.1900	3.9570	(249)
Energy for lighting	173.3285	13.1900	22.8620	(250)
Additional standing charges			0.0000	(251)
Total energy cost			341.4369	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.7843	(257)
SAP value		75.1091	
SAP rating (Section 12)		75	(258)
SAP band		C	

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	1502.4573	0.5190	779.7754	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	882.8188	0.5190	458.1829	(264)
Space and water heating			1237.9583	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Total kg/year			1343.4858	(272)
CO2 emissions per m2			37.9800	(273)
EI value			77.6002	
EI rating			78	(274)
EI band			C	

Calculation of stars for heating and DHW

Main heating energy efficiency	13.19 × (1 + 0.29 × 0.00) / 1.7000 = 7.759, stars = 2
Main heating environmental impact	0.519 × (1 + 0.29 × 0.00) / 1.7000 = 0.3053, stars = 4
Water heating energy efficiency	13.19 / 1.7000 = 7.759, stars = 2
Water heating environmental impact	0.519 / 1.7000 = 0.3053, stars = 4

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		4.9500	
Infiltration rate		0.3399	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2889	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	6.6000	6.2000	5.9000	5.1000	4.9000	4.6000	4.2000	4.3000	4.9000	5.4000	5.9000	5.7000	(22)
Wind factor	1.6500	1.5500	1.4750	1.2750	1.2250	1.1500	1.0500	1.0750	1.2250	1.3500	1.4750	1.4250	(22a)
Adj infilt rate	0.4767	0.4478	0.4261	0.3684	0.3539	0.3322	0.3034	0.3106	0.3539	0.3900	0.4261	0.4117	(22b)
Effective ac	0.6136	0.6003	0.5908	0.5678	0.5626	0.5552	0.5460	0.5482	0.5626	0.5761	0.5908	0.5847	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	74.4500	16.5900	57.8600	0.2300	13.3078	9.0000	520.7400	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			145.1900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.4501			(33)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		4183.9200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							118.2901	(35)
Thermal bridges (User defined value 0.051 * total exposed area)							7.4047	(36)
Total fabric heat loss					(33) + (36) =		56.8548	(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	21.9165	21.4395	21.1013	20.2815	20.0952	19.8296	19.5017	19.5809	20.0952	20.5750	21.1013	20.8852	(38)
Heat transfer coeff	78.7713	78.2943	77.9561	77.1363	76.9500	76.6845	76.3565	76.4357	76.9500	77.4298	77.9561	77.7400	(39)
Average = Sum(39)m / 12 =												77.3884	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.2271	2.2136	2.2040	2.1808	2.1756	2.1681	2.1588	2.1610	2.1756	2.1891	2.2040	2.1979	(40)
HLP (average)												2.1880	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.2895	(42)
Average daily hot water use (litres/day)												64.8244	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0500	(48)
Temperature factor from Table 2b												0.5400	(49)

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

Enter (49) or (54) in (55)												0.5670	(55)
Total storage loss													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(56)
If cylinder contains dedicated solar storage													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(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													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(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													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
									Total per year (kWh/year) = Sum(64)m =			1500.7919	(64)
Heat gains from water heating, kWh/month													
	67.8321	60.2614	64.4045	59.2832	59.2173	54.5246	53.8982	57.0294	56.2664	61.3974	62.9741	66.7226	(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	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.5364	21.7931	17.7233	13.4177	10.0299	8.4676	9.1496	11.8930	15.9627	20.2684	23.6562	25.2184	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	164.3130	166.0181	161.7214	152.5743	141.0276	130.1755	122.9255	121.2205	125.5172	134.6643	146.2109	157.0631	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	91.1722	89.6747	86.5651	82.3377	79.5931	75.7286	72.4438	76.6525	78.1478	82.5233	87.4640	89.6810	(72)
Total internal gains													
	352.8368	350.3010	338.8250	321.1448	303.4658	287.1868	277.3341	282.5811	292.4429	310.2711	330.1462	344.7776	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	9.1400	10.3621	0.7200	0.7000	0.7700	33.0794	(74)
East	3.1200	19.0327	0.7200	0.7000	0.7700	20.7404	(76)
West	4.3300	19.0327	0.7200	0.7000	0.7700	28.7840	(80)

Solar gains	82.6038	159.9685	278.9235	428.8130	549.2388	553.3461	527.6267	441.2155	324.9600	191.1362	100.1345	67.6917	(83)
Total gains	435.4406	510.2695	617.7485	749.9578	852.7046	840.5329	804.9608	723.7966	617.4029	501.4073	430.2808	412.4693	(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	14.7541	14.8440	14.9084	15.0668	15.1033	15.1556	15.2207	15.2049	15.1033	15.0097	14.9084	14.9498	
alpha	1.9836	1.9896	1.9939	2.0045	2.0069	2.0104	2.0147	2.0137	2.0069	2.0006	1.9939	1.9967	
util living area													
	0.9307	0.9064	0.8584	0.7750	0.6710	0.5719	0.4895	0.5322	0.6903	0.8392	0.9121	0.9374	(86)
MIT	17.5817	17.9286	18.5468	19.3372	20.0019	20.4623	20.6989	20.6405	20.1884	19.2808	18.2620	17.5035	(87)
Th 2	19.8865	19.8932	19.8980	19.9096	19.9122	19.9160	19.9206	19.9195	19.9122	19.9054	19.8980	19.9010	(88)
util rest of house													
	0.9231	0.8964	0.8434	0.7515	0.6365	0.5228	0.4263	0.4682	0.6452	0.8167	0.9013	0.9306	(89)
MIT 2	16.7554	17.1001	17.7070	18.4756	19.1011	19.5226	19.7286	19.6854	19.2931	18.4386	17.4379	16.6877	(90)
Living area fraction									fLA = Living area / (4) =			0.5900	(91)
MIT	17.2430	17.5889	18.2025	18.9840	19.6327	20.0771	20.3011	20.2490	19.8214	18.9356	17.9242	17.1690	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.2430	17.5889	18.2025	18.9840	19.6327	20.0771	20.3011	20.2490	19.8214	18.9356	17.9242	17.1690	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8994	0.8699	0.8155	0.7289	0.6268	0.5305	0.4495	0.4888	0.6411	0.7929	0.8762	0.9081	(94)
Useful gains	391.6336	443.8740	503.7784	546.6214	534.5032	445.8842	361.8359	353.7821	395.8082	397.5450	377.0042	374.5723	(95)
Ext temp.	3.1000	3.6000	5.0000	7.2000	9.8000	12.7000	14.7000	14.6000	12.4000	9.1000	5.7000	2.9000	(96)
Heat loss rate W													
	1114.0592	1095.2548	1029.2158	908.9751	756.6230	565.7054	427.6803	431.7834	571.0742	761.5660	952.9504	1109.2756	(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													
	537.4846	437.7279	390.9254	260.8946	165.2571	0.0000	0.0000	0.0000	0.0000	270.8317	414.6812	546.6193	(98)
Space heating												3024.4218	(98)
Space heating per m2											(98) / (4) =	85.5081	(99)

8c. Space cooling requirement

Not applicable

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

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												170.0000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												1779.0717	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	537.4846	437.7279	390.9254	260.8946	165.2571	0.0000	0.0000	0.0000	0.0000	270.8317	414.6812	546.6193	(98)
Space heating efficiency (main heating system 1)													
	170.0000	170.0000	170.0000	170.0000	170.0000	0.0000	0.0000	0.0000	0.0000	170.0000	170.0000	170.0000	(210)
Space heating fuel (main heating system)													
	316.1674	257.4870	229.9561	153.4674	97.2101	0.0000	0.0000	0.0000	0.0000	159.3127	243.9301	321.5407	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
Efficiency of water heater												170.0000	(216)
(217)m	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	(217)
Fuel for water heating, kWh/month													
	86.2267	76.1020	80.1629	72.1922	70.9860	63.7736	61.5759	67.1155	66.8552	74.8429	78.7219	84.2640	(219)
Water heating fuel used												882.8188	(219)
Annual totals kWh/year													
Space heating fuel - main system												1779.0717	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
Total electricity for the above, kWh/year												30.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Total delivered energy for all uses												2865.2190	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1779.0717	18.7000	332.6864	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	882.8188	18.7000	165.0871	(247)
Pumps and fans for heating	30.0000	18.7000	5.6100	(249)
Energy for lighting	173.3285	18.7000	32.4124	(250)
Additional standing charges			0.0000	(251)
Total energy cost			535.7959	(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	1779.0717	0.5190	923.3382	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	882.8188	0.5190	458.1829	(264)
Space and water heating			1381.5211	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Total kg/year			1487.0486	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	1779.0717	3.0700	5461.7500	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	882.8188	3.0700	2710.2536	(264)
Space and water heating			8172.0036	(265)
Pumps and fans	30.0000	3.0700	92.1000	(267)
Energy for lighting	173.3285	3.0700	532.1186	(268)
Primary energy kWh/year			8796.2222	(272)
Primary energy kWh/m2/year			248.6916	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating:	C 75
Current environmental impact rating:	C 78

(For testing purposes):
A Not considered

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

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 3.7	-£ 73	-202 kg (13.6%)
U Solar photovoltaic panels	+ 16.6	-£ 326	-906 kg (70.5%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£73	5.72 kg/m²	C 79	B 81
Solar photovoltaic panels	£326	25.62 kg/m²	A 95	A 96
Total Savings	£399	31.34 kg/m²		

Potential energy efficiency rating: A 95
Potential environmental impact rating: A 96

Fuel prices for cost data on this page from database revision number 465 TEST (04 Sep 2020)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£536	£463	£73
Space heating	£338	£339	-£1
Water heating	£165	£92	£74
Lighting	£32	£32	£0
Generated (PV)	-£0	-£326	£326
Total cost of fuels	£536	£137	£399
Total cost of uses	£535	£137	£399
Delivered energy	81 kWh/m²	21 kWh/m²	60 kWh/m²
Carbon dioxide emissions	1.5 tonnes	0.4 tonnes	1.1 tonnes
CO2 emissions per m²	42 kg/m²	11 kg/m²	31 kg/m²
Primary energy	249 kWh/m²	63 kWh/m²	185 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		4.9500	
Infiltration rate		0.3399	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2889	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3684	0.3611	0.3539	0.3178	0.3106	0.2745	0.2745	0.2672	0.2889	0.3106	0.3250	0.3395	(22b)
Effective ac	0.5678	0.5652	0.5626	0.5505	0.5482	0.5377	0.5377	0.5357	0.5417	0.5482	0.5528	0.5576	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	74.4500	16.5900	57.8600	0.2300	13.3078	9.0000	520.7400	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			145.1900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.4501			(33)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		4183.9200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							118.2901	(35)
Thermal bridges (User defined value 0.051 * total exposed area)							7.4047	(36)
Total fabric heat loss					(33) + (36) =		56.8548	(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	20.2815	20.1874	20.0952	19.6620	19.5809	19.2036	19.2036	19.1337	19.3489	19.5809	19.7449	19.9163	(38)
Heat transfer coeff	77.1363	77.0422	76.9500	76.5168	76.4357	76.0584	76.0584	75.9885	76.2037	76.4357	76.5997	76.7711	(39)
Average = Sum(39)m / 12 =												76.5164	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1808	2.1782	2.1756	2.1633	2.1610	2.1504	2.1504	2.1484	2.1545	2.1610	2.1657	2.1705	(40)
HLP (average)												2.1633	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.2895	(42)
Average daily hot water use (litres/day)												64.8244	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0500	(48)
Temperature factor from Table 2b												0.5400	(49)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Enter (49) or (54) in (55)												0.5670	(55)
Total storage loss													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(56)
If cylinder contains dedicated solar storage													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(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													
	146.5855	129.3734	134.8811	115.9731	107.8819	95.8084	91.6521	101.9999	108.2509	125.8372	133.8273	143.2488	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.7781	(H8)
Utilisation factor												0.4302	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												64.8244	(H14)
Volume ratio Veff/V												1.1570	(H15)
Solar storage volume factor												1.0000	(H16)
Solar input												-685.9569	(H17)
Solar input	-19.8914	-33.1930	-56.5315	-75.7633	-93.5992	-92.0229	-90.8068	-79.3384	-62.1378	-42.4328	-23.5940	-16.6457	(63)
								Solar input (sum of months) = Sum(63)m =				-685.9569	(63)
Output from w/h													
	126.6941	96.1804	78.3496	40.2098	14.2827	3.7855	0.8453	22.6615	46.1131	83.4043	110.2332	126.6031	(64)
									Total per year (kWh/year) = Sum(64)m =			749.3626	(64)
Heat gains from water heating, kWh/month													
	67.8321	60.2614	63.2879	53.8803	48.9818	44.4392	43.4766	47.3523	51.9441	60.2808	62.9741	66.7226	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.5364	21.7931	17.7233	13.4177	10.0299	8.4676	9.1496	11.8930	15.9627	20.2684	23.6562	25.2184	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	164.3130	166.0181	161.7214	152.5743	141.0276	130.1755	122.9255	121.2205	125.5172	134.6643	146.2109	157.0631	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	91.1722	89.6747	85.0643	74.8337	65.8358	61.7211	58.4363	63.6455	72.1446	81.0225	87.4640	89.6810	(72)
Total internal gains													
	352.8368	350.3010	337.3242	313.6408	289.7085	273.1794	263.3266	269.5742	286.4397	308.7703	330.1462	344.7776	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	9.1400	10.6334	0.7200	0.7000	0.7700	33.9455	(74)
East	3.1200	19.6403	0.7200	0.7000	0.7700	21.4026	(76)
West	4.3300	19.6403	0.7200	0.7000	0.7700	29.7029	(80)

Solar gains	85.0509	164.8447	274.8741	417.1816	532.7943	556.5848	525.1898	435.4886	324.0202	195.8476	105.5986	70.3253	(83)
Total gains	437.8877	515.1457	612.1983	730.8224	822.5028	829.7641	788.5164	705.0628	610.4598	504.6180	435.7449	415.1029	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	15.0668	15.0852	15.1033	15.1888	15.2049	15.2804	15.2804	15.2944	15.2512	15.2049	15.1724	15.1385	
alpha	2.0045	2.0057	2.0069	2.0126	2.0137	2.0187	2.0187	2.0196	2.0167	2.0137	2.0115	2.0092	
util living area													
	0.9210	0.8920	0.8381	0.7432	0.6184	0.4834	0.3776	0.4269	0.6175	0.8039	0.8949	0.9281	(86)
MIT	17.9553	18.3114	18.9235	19.6776	20.3009	20.7030	20.8720	20.8316	20.4846	19.6541	18.6696	17.8800	(87)
Th 2	19.9096	19.9109	19.9122	19.9183	19.9195	19.9248	19.9248	19.9258	19.9228	19.9195	19.9172	19.9147	(88)
util rest of house													
	0.9120	0.8799	0.8199	0.7145	0.5752	0.4217	0.2980	0.3447	0.5580	0.7746	0.8812	0.9199	(89)
MIT 2	17.1407	17.4898	18.0858	18.8094	19.3831	19.7340	19.8629	19.8395	19.5659	18.8080	17.8525	17.0703	(90)
Living area fraction									fLA = Living area / (4) =			0.5900	(91)
MIT	17.6214	17.9745	18.5801	19.3217	19.9246	20.3057	20.4583	20.4249	20.1080	19.3072	18.3347	17.5480	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.6214	17.9745	18.5801	19.3217	19.9246	20.3057	20.4583	20.4249	20.1080	19.3072	18.3347	17.5480	(93)

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8. Space heating requirement

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8875	0.8531	0.7935	0.6967	0.5755	0.4445	0.3387	0.3843	0.5691	0.7552	0.8559	0.8964	(94)
Useful gains	388.6307	439.4851	485.7998	509.1864	473.3119	368.8214	267.0697	270.9901	347.3938	381.1092	372.9337	372.0814	(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	1027.5615	1007.2920	929.5629	797.4326	628.6566	433.9687	293.4564	305.8450	457.8318	665.5448	860.5712	1024.7442	(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	475.3645	381.5663	330.1597	207.5373	115.5765	0.0000	0.0000	0.0000	0.0000	211.6201	351.0990	485.5811	(98)
Space heating												2558.5044	(98)
Space heating per m2											(98) / (4) =	72.3354	(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 %)	170.0000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1505.0026	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	475.3645	381.5663	330.1597	207.5373	115.5765	0.0000	0.0000	0.0000	0.0000	211.6201	351.0990	485.5811	(98)
Space heating efficiency (main heating system 1)	170.0000	170.0000	170.0000	170.0000	170.0000	0.0000	0.0000	0.0000	0.0000	170.0000	170.0000	170.0000	(210)
Space heating fuel (main heating system)	279.6262	224.4507	194.2116	122.0807	67.9862	0.0000	0.0000	0.0000	0.0000	124.4824	206.5288	285.6360	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	126.6941	96.1804	78.3496	40.2098	14.2827	3.7855	0.8453	22.6615	46.1131	83.4043	110.2332	126.6031	(64)
Efficiency of water heater												170.0000	(216)
(217)m	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	(217)
Fuel for water heating, kWh/month	74.5259	56.5767	46.0880	23.6528	8.4016	2.2268	0.4972	13.3303	27.1254	49.0614	64.8431	74.4724	(219)
Water heating fuel used												440.8015	(219)
Annual totals kWh/year													
Space heating fuel - main system												1505.0026	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												80.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												471.8933	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1505.0026	13.1900	198.5098	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	440.8015	13.1900	58.1417	(247)
Pumps and fans for heating	30.0000	13.1900	3.9570	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	173.3285	13.1900	22.8620	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			62.2427	(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] =	0.3253	(257)
SAP value	95.4625	
SAP rating (Section 12)	95	(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	1505.0026	0.5190	781.0964	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Water heating (other fuel)	440.8015	0.5190	228.7760	(264)
Space and water heating			1009.8723	(265)
Pumps and fans	80.0000	0.5190	41.5200	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Energy saving/generation technologies				
PV Unit	-1727.2394	0.5190	-896.4372	(269)
Total kg/year			244.9126	(272)
CO2 emissions per m2			6.9200	(273)
EI value			95.9166	
EI rating			96	(274)
EI band			A	

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		4.9500	
Infiltration rate		0.3399	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2889	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	6.6000	6.2000	5.9000	5.1000	4.9000	4.6000	4.2000	4.3000	4.9000	5.4000	5.9000	5.7000	(22)
Wind factor	1.6500	1.5500	1.4750	1.2750	1.2250	1.1500	1.0500	1.0750	1.2250	1.3500	1.4750	1.4250	(22a)
Adj infilt rate	0.4767	0.4478	0.4261	0.3684	0.3539	0.3322	0.3034	0.3106	0.3539	0.3900	0.4261	0.4117	(22b)
Effective ac	0.6136	0.6003	0.5908	0.5678	0.5626	0.5552	0.5460	0.5482	0.5626	0.5761	0.5908	0.5847	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	74.4500	16.5900	57.8600	0.2300	13.3078	9.0000	520.7400	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			145.1900					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	49.4501			(33)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		4183.9200	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							118.2901	(35)
Thermal bridges (User defined value 0.051 * total exposed area)							7.4047	(36)
Total fabric heat loss					(33) + (36) =		56.8548	(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	21.9165	21.4395	21.1013	20.2815	20.0952	19.8296	19.5017	19.5809	20.0952	20.5750	21.1013	20.8852	(38)
Heat transfer coeff	78.7713	78.2943	77.9561	77.1363	76.9500	76.6845	76.3565	76.4357	76.9500	77.4298	77.9561	77.7400	(39)
Average = Sum(39)m / 12 =												77.3884	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.2271	2.2136	2.2040	2.1808	2.1756	2.1681	2.1588	2.1610	2.1756	2.1891	2.2040	2.1979	(40)
HLP (average)												2.1880	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895	(42)
Average daily hot water use (litres/day)	64.8244	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)

Water storage loss:		
Store volume	125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):	1.0500	(48)
Temperature factor from Table 2b	0.5400	(49)

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

Enter (49) or (54) in (55)												0.5670	(55)
Total storage loss													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(56)
If cylinder contains dedicated solar storage													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(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													
	146.5855	129.3734	134.8811	115.9731	107.8819	95.8084	91.6521	101.9999	108.2509	125.8372	133.8273	143.2488	(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												1091.0709	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1832.9992	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.7972	(H8)
Utilisation factor												0.4267	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												64.8244	(H14)
Volume ratio Veff/V												1.1570	(H15)
Solar storage volume factor												1.0000	(H16)
Solar input												-687.8113	(H17)
Solar input	-19.2686	-32.1683	-57.3554	-77.8632	-96.3853	-91.3308	-91.0993	-80.3442	-62.3188	-41.3797	-22.3236	-15.9741	(63)
								Solar input (sum of months) = Sum(63)m =				-687.8113	(63)
Output from w/h													
	127.3169	97.2050	77.5257	38.1099	11.4966	4.4776	0.5528	21.6557	45.9322	84.4575	111.5037	127.2747	(64)
									Total per year (kWh/year) = Sum(64)m =			747.5082	(64)
Heat gains from water heating, kWh/month													
	67.8321	60.2614	63.2879	53.8803	48.9818	44.4392	43.4766	47.3523	51.9441	60.2808	62.9741	66.7226	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.5364	21.7931	17.7233	13.4177	10.0299	8.4676	9.1496	11.8930	15.9627	20.2684	23.6562	25.2184	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	164.3130	166.0181	161.7214	152.5743	141.0276	130.1755	122.9255	121.2205	125.5172	134.6643	146.2109	157.0631	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	91.1722	89.6747	85.0643	74.8337	65.8358	61.7211	58.4363	63.6455	72.1446	81.0225	87.4640	89.6810	(72)
Total internal gains													
	352.8368	350.3010	337.3242	313.6408	289.7085	273.1794	263.3266	269.5742	286.4397	308.7703	330.1462	344.7776	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	9.1400	10.3621	0.7200	0.7000	0.7700	33.0794	(74)
East	3.1200	19.0327	0.7200	0.7000	0.7700	20.7404	(76)
West	4.3300	19.0327	0.7200	0.7000	0.7700	28.7840	(80)

Solar gains	82.6038	159.9685	278.9235	428.8130	549.2388	553.3461	527.6267	441.2155	324.9600	191.1362	100.1345	67.6917	(83)
Total gains	435.4406	510.2695	616.2477	742.4538	838.9472	826.5255	790.9533	710.7896	611.3997	499.9065	430.2808	412.4693	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	14.7541	14.8440	14.9084	15.0668	15.1033	15.1556	15.2207	15.2049	15.1033	15.0097	14.9084	14.9498	
alpha	1.9836	1.9896	1.9939	2.0045	2.0069	2.0104	2.0147	2.0137	2.0069	2.0006	1.9939	1.9967	
util living area													
	0.9307	0.9064	0.8589	0.7778	0.6764	0.5778	0.4955	0.5386	0.6935	0.8398	0.9121	0.9374	(86)
MIT	17.5817	17.9286	18.5434	19.3243	19.9857	20.4514	20.6917	20.6322	20.1808	19.2777	18.2620	17.5035	(87)
Th 2	19.8865	19.8932	19.8980	19.9096	19.9122	19.9160	19.9206	19.9195	19.9122	19.9054	19.8980	19.9010	(88)
util rest of house													
	0.9231	0.8964	0.8439	0.7545	0.6420	0.5286	0.4320	0.4744	0.6486	0.8174	0.9013	0.9306	(89)
MIT 2	16.7554	17.1001	17.7038	18.4637	19.0871	19.5141	19.7236	19.6795	19.2868	18.4357	17.4379	16.6877	(90)
Living area fraction									fLA = Living area / (4) =			0.5900	(91)
MIT	17.2430	17.5889	18.1992	18.9715	19.6173	20.0672	20.2949	20.2417	19.8143	18.9325	17.9242	17.1690	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.2430	17.5889	18.1992	18.9715	19.6173	20.0672	20.2949	20.2417	19.8143	18.9325	17.9242	17.1690	(93)

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8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8994	0.8699	0.8160	0.7316	0.6319	0.5359	0.4550	0.4946	0.6441	0.7936	0.8762	0.9081	(94)
Useful gains	391.6336	443.8740	502.8821	543.1931	530.1242	442.9338	359.8991	351.5533	393.7978	396.7079	377.0042	374.5723	(95)
Ext temp.	3.1000	3.6000	5.0000	7.2000	9.8000	12.7000	14.7000	14.6000	12.4000	9.1000	5.7000	2.9000	(96)
Heat loss rate W													
	1114.0592	1095.2548	1028.9580	908.0109	755.4421	564.9489	427.2047	431.2247	570.5290	761.3268	952.9504	1109.2756	(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													
	537.4846	437.7279	391.4005	262.6688	167.6365	0.0000	0.0000	0.0000	0.0000	271.2764	414.6812	546.6193	(98)
Space heating												3029.4951	(98)
Space heating per m2											(98) / (4) =	85.6515	(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 %)	170.0000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1782.0559	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	537.4846	437.7279	391.4005	262.6688	167.6365	0.0000	0.0000	0.0000	0.0000	271.2764	414.6812	546.6193	(98)
Space heating efficiency (main heating system 1)													
	170.0000	170.0000	170.0000	170.0000	170.0000	0.0000	0.0000	0.0000	0.0000	170.0000	170.0000	170.0000	(210)
Space heating fuel (main heating system)													
	316.1674	257.4870	230.2356	154.5110	98.6097	0.0000	0.0000	0.0000	0.0000	159.5744	243.9301	321.5407	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	127.3169	97.2050	77.5257	38.1099	11.4966	4.4776	0.5528	21.6557	45.9322	84.4575	111.5037	127.2747	(64)
Efficiency of water heater												170.0000	(216)
(217)m	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	170.0000	(217)
Fuel for water heating, kWh/month													
	74.8923	57.1794	45.6033	22.4176	6.7627	2.6339	0.3252	12.7386	27.0189	49.6809	65.5904	74.8675	(219)
Water heating fuel used												439.7107	(219)
Annual totals kWh/year													
Space heating fuel - main system												1782.0559	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												80.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1091 * 0.80) =										-1745.7135		-1745.7135	(233)
Total delivered energy for all uses												729.3817	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1782.0559	18.7000	333.2445	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	439.7107	18.7000	82.2259	(247)
Pumps and fans for heating	30.0000	18.7000	5.6100	(249)
Pump for solar water heating	50.0000	18.7000	9.3500	(249)
Energy for lighting	173.3285	18.7000	32.4124	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-1745.7135	18.7000	-326.4484	(252)
Total energy cost			136.3944	(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	1782.0559	0.5190	924.8870	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	439.7107	0.5190	228.2098	(264)
Space and water heating			1153.0969	(265)
Pumps and fans	80.0000	0.5190	41.5200	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Energy saving/generation technologies				
PV Unit	-1745.7135	0.5190	-906.0253	(269)
Total kg/year			378.5491	(272)

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

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	1782.0559	3.0700	5470.9118	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	439.7107	3.0700	1349.9118	(264)
Space and water heating			6820.8236	(265)
Pumps and fans	80.0000	3.0700	245.6000	(267)
Energy for lighting	173.3285	3.0700	532.1186	(268)
Energy saving/generation technologies				
PV Unit	-1745.7135	3.0700	-5359.3404	(269)
Primary energy kWh/year			2239.2017	(272)
Primary energy kWh/m2/year			63.3079	(273)

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

Overheating Calculation Input Data

Dwelling type	Detached Bungalow
Number of storeys	1
Cross ventilation possible	Yes
SAP Region	North East England
Front of dwelling faces	East
Overshading	Average or unknown
Thermal mass parameter	118.3 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	6.00 (Windows fully open)

Overheating Calculation

Summer ventilation heat loss coefficient	214.30	(P1)
Transmission heat loss coefficient	56.85	(37)
Summer heat loss coefficient	271.15	(P2)

Overhangs

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

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North	1.000	0.90	1.000	0.900	(P8)
East	1.000	0.90	1.000	0.900	(P8)
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	9.1400	74.6426	0.7200	0.7000	0.9000	278.5151
East	3.1200	111.2086	0.7200	0.7000	0.9000	141.6474
West	4.3300	111.2086	0.7200	0.7000	0.9000	196.5811
total:						616.7436

	Jun	Jul	Aug	
Solar gains	644	617	506	(P3)
Internal gains	284	274	280	
Total summer gains	928	891	786	(P5)
Summer gain/loss ratio	3.42	3.29	2.90	(P6)
Summer external temperature	13.80	15.80	15.60	
Thermal mass temperature increment (TMP = 118.3)	1.17	1.17	1.17	
Threshold temperature	18.39	20.26	19.67	(P7)
Likelihood of high internal temperature	Not significant	Not significant	Not significant	

Assessment of likelihood of high internal temperature: Not significant

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

Anderson Goddard Ltd

Property Reference	73940-WR05	**Issued on Date**	07/10/2020
Assessment Reference	001	**Prop Type Ref**	Semi
Property	Woodlands Room 5, Raithwaite Bay, WHITBY, YO21 3ST		

SAP Rating	78 C	**DER**	35.10	**TER**	41.12
Environmental	80 C	**% DER<TER**	14.65		
CO_2 Emissions (t/year)	1.31	**DFEE**	76.66	**TFEE**	77.55
General Requirements Compliance	Pass	**% DFEE<TFEE**	1.14		

Assessor Details	Mr. Paul Goddard, Anderson Goddard Limited, Tel: 0161 7757770, paul.goddard@andersongoddard.com	**Assessor ID**	B342-0001
Client			

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

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

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DWELLING AS DESIGNED

Semi-Detached Bungalow, total floor area 35 m²

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

1a TER and DER
Fuel for main heating:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 41.12 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 35.10 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)77.6 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)76.7 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.23 (max. 0.30)	0.23 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.22 (max. 0.25)	0.22 (max. 0.70)	OK
Roof	0.18 (max. 0.20)	0.18 (max. 0.35)	OK
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated using user-specified y-value of 0.052

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

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4 Heating efficiency
Main heating system: Heat pump with radiators or underfloor - Electric
Air-to-water heat pump

Secondary heating system: None

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5 Cylinder insulation
Hot water storage Measured cylinder loss: 1.05 kWh/day
Permitted by DBSCG 1.70 OK
Primary pipework insulated: Yes OK

---

6 Controls
Space heating controls: Programmer and room thermostat OK

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

---

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

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8 Mechanical ventilation
Not applicable

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9 Summertime temperature
Overheating risk (North East England): Slight OK
Based on:
Overshading: Average
Windows facing East: 3.12 m², No overhang
Windows facing South: 9.14 m², No overhang
Windows facing West: 4.33 m², No overhang
Air change rate: 8.00 ach
Blinds/curtains: None

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10 Key features
Party wall U-value 0.00 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3424	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2910	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3711	0.3638	0.3565	0.3201	0.3129	0.2765	0.2765	0.2692	0.2910	0.3129	0.3274	0.3420	(22b)
Effective ac	0.5688	0.5662	0.5636	0.5512	0.5489	0.5382	0.5382	0.5362	0.5424	0.5489	0.5536	0.5585	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	66.7400	16.5900	50.1500	0.2300	11.5345	9.0000	451.3500	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			137.4800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	47.6768			(33)
Party Wall 1			8.0100	0.0000	0.0000	20.0000	160.2000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		4274.7300	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							120.8575	(35)
Thermal bridges (User defined value 0.052 * total exposed area)							7.1490	(36)
Total fabric heat loss					(33) + (36) =		54.8258	(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	20.3173	20.2218	20.1282	19.6886	19.6063	19.2235	19.2235	19.1526	19.3709	19.6063	19.7727	19.9467	(38)
Heat transfer coeff	75.1430	75.0476	74.9540	74.5144	74.4321	74.0492	74.0492	73.9783	74.1967	74.4321	74.5985	74.7725	(39)
Average = Sum(39)m / 12 =												74.5140	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1245	2.1218	2.1191	2.1067	2.1044	2.0936	2.0936	2.0916	2.0977	2.1044	2.1091	2.1140	(40)
HLP (average)												2.1067	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895	(42)
Average daily hot water use (litres/day)	64.8244	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0500	(48)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.5670	(55)
Total storage loss													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(56)
If cylinder contains dedicated solar storage													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(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													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(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													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
								Total per year (kWh/year) = Sum(64)m =				1500.7919	(64)
Heat gains from water heating, kWh/month													
	67.8321	60.2614	64.4045	59.2832	59.2173	54.5246	53.8982	57.0294	56.2664	61.3974	62.9741	66.7226	(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	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	9.8146	8.7172	7.0893	5.3671	4.0119	3.3871	3.6598	4.7572	6.3851	8.1073	9.4625	10.0874	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	110.0897	111.2321	108.3533	102.2247	94.4885	87.2176	82.3601	81.2177	84.0965	90.2251	97.9613	105.2323	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	91.1722	89.6747	86.5651	82.3377	79.5931	75.7286	72.4438	76.6525	78.1478	82.5233	87.4640	89.6810	(72)
Total internal gains													
	256.4182	254.9658	247.3495	235.2713	223.4353	211.6749	203.8055	207.9691	213.9712	226.1975	240.2295	250.3424	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.1200	19.6403	0.7200	0.7000	0.7700	21.4026	(76)
South	9.1400	46.7521	0.7200	0.7000	0.7700	149.2488	(78)
West	4.3300	19.6403	0.7200	0.7000	0.7700	29.7029	(80)

Solar gains	200.3542	344.4042	476.0033	592.0262	660.9841	654.1505	631.6077	581.2134	516.7390	382.2683	240.6332	170.9913	(83)
Total gains	456.7724	599.3700	723.3528	827.2975	884.4194	865.8254	835.4132	789.1826	730.7102	608.4658	480.8627	421.3337	(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	15.8022	15.8223	15.8421	15.9355	15.9531	16.0356	16.0356	16.0510	16.0037	15.9531	15.9175	15.8805	
alpha	2.0535	2.0548	2.0561	2.0624	2.0635	2.0690	2.0690	2.0701	2.0669	2.0635	2.0612	2.0587	
util living area													
	0.9163	0.8648	0.7966	0.7019	0.5884	0.4629	0.3541	0.3847	0.5493	0.7505	0.8784	0.9273	(86)
MIT	18.1128	18.6166	19.2350	19.8875	20.4039	20.7456	20.8957	20.8723	20.6157	19.8988	18.8707	18.0047	(87)
Th 2	19.9378	19.9391	19.9404	19.9466	19.9478	19.9532	19.9532	19.9542	19.9511	19.9478	19.9455	19.9430	(88)
util rest of house													
	0.9070	0.8507	0.7759	0.6718	0.5457	0.4036	0.2798	0.3095	0.4910	0.7175	0.8632	0.9191	(89)
MIT 2	17.3114	17.8015	18.3981	19.0196	19.4923	19.7899	19.9027	19.8893	19.6894	19.0488	18.0633	17.2092	(90)
Living area fraction										fLA = Living area / (4) =		0.5900	(91)
MIT	17.7843	18.2825	18.8919	19.5317	20.0302	20.3538	20.4886	20.4693	20.2360	19.5503	18.5397	17.6786	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.7843	18.2825	18.8919	19.5317	20.0302	20.3538	20.4886	20.4693	20.2360	19.5503	18.5397	17.6786	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8828	0.8240	0.7524	0.6588	0.5492	0.4271	0.3188	0.3476	0.5077	0.7036	0.8382	0.8962	(94)
Useful gains	403.2176	493.9072	544.2247	544.9877	485.7219	369.7795	266.2961	274.3290	370.9738	428.1000	403.0773	377.5820	(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													
	1013.2492	1004.3233	928.8220	792.2138	620.0334	426.0651	287.9484	301.0407	455.2692	666.1901	853.3862	1007.8290	(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													
	453.8635	342.9996	286.1404	178.0027	99.9277	0.0000	0.0000	0.0000	0.0000	177.1390	324.2224	468.9038	(98)
Space heating												2331.1991	(98)
Space heating per m2											(98) / (4) =	65.9089	(99)

8c. Space cooling requirement

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												175.1000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												1331.3530	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	453.8635	342.9996	286.1404	178.0027	99.9277	0.0000	0.0000	0.0000	0.0000	177.1390	324.2224	468.9038	(98)
Space heating efficiency (main heating system 1)													
	175.1000	175.1000	175.1000	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175.1000	175.1000	(210)
Space heating fuel (main heating system)													
	259.2024	195.8879	163.4154	101.6578	57.0689	0.0000	0.0000	0.0000	0.0000	101.1645	185.1641	267.7920	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
Efficiency of water heater												175.1000	(216)
(217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(217)
Fuel for water heating, kWh/month													
	83.7153	73.8854	77.8280	70.0895	68.9185	61.9161	59.7824	65.1607	64.9080	72.6630	76.4290	81.8097	(219)
Water heating fuel used												857.1056	(219)
Annual totals kWh/year													
Space heating fuel - main system												1331.3530	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
Total electricity for the above, kWh/year												30.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Total delivered energy for all uses												2391.7871	(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	1331.3530	0.5190	690.9722	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	857.1056	0.5190	444.8378	(264)
Space and water heating			1135.8100	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Total CO2, kg/year			1241.3375	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			35.1000	(273)

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

DER		35.1000	ZC1
Total Floor Area	TFA	35.3700	
Assumed number of occupants	N	1.2895	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		18.4441	ZC2
CO2 emissions from cooking, equation (L16)		4.2394	ZC3
Total CO2 emissions		57.7835	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		57.7835	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1848	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4348	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3696	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4712	0.4620	0.4527	0.4065	0.3973	0.3511	0.3511	0.3419	0.3696	0.3973	0.4158	0.4342	(22b)
Effective ac	0.6110	0.6067	0.6025	0.5826	0.5789	0.5616	0.5616	0.5584	0.5683	0.5789	0.5864	0.5943	(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 Opening Type (Uw = 1.40)			8.8400	1.3258	11.7197			(27)
GF			35.3700	0.1300	4.5981			(28b)
Main	66.7400	8.8400	57.9000	0.1800	10.4220			(29a)
Flat	35.3700		35.3700	0.1300	4.5981			(30)
Total net area of external elements Aum(A, m2)			137.4800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	31.3379			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.1326	(36)
Total fabric heat loss					(33) + (36) =		39.4705	(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	21.8234	21.6694	21.5185	20.8096	20.6770	20.0596	20.0596	19.9453	20.2974	20.6770	20.9453	21.2258	(38)
Heat transfer coeff	61.2939	61.1399	60.9890	60.2801	60.1475	59.5301	59.5301	59.4158	59.7679	60.1475	60.4158	60.6963	(39)
Average = Sum(39)m / 12 =												60.2795	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.7329	1.7286	1.7243	1.7043	1.7005	1.6831	1.6831	1.6798	1.6898	1.7005	1.7081	1.7160	(40)
HLP (average)												1.7043	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.2895	(42)
Average daily hot water use (litres/day)												64.8244	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.2538	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.6770	(55)
Total storage loss													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	20.9878	18.9567	20.9878	20.3108	20.9878	20.3108	20.9878	20.9878	20.3108	20.9878	20.3108	20.9878	(56)
If cylinder contains dedicated solar storage													
	20.9878	18.9567	20.9878	20.3108	20.9878	20.3108	20.9878	20.9878	20.3108	20.9878	20.3108	20.9878	(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													
	149.9962	132.4541	139.6876	126.0274	124.0870	111.7159	108.0898	117.5071	116.9546	130.6437	137.1280	146.6596	(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													
	149.9962	132.4541	139.6876	126.0274	124.0870	111.7159	108.0898	117.5071	116.9546	130.6437	137.1280	146.6596	(64)
								Total per year (kWh/year) = Sum(64)m =				1540.9510	(64)
Heat gains from water heating, kWh/month													
	70.5607	62.7260	67.1331	61.9238	61.9459	57.1652	56.6268	59.7581	58.9070	64.1260	65.6147	69.4513	(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	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	9.8146	8.7172	7.0893	5.3671	4.0119	3.3871	3.6598	4.7572	6.3851	8.1073	9.4625	10.0874	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	110.0897	111.2321	108.3533	102.2247	94.4885	87.2176	82.3601	81.2177	84.0965	90.2251	97.9613	105.2323	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	94.8397	93.3422	90.2326	86.0052	83.2606	79.3961	76.1113	80.3200	81.8153	86.1908	91.1315	93.3485	(72)
Total internal gains													
	260.0857	258.6333	251.0170	238.9388	227.1028	215.3424	207.4730	211.6366	217.6387	229.8650	243.8970	254.0099	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	1.6600	19.6403	0.6300	0.7000	0.7700	9.9639	(76)
South	4.8700	46.7521	0.6300	0.7000	0.7700	69.5827	(78)
West	2.3100	19.6403	0.6300	0.7000	0.7700	13.8654	(80)

Solar gains	93.4120	160.5736	221.9313	276.0277	308.1802	304.9946	294.4839	270.9869	240.9246	178.2277	112.1915	79.7219	(83)
Total gains	353.4977	419.2069	472.9484	514.9665	535.2830	520.3371	501.9569	482.6235	458.5633	408.0927	356.0886	333.7317	(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	40.0733	40.1742	40.2736	40.7472	40.8371	41.2606	41.2606	41.3400	41.0965	40.8371	40.6557	40.4679	
alpha	3.6716	3.6783	3.6849	3.7165	3.7225	3.7507	3.7507	3.7560	3.7398	3.7225	3.7104	3.6979	
util living area													
	0.9867	0.9747	0.9510	0.9000	0.8052	0.6534	0.4990	0.5352	0.7453	0.9182	0.9757	0.9891	(86)
MIT	19.3802	19.6170	19.9554	20.3587	20.6903	20.9007	20.9723	20.9637	20.8292	20.3947	19.8133	19.3401	(87)
Th 2	19.5173	19.5204	19.5235	19.5378	19.5405	19.5530	19.5530	19.5553	19.5482	19.5405	19.5350	19.5294	(88)
util rest of house													
	0.9822	0.9663	0.9343	0.8648	0.7357	0.5354	0.3457	0.3816	0.6388	0.8815	0.9660	0.9854	(89)
MIT 2	17.4588	17.8006	18.2828	18.8457	19.2656	19.4953	19.5450	19.5435	19.4324	18.9112	18.0973	17.4085	(90)
Living area fraction										fLA = Living area / (4) =		0.5900	(91)
MIT	18.5925	18.8723	19.2697	19.7384	20.1062	20.3246	20.3872	20.3815	20.2566	19.7865	19.1098	18.5482	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5925	18.8723	19.2697	19.7384	20.1062	20.3246	20.3872	20.3815	20.2566	19.7865	19.1098	18.5482	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9784	0.9615	0.9308	0.8704	0.7652	0.6016	0.4366	0.4724	0.6950	0.8888	0.9624	0.9820	(94)
Useful gains	345.8560	403.0630	440.2274	448.2018	409.6063	313.0237	219.1409	227.9886	318.6876	362.7151	342.6931	327.7343	(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													
	876.0435	854.2679	778.8129	653.3428	505.6133	340.7836	225.4519	236.5621	367.9673	552.5479	725.5840	870.8849	(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													
	394.4595	303.2097	251.9076	147.7015	71.4292	0.0000	0.0000	0.0000	0.0000	141.2356	275.6814	404.1041	(98)
Space heating												1989.7285	(98)
Space heating per m2											(98) / (4) =	56.2547	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2128.0519	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	394.4595	303.2097	251.9076	147.7015	71.4292	0.0000	0.0000	0.0000	0.0000	141.2356	275.6814	404.1041	(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)													
	421.8818	324.2885	269.4199	157.9695	76.3948	0.0000	0.0000	0.0000	0.0000	151.0541	294.8464	432.1969	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	149.9962	132.4541	139.6876	126.0274	124.0870	111.7159	108.0898	117.5071	116.9546	130.6437	137.1280	146.6596	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.2760	86.9552	86.3690	85.2379	83.4025	79.8000	79.8000	79.8000	79.8000	85.0220	86.6409	87.3801	(217)
Fuel for water heating, kWh/month													
	171.8642	152.3245	161.7336	147.8537	148.7809	139.9949	135.4509	147.2520	146.5596	153.6587	158.2716	167.8409	(219)
Water heating fuel used												1831.5855	(219)
Annual totals kWh/year													
Space heating fuel - main system												2128.0519	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Total delivered energy for all uses												4207.9659	(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	2128.0519	0.2160	459.6592	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1831.5855	0.2160	395.6225	(264)
Space and water heating			855.2817	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Total CO2, kg/m2/year			984.1642	(272)
Emissions per m2 for space and water heating			24.1810	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			2.5433	(272b)
Emissions per m2 for pumps and fans			1.1005	(272c)
Target Carbon Dioxide Emission Rate (TER) = (24.1810 * 1.55) + 2.5433 + 1.1005, rounded to 2 d.p.			41.1200	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1848	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4348	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3696	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4712	0.4620	0.4527	0.4065	0.3973	0.3511	0.3511	0.3419	0.3696	0.3973	0.4158	0.4342	(22b)
Effective ac	0.6110	0.6067	0.6025	0.5826	0.5789	0.5616	0.5616	0.5584	0.5683	0.5789	0.5864	0.5943	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	66.7400	16.5900	50.1500	0.2300	11.5345	9.0000	451.3500	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			137.4800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	47.6768			(33)
Party Wall 1			8.0100	0.0000	0.0000	20.0000	160.2000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	4274.7300 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		120.8575 (35)
Thermal bridges (User defined value 0.052 * total exposed area)		7.1490 (36)
Total fabric heat loss	(33) + (36) =	54.8258 (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	21.8234	21.6694	21.5185	20.8096	20.6770	20.0596	20.0596	19.9453	20.2974	20.6770	20.9453	21.2258	(38)
Heat transfer coeff	76.6492	76.4952	76.3443	75.6354	75.5028	74.8854	74.8854	74.7711	75.1232	75.5028	75.7711	76.0516	(39)
Average = Sum(39)m / 12 =												75.6348	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1671	2.1627	2.1584	2.1384	2.1347	2.1172	2.1172	2.1140	2.1239	2.1347	2.1422	2.1502	(40)
HLP (average)												2.1384	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895 (42)
Average daily hot water use (litres/day)	64.8244 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage

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

Heat gains from water heating, kWh/month

	22.4710	19.6533	20.2805	17.6810	16.9653	14.6398	13.5659	15.5671	15.7530	18.3586	20.0399	21.7620 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	(66)

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

	9.8146	8.7172	7.0893	5.3671	4.0119	3.3871	3.6598	4.7572	6.3851	8.1073	9.4625	10.0874 (67)

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

	110.0897	111.2321	108.3533	102.2247	94.4885	87.2176	82.3601	81.2177	84.0965	90.2251	97.9613	105.2323 (68)

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

	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473 (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)

	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780 (71)

Water heating gains (Table 5)

	30.2030	29.2460	27.2587	24.5569	22.8029	20.3330	18.2338	20.9235	21.8792	24.6756	27.8331	29.2500 (72)

Total internal gains

	192.4491	191.5371	185.0431	174.4905	163.6451	153.2794	146.5955	149.2402	154.7025	165.3497	177.5987	186.9114 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.1200	19.6403	0.7200	0.7000	0.7700	21.4026	(76)
South	9.1400	46.7521	0.7200	0.7000	0.7700	149.2488	(78)
West	4.3300	19.6403	0.7200	0.7000	0.7700	29.7029	(80)

Solar gains	200.3542	344.4042	476.0033	592.0262	660.9841	654.1505	631.6077	581.2134	516.7390	382.2683	240.6332	170.9913 (83)
Total gains	392.8033	535.9412	661.0464	766.5167	824.6292	807.4299	778.2032	730.4536	671.4416	547.6181	418.2319	357.9027 (84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	15.4917	15.5229	15.5536	15.6993	15.7269	15.8566	15.8566	15.8808	15.8064	15.7269	15.6712	15.6134	
alpha	2.0328	2.0349	2.0369	2.0466	2.0485	2.0571	2.0571	2.0587	2.0538	2.0485	2.0447	2.0409	
util living area	0.9354	0.8871	0.8218	0.7292	0.6167	0.4901	0.3785	0.4122	0.5826	0.7831	0.9029	0.9452	(86)
MIT	17.8814	18.4133	19.0696	19.7742	20.3331	20.7110	20.8791	20.8516	20.5610	19.7726	18.6776	17.7769	(87)
Th 2	19.2243	19.2271	19.2298	19.2427	19.2451	19.2563	19.2563	19.2584	19.2520	19.2451	19.2402	19.2351	(88)
util rest of house	0.9222	0.8655	0.7885	0.6786	0.5428	0.3846	0.2439	0.2757	0.4797	0.7289	0.8803	0.9339	(89)
MIT 2	16.5530	17.0647	17.6868	18.3407	18.8246	19.1244	19.2249	19.2158	19.0277	18.3717	17.3437	16.4586	(90)
Living area fraction									fLA = Living area / (4) =			0.5900	(91)
MIT	17.3368	17.8604	18.5027	19.1865	19.7147	20.0606	20.2010	20.1810	19.9324	19.1983	18.1308	17.2365	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.3368	17.8604	18.5027	19.1865	19.7147	20.0606	20.2010	20.1810	19.9324	19.1983	18.1308	17.2365	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9034	0.8446	0.7723	0.6768	0.5642	0.4360	0.3199	0.3515	0.5230	0.7272	0.8620	0.9164	(94)
Useful gains	354.8398	452.6330	510.5128	518.7479	465.2227	352.0146	248.9318	256.7324	351.1756	398.2099	360.4951	327.9649	(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	999.2613	991.4116	916.3395	778.0256	605.1322	408.9160	269.6603	282.7068	438.1486	649.1961	835.8137	991.4469	(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	479.4496	362.0592	301.9351	186.6800	104.0926	0.0000	0.0000	0.0000	0.0000	186.7338	342.2294	493.6306	(98)
Space heating												2456.8103	(98)
Space heating per m2											(98) / (4) =	69.4603	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	703.9227	554.1519	568.2601	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7797	0.8318	0.8114	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	548.8220	460.9496	461.1117	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	993.3828	958.3668	903.1925	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	320.0838	370.0784	328.9081	0.0000	0.0000	0.0000	0.0000	(104)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling											1019.0703	(104)
Cooled fraction									fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	80.0209	92.5196	82.2270	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling											254.7676	(107)
Space cooling per m2											7.2029	(108)
Energy for space heating											69.4603	(99)
Energy for space cooling											7.2029	(108)
Total											76.6632	(109)
Dwelling Fabric Energy Efficiency (DFEE)											76.7	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1848	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4348	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3696	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4712	0.4620	0.4527	0.4065	0.3973	0.3511	0.3511	0.3419	0.3696	0.3973	0.4158	0.4342	(22b)
Effective ac	0.6110	0.6067	0.6025	0.5826	0.5789	0.5616	0.5616	0.5584	0.5683	0.5789	0.5864	0.5943	(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 Opening Type (Uw = 1.40)			8.8400	1.3258	11.7197			(27)
GF			35.3700	0.1300	4.5981			(28b)
Main	66.7400	8.8400	57.9000	0.1800	10.4220			(29a)
Flat	35.3700		35.3700	0.1300	4.5981			(30)
Total net area of external elements Aum(A, m2)			137.4800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		31.3379			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.1326	(36)
Total fabric heat loss					(33) + (36) =		39.4705	(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	21.8234	21.6694	21.5185	20.8096	20.6770	20.0596	20.0596	19.9453	20.2974	20.6770	20.9453	21.2258	(38)
Heat transfer coeff	61.2939	61.1399	60.9890	60.2801	60.1475	59.5301	59.5301	59.4158	59.7679	60.1475	60.4158	60.6963	(39)
Average = Sum(39)m / 12 =												60.2795	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.7329	1.7286	1.7243	1.7043	1.7005	1.6831	1.6831	1.6798	1.6898	1.7005	1.7081	1.7160	(40)
HLP (average)												1.7043	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895	(42)
Average daily hot water use (litres/day)	64.8244	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(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)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Heat gains from water heating, kWh/month

	22.4710	19.6533	20.2805	17.6810	16.9653	14.6398	13.5659	15.5671	15.7530	18.3586	20.0399	21.7620 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	9.8146	8.7172	7.0893	5.3671	4.0119	3.3871	3.6598	4.7572	6.3851	8.1073	9.4625	10.0874	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	110.0897	111.2321	108.3533	102.2247	94.4885	87.2176	82.3601	81.2177	84.0965	90.2251	97.9613	105.2323	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	30.2030	29.2460	27.2587	24.5569	22.8029	20.3330	18.2338	20.9235	21.8792	24.6756	27.8331	29.2500	(72)
Total internal gains													
	192.4491	191.5371	185.0431	174.4905	163.6451	153.2794	146.5955	149.2402	154.7025	165.3497	177.5987	186.9114	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	1.6600	19.6403	0.6300	0.7000	0.7700	9.9639	(76)
South	4.8700	46.7521	0.6300	0.7000	0.7700	69.5827	(78)
West	2.3100	19.6403	0.6300	0.7000	0.7700	13.8654	(80)

Solar gains	93.4120	160.5736	221.9313	276.0277	308.1802	304.9946	294.4839	270.9869	240.9246	178.2277	112.1915	79.7219	(83)
Total gains	285.8610	352.1107	406.9744	450.5182	471.8253	458.2740	441.0794	420.2271	395.6271	343.5774	289.7902	266.6333	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	40.0733	40.1742	40.2736	40.7472	40.8371	41.2606	41.2606	41.3400	41.0965	40.8371	40.6557	40.4679	
alpha	3.6716	3.6783	3.6849	3.7165	3.7225	3.7507	3.7507	3.7560	3.7398	3.7225	3.7104	3.6979	
util living area													
	0.9933	0.9852	0.9682	0.9289	0.8496	0.7113	0.5566	0.5985	0.8051	0.9485	0.9873	0.9948	(86)
MIT	19.2245	19.4688	19.8214	20.2501	20.6175	20.8668	20.9602	20.9472	20.7730	20.2769	19.6655	19.1840	(87)
Th 2	19.5173	19.5204	19.5235	19.5378	19.5405	19.5530	19.5530	19.5553	19.5482	19.5405	19.5350	19.5294	(88)
util rest of house													
	0.9909	0.9801	0.9566	0.9012	0.7880	0.5934	0.3908	0.4339	0.7064	0.9225	0.9819	0.9930	(89)
MIT 2	17.9584	18.2021	18.5500	18.9704	19.2997	19.4975	19.5448	19.5429	19.4366	19.0076	18.4101	17.9270	(90)
Living area fraction									fLA = Living area / (4) =			0.5900	(91)
MIT	18.7055	18.9495	19.3002	19.7255	20.0773	20.3055	20.3799	20.3715	20.2251	19.7565	19.1508	18.6687	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7055	18.9495	19.3002	19.7255	20.0773	20.3055	20.3799	20.3715	20.2251	19.7565	19.1508	18.6687	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9892	0.9775	0.9544	0.9054	0.8133	0.6590	0.4893	0.5314	0.7574	0.9272	0.9800	0.9915	(94)
Useful gains	282.7692	344.1726	388.4312	407.8951	383.7549	301.9886	215.8137	223.3143	299.6405	318.5705	283.9973	264.3630	(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													
	882.9676	858.9874	780.6722	652.5647	503.8723	339.6473	225.0199	235.9702	366.0872	550.7437	728.0618	878.1961	(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													
	446.5477	345.9556	291.8273	176.1621	89.3674	0.0000	0.0000	0.0000	0.0000	172.7369	319.7265	456.6919	(98)
Space heating												2299.0152	(98)
Space heating per m2											(98) / (4) =	64.9990	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	559.5831	440.5229	451.5599	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8069	0.8747	0.8543	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	451.5009	385.3361	385.7769	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	585.2785	564.3260	540.5900	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	96.3199	133.1685	115.1809	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												344.6693	(104)
Cooled fraction									fC = cooled area / (4) =			1.0000	(105)
Intermittency factor (Table 10b)													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	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	24.0800	33.2921	28.7952	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												86.1673 (107)
Space cooling per m2												2.4362 (108)
Energy for space heating												64.9990 (99)
Energy for space cooling												2.4362 (108)
Total												67.4352 (109)
Target Fabric Energy Efficiency (TFEE)												77.6 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3424	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2910	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	6.6000	6.2000	5.9000	5.1000	4.9000	4.6000	4.2000	4.3000	4.9000	5.4000	5.9000	5.7000	(22)
Wind factor	1.6500	1.5500	1.4750	1.2750	1.2250	1.1500	1.0500	1.0750	1.2250	1.3500	1.4750	1.4250	(22a)
Adj infilt rate	0.4802	0.4511	0.4293	0.3711	0.3565	0.3347	0.3056	0.3129	0.3565	0.3929	0.4293	0.4147	(22b)
Effective ac	0.6153	0.6017	0.5921	0.5688	0.5636	0.5560	0.5467	0.5489	0.5636	0.5772	0.5921	0.5860	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	66.7400	16.5900	50.1500	0.2300	11.5345	9.0000	451.3500	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			137.4800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	47.6768			(33)
Party Wall 1			8.0100	0.0000	0.0000	20.0000	160.2000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		4274.7300	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							120.8575	(35)
Thermal bridges (User defined value 0.052 * total exposed area)							7.1490	(36)
Total fabric heat loss					(33) + (36) =		54.8258	(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	21.9764	21.4924	21.1492	20.3173	20.1282	19.8588	19.5260	19.6063	20.1282	20.6151	21.1492	20.9299	(38)
Heat transfer coeff	76.8022	76.3182	75.9750	75.1430	74.9540	74.6845	74.3518	74.4321	74.9540	75.4408	75.9750	75.7557	(39)
Average = Sum(39)m / 12 =												75.3989	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1714	2.1577	2.1480	2.1245	2.1191	2.1115	2.1021	2.1044	2.1191	2.1329	2.1480	2.1418	(40)
HLP (average)												2.1317	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895	(42)
Average daily hot water use (litres/day)	64.8244	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0500	(48)

CALCULATION OF HEAT DEMAND 09 Jan 2014

```
  Temperature factor from Table 2b                                                                                0.5400 (49)
Enter (49) or (54) in (55)                                                                                        0.5670 (55)
Total storage loss
              17.5770    15.8760    17.5770    17.0100    17.5770    17.0100    17.5770    17.5770    17.0100    17.5770    17.0100    17.5770 (56)
If cylinder contains dedicated solar storage
              17.5770    15.8760    17.5770    17.0100    17.5770    17.0100    17.5770    17.5770    17.0100    17.5770    17.0100    17.5770 (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
              146.5855   129.3734   136.2768   122.7267   120.6763   108.4151   104.6790   114.0963   113.6538   127.2329   133.8273   143.2488 (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
              146.5855   129.3734   136.2768   122.7267   120.6763   108.4151   104.6790   114.0963   113.6538   127.2329   133.8273   143.2488 (64)
                                                                                    Total per year (kWh/year) = Sum(64)m =   1500.7919 (64)
RHI water heating demand                                                                                          1501 (64)
Heat gains from water heating, kWh/month
              67.8321    60.2614    64.4045    59.2832    59.2173    54.5246    53.8982    57.0294    56.2664    61.3974    62.9741    66.7226 (65)


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5. Internal gains (see Table 5 and 5a)
------------------------------------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m         77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              24.5364    21.7931    17.7233    13.4177    10.0299     8.4676     9.1496    11.8930    15.9627    20.2684    23.6562    25.2184 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              164.3130   166.0181   161.7214   152.5743   141.0276   130.1755   122.9255   121.2205   125.5172   134.6643   146.2109   157.0631 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262 (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)
              -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780 (71)
Water heating gains (Table 5)
              91.1722    89.6747    86.5651    82.3377    79.5931    75.7286    72.4438    76.6525    78.1478    82.5233    87.4640    89.6810 (72)
Total internal gains
              352.8368   350.3010   338.8250   321.1448   303.4658   287.1868   277.3341   282.5811   292.4429   310.2711   330.1462   344.7776 (73)


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6. Solar gains
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[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
------------------------------------------------------------------------------------------------------------------------
East                                    3.1200           19.0327            0.7200           0.7000           0.7700           20.7404 (76)
South                                   9.1400           46.2981            0.7200           0.7000           0.7700          147.7996 (78)
West                                    4.3300           19.0327            0.7200           0.7000           0.7700           28.7840 (80)
------------------------------------------------------------------------------------------------------------------------

Solar gains   197.3240   339.6308   491.5717   618.5759   690.7157   658.1417   642.6356   597.9534   527.3562   379.4219   231.5438   166.7843 (83)
Total gains   550.1608   689.9318   830.3967   939.7207   994.1815   945.3285   919.9697   880.5344   819.7991   689.6930   561.6900   511.5619 (84)


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7. Mean internal temperature (heating season)
------------------------------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                     21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau           15.4608    15.5589    15.6292    15.8022    15.8421    15.8992    15.9704    15.9531    15.8421    15.7398    15.6292    15.6744
alpha          2.0307     2.0373     2.0419     2.0535     2.0561     2.0599     2.0647     2.0635     2.0561     2.0493     2.0419     2.0450
util living area
               0.9004     0.8534     0.7879     0.7050     0.6145     0.5252     0.4382     0.4585     0.5893     0.7556     0.8686     0.9122 (86)

MIT           17.9980    18.4684    19.0732    19.7072    20.2099    20.5727    20.7733    20.7482    20.4419    19.7025    18.6844    17.8902 (87)
Th 2          19.9143    19.9211    19.9260    19.9378    19.9404    19.9442    19.9489    19.9478    19.9404    19.9335    19.9260    19.9291 (88)
util rest of house
               0.8903     0.8394     0.7686     0.6787     0.5794     0.4776     0.3794     0.3993     0.5427     0.7271     0.8538     0.9032 (89)
MIT 2         17.1779    17.6386    18.2242    18.8351    19.3042    19.6342    19.8058    19.7867    19.5245    18.8456    17.8620    17.0824 (90)
Living area fraction                                                                                fLA = Living area / (4) =      0.5900 (91)
MIT           17.6618    18.1282    18.7251    19.3497    19.8386    20.1880    20.3767    20.3540    20.0658    19.3512    18.3473    17.5590 (92)
Temperature adjustment                                                                                            0.0000
adjusted MIT  17.6618    18.1282    18.7251    19.3497    19.8386    20.1880    20.3767    20.3540    20.0658    19.3512    18.3473    17.5590 (93)


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8. Space heating requirement
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                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation    0.8638     0.8117     0.7440     0.6627     0.5758     0.4891     0.4041     0.4230     0.5485     0.7097     0.8275     0.8779 (94)
Useful gains 475.2516   560.0416   617.8534   622.7948   572.4369   462.3395   371.7319   372.4334   449.6622   489.4599   464.8062   449.1237 (95)
Ext temp.      3.1000     3.6000     5.0000     7.2000     9.8000    12.7000    14.7000    14.6000    12.4000     9.1000     5.7000     2.9000 (96)
Heat loss rate W
             1118.3761  1108.7664  1042.7666   912.9660   752.4338   559.2355   422.0725   428.2817   574.5819   773.3573   960.8751  1110.5048 (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
              478.4846   368.7431   316.1354   208.9233   133.9177     0.0000     0.0000     0.0000     0.0000   211.2197   357.1696   492.0675 (98)
Space heating                                                                                                    2566.6608 (98)
RHI space heating demand                                                                                            2567 (98)


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CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3424	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2910	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3711	0.3638	0.3565	0.3201	0.3129	0.2765	0.2765	0.2692	0.2910	0.3129	0.3274	0.3420	(22b)
Effective ac	0.5688	0.5662	0.5636	0.5512	0.5489	0.5382	0.5382	0.5362	0.5424	0.5489	0.5536	0.5585	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	66.7400	16.5900	50.1500	0.2300	11.5345	9.0000	451.3500	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			137.4800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	47.6768			(33)
Party Wall 1			8.0100	0.0000	0.0000	20.0000	160.2000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		4274.7300	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							120.8575	(35)
Thermal bridges (User defined value 0.052 * total exposed area)							7.1490	(36)
Total fabric heat loss					(33) + (36) =		54.8258	(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	20.3173	20.2218	20.1282	19.6886	19.6063	19.2235	19.2235	19.1526	19.3709	19.6063	19.7727	19.9467	(38)
Heat transfer coeff	75.1430	75.0476	74.9540	74.5144	74.4321	74.0492	74.0492	73.9783	74.1967	74.4321	74.5985	74.7725	(39)
Average = Sum(39)m / 12 =												74.5140	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1245	2.1218	2.1191	2.1067	2.1044	2.0936	2.0936	2.0916	2.0977	2.1044	2.1091	2.1140	(40)
HLP (average)												2.1067	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895	(42)
Average daily hot water use (litres/day)	64.8244	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0500	(48)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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  Temperature factor from Table 2b                                                                                0.5400 (49)
Enter (49) or (54) in (55)                                                                                        0.5670 (55)
Total storage loss
              17.5770    15.8760    17.5770    17.0100    17.5770    17.0100    17.5770    17.5770    17.0100    17.5770    17.0100    17.5770 (56)
If cylinder contains dedicated solar storage
              17.5770    15.8760    17.5770    17.0100    17.5770    17.0100    17.5770    17.5770    17.0100    17.5770    17.0100    17.5770 (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
             146.5855   129.3734   136.2768   122.7267   120.6763   108.4151   104.6790   114.0963   113.6538   127.2329   133.8273   143.2488 (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
             146.5855   129.3734   136.2768   122.7267   120.6763   108.4151   104.6790   114.0963   113.6538   127.2329   133.8273   143.2488 (64)
                                                                                  Total per year (kWh/year) = Sum(64)m =   1500.7919 (64)
Heat gains from water heating, kWh/month
              67.8321    60.2614    64.4045    59.2832    59.2173    54.5246    53.8982    57.0294    56.2664    61.3974    62.9741    66.7226 (65)


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5. Internal gains (see Table 5 and 5a)
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Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m         77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              24.5364    21.7931    17.7233    13.4177    10.0299     8.4676     9.1496    11.8930    15.9627    20.2684    23.6562    25.2184 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             164.3130   166.0181   161.7214   152.5743   141.0276   130.1755   122.9255   121.2205   125.5172   134.6643   146.2109   157.0631 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262 (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)
             -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780 (71)
Water heating gains (Table 5)
              91.1722    89.6747    86.5651    82.3377    79.5931    75.7286    72.4438    76.6525    78.1478    82.5233    87.4640    89.6810 (72)
Total internal gains
             352.8368   350.3010   338.8250   321.1448   303.4658   287.1868   277.3341   282.5811   292.4429   310.2711   330.1462   344.7776 (73)


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6. Solar gains
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[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
-------------------------------------------------------------------------------------------------------------
East                                   3.1200             19.6403            0.7200           0.7000         0.7700            21.4026 (76)
South                                  9.1400             46.7521            0.7200           0.7000         0.7700           149.2488 (78)
West                                   4.3300             19.6403            0.7200           0.7000         0.7700            29.7029 (80)
-------------------------------------------------------------------------------------------------------------

Solar gains   200.3542   344.4042   476.0033   592.0262   660.9841   654.1505   631.6077   581.2134   516.7390   382.2683   240.6332   170.9913 (83)
Total gains   553.1910   694.7052   814.8283   913.1710   964.4499   941.3373   908.9418   863.7945   809.1819   692.5395   570.7794   515.7689 (84)


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7. Mean internal temperature (heating season)
-------------------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                     21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau           15.8022    15.8223    15.8421    15.9355    15.9531    16.0356    16.0356    16.0510    16.0037    15.9531    15.9175    15.8805
alpha          2.0535     2.0548     2.0561     2.0624     2.0635     2.0690     2.0690     2.0701     2.0669     2.0635     2.0612     2.0587
util living area
               0.8867     0.8329     0.7635     0.6692     0.5576     0.4346     0.3297     0.3571     0.5131     0.7103     0.8435     0.8991 (86)

MIT           18.3612    18.8249    19.3937    19.9926    20.4641    20.7748    20.9091    20.8893    20.6638    20.0211    19.0754    18.2574 (87)
Th 2          19.9378    19.9391    19.9404    19.9466    19.9478    19.9532    19.9532    19.9542    19.9511    19.9478    19.9455    19.9430 (88)
util rest of house
               0.8748     0.8165     0.7410     0.6379     0.5150     0.3773     0.2594     0.2859     0.4559     0.6751     0.8252     0.8883 (89)
MIT 2         17.5518    17.9997    18.5452    19.1125    19.5412    19.8098    19.9096    19.8985    19.7246    19.1562    18.2573    17.4547 (90)
Living area fraction                                                                                fLA = Living area / (4) =      0.5900 (91)
MIT           18.0294    18.4866    19.0459    19.6318    20.0858    20.3792    20.4993    20.4831    20.2787    19.6665    18.7400    17.9283 (92)
Temperature adjustment                                                                                           0.0000
adjusted MIT  18.0294    18.4866    19.0459    19.6318    20.0858    20.3792    20.4993    20.4831    20.2787    19.6665    18.7400    17.9283 (93)


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8. Space heating requirement
-------------------------------------------------------------------------------------------------------------

                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation    0.8484     0.7902     0.7196     0.6279     0.5208     0.4013     0.2968     0.3228     0.4746     0.6648     0.8004     0.8626 (94)
Useful gains 469.3374   548.9322   586.3611   573.3392   502.3200   377.8007   269.8136   278.8247   384.0088   460.4153   456.8792   444.9164 (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
            1031.6687  1019.6396   940.3633   799.6758   624.1702   427.9436   288.7427   302.0643   458.4425   674.8393   868.3251  1026.4995 (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
              418.3745   316.3154   263.3777   162.9623    90.6566     0.0000     0.0000     0.0000     0.0000   159.5315   296.2411   432.6978 (98)
Space heating                                                                                                   2140.1568 (98)
Space heating per m2                                                                                 (98) / (4) =     60.5077 (99)


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8c. Space cooling requirement
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CALCULATION OF ENERGY RATINGS 09 Jan 2014

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	175.1000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1222.2483	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	418.3745	316.3154	263.3777	162.9623	90.6566	0.0000	0.0000	0.0000	0.0000	159.5315	296.2411	432.6978	(98)
Space heating efficiency (main heating system 1)	175.1000	175.1000	175.1000	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175.1000	175.1000	(210)
Space heating fuel (main heating system)	238.9346	180.6484	150.4156	93.0681	51.7742	0.0000	0.0000	0.0000	0.0000	91.1088	169.1839	247.1147	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
Efficiency of water heater												175.1000	(216)
(217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(217)
Fuel for water heating, kWh/month	83.7153	73.8854	77.8280	70.0895	68.9185	61.9161	59.7824	65.1607	64.9080	72.6630	76.4290	81.8097	(219)
Water heating fuel used												857.1056	(219)
Annual totals kWh/year													
Space heating fuel - main system												1222.2483	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
Total electricity for the above, kWh/year												30.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Total delivered energy for all uses												2282.6824	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1222.2483	13.1900	161.2145	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	857.1056	13.1900	113.0522	(247)
Pumps and fans for heating	30.0000	13.1900	3.9570	(249)
Energy for lighting	173.3285	13.1900	22.8620	(250)
Additional standing charges			0.0000	(251)
Total energy cost			301.0858	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.5734	(257)
SAP value		78.0507	
SAP rating (Section 12)		78	(258)
SAP band		C	

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	1222.2483	0.5190	634.3469	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	857.1056	0.5190	444.8378	(264)
Space and water heating			1079.1847	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Total kg/year			1184.7122	(272)
CO2 emissions per m2			33.4900	(273)
EI value			80.2474	
EI rating			80	(274)
EI band			C	

Calculation of stars for heating and DHW

Main heating energy efficiency	13.19 × (1 + 0.29 × 0.00) / 1.7510 = 7.533, stars = 2
Main heating environmental impact	0.519 × (1 + 0.29 × 0.00) / 1.7510 = 0.2964, stars = 4
Water heating energy efficiency	13.19 / 1.7510 = 7.533, stars = 2
Water heating environmental impact	0.519 / 1.7510 = 0.2964, stars = 4

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3424	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2910	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	6.6000	6.2000	5.9000	5.1000	4.9000	4.6000	4.2000	4.3000	4.9000	5.4000	5.9000	5.7000	(22)
Wind factor	1.6500	1.5500	1.4750	1.2750	1.2250	1.1500	1.0500	1.0750	1.2250	1.3500	1.4750	1.4250	(22a)
Adj infilt rate	0.4802	0.4511	0.4293	0.3711	0.3565	0.3347	0.3056	0.3129	0.3565	0.3929	0.4293	0.4147	(22b)
Effective ac	0.6153	0.6017	0.5921	0.5688	0.5636	0.5560	0.5467	0.5489	0.5636	0.5772	0.5921	0.5860	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	66.7400	16.5900	50.1500	0.2300	11.5345	9.0000	451.3500	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			137.4800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	47.6768			(33)
Party Wall 1			8.0100	0.0000	0.0000	20.0000	160.2000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		4274.7300	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							120.8575	(35)
Thermal bridges (User defined value 0.052 * total exposed area)							7.1490	(36)
Total fabric heat loss					(33) + (36) =		54.8258	(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	21.9764	21.4924	21.1492	20.3173	20.1282	19.8588	19.5260	19.6063	20.1282	20.6151	21.1492	20.9299	(38)
Heat transfer coeff	76.8022	76.3182	75.9750	75.1430	74.9540	74.6845	74.3518	74.4321	74.9540	75.4408	75.9750	75.7557	(39)
Average = Sum(39)m / 12 =												75.3989	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1714	2.1577	2.1480	2.1245	2.1191	2.1115	2.1021	2.1044	2.1191	2.1329	2.1480	2.1418	(40)
HLP (average)												2.1317	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895	(42)
Average daily hot water use (litres/day)	64.8244	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0500	(48)

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

Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.5670	(55)
Total storage loss													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(56)
If cylinder contains dedicated solar storage													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(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													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(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													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
								Total per year (kWh/year) = Sum(64)m =				1500.7919	(64)
Heat gains from water heating, kWh/month													
	67.8321	60.2614	64.4045	59.2832	59.2173	54.5246	53.8982	57.0294	56.2664	61.3974	62.9741	66.7226	(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	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.5364	21.7931	17.7233	13.4177	10.0299	8.4676	9.1496	11.8930	15.9627	20.2684	23.6562	25.2184	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	164.3130	166.0181	161.7214	152.5743	141.0276	130.1755	122.9255	121.2205	125.5172	134.6643	146.2109	157.0631	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	91.1722	89.6747	86.5651	82.3377	79.5931	75.7286	72.4438	76.6525	78.1478	82.5233	87.4640	89.6810	(72)
Total internal gains													
	352.8368	350.3010	338.8250	321.1448	303.4658	287.1868	277.3341	282.5811	292.4429	310.2711	330.1462	344.7776	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.1200	19.0327	0.7200	0.7000	0.7700	20.7404	(76)
South	9.1400	46.2981	0.7200	0.7000	0.7700	147.7996	(78)
West	4.3300	19.0327	0.7200	0.7000	0.7700	28.7840	(80)

Solar gains	197.3240	339.6308	491.5717	618.5759	690.7157	658.1417	642.6356	597.9534	527.3562	379.4219	231.5438	166.7843	(83)
Total gains	550.1608	689.9318	830.3967	939.7207	994.1815	945.3285	919.9697	880.5344	819.7991	689.6930	561.6900	511.5619	(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	15.4608	15.5589	15.6292	15.8022	15.8421	15.8992	15.9704	15.9531	15.8421	15.7398	15.6292	15.6744	
alpha	2.0307	2.0373	2.0419	2.0535	2.0561	2.0599	2.0647	2.0635	2.0561	2.0493	2.0419	2.0450	
util living area													
	0.9004	0.8534	0.7879	0.7050	0.6145	0.5252	0.4382	0.4585	0.5893	0.7556	0.8686	0.9122	(86)
MIT	17.9980	18.4684	19.0732	19.7072	20.2099	20.5727	20.7733	20.7482	20.4419	19.7025	18.6844	17.8902	(87)
Th 2	19.9143	19.9211	19.9260	19.9378	19.9404	19.9442	19.9489	19.9478	19.9404	19.9335	19.9260	19.9291	(88)
util rest of house													
	0.8903	0.8394	0.7686	0.6787	0.5794	0.4776	0.3794	0.3993	0.5427	0.7271	0.8538	0.9032	(89)
MIT 2	17.1779	17.6386	18.2242	18.8351	19.3042	19.6342	19.8058	19.7867	19.5245	18.8456	17.8620	17.0824	(90)
Living area fraction										fLA = Living area / (4) =		0.5900	(91)
MIT	17.6618	18.1282	18.7251	19.3497	19.8386	20.1880	20.3767	20.3540	20.0658	19.3512	18.3473	17.5590	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.6618	18.1282	18.7251	19.3497	19.8386	20.1880	20.3767	20.3540	20.0658	19.3512	18.3473	17.5590	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8638	0.8117	0.7440	0.6627	0.5758	0.4891	0.4041	0.4230	0.5485	0.7097	0.8275	0.8779	(94)
Useful gains	475.2516	560.0416	617.8534	622.7948	572.4369	462.3395	371.7319	372.4334	449.6622	489.4599	464.8062	449.1237	(95)
Ext temp.	3.1000	3.6000	5.0000	7.2000	9.8000	12.7000	14.7000	14.6000	12.4000	9.1000	5.7000	2.9000	(96)
Heat loss rate W													
	1118.3761	1108.7664	1042.7666	912.9660	752.4338	559.2355	422.0725	428.2817	574.5819	773.3573	960.8751	1110.5048	(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													
	478.4846	368.7431	316.1354	208.9233	133.9177	0.0000	0.0000	0.0000	0.0000	211.2197	357.1696	492.0675	(98)
Space heating												2566.6608	(98)
Space heating per m2											(98) / (4) =	72.5660	(99)

8c. Space cooling requirement

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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 %)	175.1000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1465.8257	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	478.4846	368.7431	316.1354	208.9233	133.9177	0.0000	0.0000	0.0000	0.0000	211.2197	357.1696	492.0675	(98)
Space heating efficiency (main heating system 1)													
	175.1000	175.1000	175.1000	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175.1000	175.1000	(210)
Space heating fuel (main heating system)													
	273.2636	210.5900	180.5456	119.3165	76.4807	0.0000	0.0000	0.0000	0.0000	120.6280	203.9804	281.0208	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
Efficiency of water heater												175.1000	(216)
(217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(217)
Fuel for water heating, kWh/month													
	83.7153	73.8854	77.8280	70.0895	68.9185	61.9161	59.7824	65.1607	64.9080	72.6630	76.4290	81.8097	(219)
Water heating fuel used												857.1056	(219)
Annual totals kWh/year													
Space heating fuel - main system												1465.8257	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
Total electricity for the above, kWh/year												30.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Total delivered energy for all uses												2526.2598	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1465.8257	18.7000	274.1094	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	857.1056	18.7000	160.2787	(247)
Pumps and fans for heating	30.0000	18.7000	5.6100	(249)
Energy for lighting	173.3285	18.7000	32.4124	(250)
Additional standing charges			0.0000	(251)
Total energy cost			472.4106	(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	1465.8257	0.5190	760.7635	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	857.1056	0.5190	444.8378	(264)
Space and water heating			1205.6013	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Total kg/year			1311.1288	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	1465.8257	3.0700	4500.0849	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	857.1056	3.0700	2631.3142	(264)
Space and water heating			7131.3991	(265)
Pumps and fans	30.0000	3.0700	92.1000	(267)
Energy for lighting	173.3285	3.0700	532.1186	(268)
Primary energy kWh/year			7755.6177	(272)
Primary energy kWh/m2/year			219.2711	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating:	C 78
Current environmental impact rating:	C 80

(For testing purposes):

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 3.6	-£ 71	-196 kg (15.0%)
U Solar photovoltaic panels	+ 16.6	-£ 326	-906 kg (81.3%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£71	5.54 kg/m²	B 82	B 84
Solar photovoltaic panels	£326	25.62 kg/m²	A 98	A 98
Total Savings	£397	31.16 kg/m²		

Potential energy efficiency rating: A 98
Potential environmental impact rating: A 98

Fuel prices for cost data on this page from database revision number 465 TEST (04 Sep 2020)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£472	£402	£71
Space heating	£280	£280	-£0
Water heating	£160	£89	£71
Lighting	£32	£32	£0
Generated (PV)	-£0	-£326	£326
Total cost of fuels	£472	£76	£397
Total cost of uses	£472	£75	£397
Delivered energy	71 kWh/m²	11 kWh/m²	60 kWh/m²
Carbon dioxide emissions	1.3 tonnes	0.2 tonnes	1.1 tonnes
CO2 emissions per m²	37 kg/m²	6 kg/m²	31 kg/m²
Primary energy	219 kWh/m²	35 kWh/m²	184 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3424	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2910	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3711	0.3638	0.3565	0.3201	0.3129	0.2765	0.2765	0.2692	0.2910	0.3129	0.3274	0.3420	(22b)
Effective ac	0.5688	0.5662	0.5636	0.5512	0.5489	0.5382	0.5382	0.5362	0.5424	0.5489	0.5536	0.5585	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	66.7400	16.5900	50.1500	0.2300	11.5345	9.0000	451.3500	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			137.4800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	47.6768			(33)
Party Wall 1			8.0100	0.0000	0.0000	20.0000	160.2000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		4274.7300	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							120.8575	(35)
Thermal bridges (User defined value 0.052 * total exposed area)							7.1490	(36)
Total fabric heat loss					(33) + (36) =		54.8258	(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	20.3173	20.2218	20.1282	19.6886	19.6063	19.2235	19.2235	19.1526	19.3709	19.6063	19.7727	19.9467	(38)
Heat transfer coeff	75.1430	75.0476	74.9540	74.5144	74.4321	74.0492	74.0492	73.9783	74.1967	74.4321	74.5985	74.7725	(39)
Average = Sum(39)m / 12 =												74.5140	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1245	2.1218	2.1191	2.1067	2.1044	2.0936	2.0936	2.0916	2.0977	2.1044	2.1091	2.1140	(40)
HLP (average)												2.1067	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895	(42)
Average daily hot water use (litres/day)	64.8244	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0500	(48)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.5670	(55)
Total storage loss													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(56)
If cylinder contains dedicated solar storage													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(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													
	146.5855	129.3734	134.8811	115.9731	107.8819	95.8084	91.6521	101.9999	108.2509	125.8372	133.8273	143.2488	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.7781	(H8)
Utilisation factor												0.4302	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												64.8244	(H14)
Volume ratio Veff/V												1.1570	(H15)
Solar storage volume factor												1.0000	(H16)
Solar input												-685.9569	(H17)
Solar input	-19.8914	-33.1930	-56.5315	-75.7633	-93.5992	-92.0229	-90.8068	-79.3384	-62.1378	-42.4328	-23.5940	-16.6457	(63)
								Solar input (sum of months) = Sum(63)m =				-685.9569	(63)
Output from w/h													
	126.6941	96.1804	78.3496	40.2098	14.2827	3.7855	0.8453	22.6615	46.1131	83.4043	110.2332	126.6031	(64)
								Total per year (kWh/year) = Sum(64)m =				749.3626	(64)
Heat gains from water heating, kWh/month													
	67.8321	60.2614	63.2879	53.8803	48.9818	44.4392	43.4766	47.3523	51.9441	60.2808	62.9741	66.7226	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.5364	21.7931	17.7233	13.4177	10.0299	8.4676	9.1496	11.8930	15.9627	20.2684	23.6562	25.2184	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	164.3130	166.0181	161.7214	152.5743	141.0276	130.1755	122.9255	121.2205	125.5172	134.6643	146.2109	157.0631	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	91.1722	89.6747	85.0643	74.8337	65.8358	61.7211	58.4363	63.6455	72.1446	81.0225	87.4640	89.6810	(72)
Total internal gains													
	352.8368	350.3010	337.3242	313.6408	289.7085	273.1794	263.3266	269.5742	286.4397	308.7703	330.1462	344.7776	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.1200	19.6403	0.7200	0.7000	0.7700	21.4026	(76)
South	9.1400	46.7521	0.7200	0.7000	0.7700	149.2488	(78)
West	4.3300	19.6403	0.7200	0.7000	0.7700	29.7029	(80)

Solar gains	200.3542	344.4042	476.0033	592.0262	660.9841	654.1505	631.6077	581.2134	516.7390	382.2683	240.6332	170.9913	(83)
Total gains	553.1910	694.7052	813.3275	905.6670	950.6926	927.3299	894.9343	850.7876	803.1787	691.0387	570.7794	515.7689	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	15.8022	15.8223	15.8421	15.9355	15.9531	16.0356	16.0356	16.0510	16.0037	15.9531	15.9175	15.8805	
alpha	2.0535	2.0548	2.0561	2.0624	2.0635	2.0690	2.0690	2.0701	2.0669	2.0635	2.0612	2.0587	
util living area													
	0.8867	0.8329	0.7641	0.6719	0.5627	0.4396	0.3341	0.3617	0.5157	0.7110	0.8435	0.8991	(86)
MIT	18.3612	18.8249	19.3913	19.9840	20.4544	20.7697	20.9067	20.8866	20.6604	20.0190	19.0754	18.2574	(87)
Th 2	19.9378	19.9391	19.9404	19.9466	19.9478	19.9532	19.9532	19.9542	19.9511	19.9478	19.9455	19.9430	(88)
util rest of house													
	0.8748	0.8165	0.7415	0.6408	0.5201	0.3819	0.2630	0.2897	0.4584	0.6759	0.8252	0.8883	(89)
MIT 2	17.5518	17.9997	18.5429	19.1049	19.5333	19.8064	19.9084	19.8971	19.7221	19.1544	18.2573	17.4547	(90)
Living area fraction									fLA = Living area / (4) =			0.5900	(91)
MIT	18.0294	18.4866	19.0435	19.6236	20.0768	20.3748	20.4975	20.4809	20.2758	19.6646	18.7400	17.9283	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0294	18.4866	19.0435	19.6236	20.0768	20.3748	20.4975	20.4809	20.2758	19.6646	18.7400	17.9283	(93)

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8. Space heating requirement

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8484	0.7902	0.7201	0.6305	0.5255	0.4059	0.3008	0.3269	0.4770	0.6655	0.8004	0.8626	(94)
Useful gains	469.3374	548.9322	585.7060	570.9942	499.6240	376.4104	269.1950	278.1041	383.0896	459.8770	456.8792	444.9164	(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	1031.6687	1019.6396	940.1848	799.0626	623.5024	427.6196	288.6034	301.9009	458.2205	674.6963	868.3251	1026.4995	(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	418.3745	316.3154	263.7322	164.2093	92.1656	0.0000	0.0000	0.0000	0.0000	159.8256	296.2411	432.6978	(98)
Space heating												2143.5614	(98)
Space heating per m2											(98) / (4) =	60.6039	(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 %)	175.1000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1224.1927	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	418.3745	316.3154	263.7322	164.2093	92.1656	0.0000	0.0000	0.0000	0.0000	159.8256	296.2411	432.6978	(98)
Space heating efficiency (main heating system 1)	175.1000	175.1000	175.1000	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175.1000	175.1000	(210)
Space heating fuel (main heating system)	238.9346	180.6484	150.6181	93.7803	52.6360	0.0000	0.0000	0.0000	0.0000	91.2768	169.1839	247.1147	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	126.6941	96.1804	78.3496	40.2098	14.2827	3.7855	0.8453	22.6615	46.1131	83.4043	110.2332	126.6031	(64)
Efficiency of water heater												175.1000	(216)
(217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(217)
Fuel for water heating, kWh/month	72.3553	54.9288	44.7456	22.9639	8.1569	2.1619	0.4827	12.9420	26.3353	47.6324	62.9544	72.3033	(219)
Water heating fuel used												427.9626	(219)
Annual totals kWh/year													
Space heating fuel - main system												1224.1927	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												80.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												178.2445	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1224.1927	13.1900	161.4710	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	427.9626	13.1900	56.4483	(247)
Pumps and fans for heating	30.0000	13.1900	3.9570	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	173.3285	13.1900	22.8620	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			23.5104	(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] =	0.1229	(257)
SAP value	98.2861	
SAP rating (Section 12)	98	(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	1224.1927	0.5190	635.3560	(261)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	427.9626	0.5190	222.1126 (264)
Space and water heating			857.4686 (265)
Pumps and fans	80.0000	0.5190	41.5200 (267)
Energy for lighting	173.3285	0.5190	89.9575 (268)
Energy saving/generation technologies			
PV Unit	-1727.2394	0.5190	-896.4372 (269)
Total kg/year			92.5089 (272)
CO2 emissions per m2			2.6200 (273)
EI value			98.4576
EI rating			98 (274)
EI band			A

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3424	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2910	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	6.6000	6.2000	5.9000	5.1000	4.9000	4.6000	4.2000	4.3000	4.9000	5.4000	5.9000	5.7000	(22)
Wind factor	1.6500	1.5500	1.4750	1.2750	1.2250	1.1500	1.0500	1.0750	1.2250	1.3500	1.4750	1.4250	(22a)
Adj infilt rate	0.4802	0.4511	0.4293	0.3711	0.3565	0.3347	0.3056	0.3129	0.3565	0.3929	0.4293	0.4147	(22b)
Effective ac	0.6153	0.6017	0.5921	0.5688	0.5636	0.5560	0.5467	0.5489	0.5636	0.5772	0.5921	0.5860	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	66.7400	16.5900	50.1500	0.2300	11.5345	9.0000	451.3500	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			137.4800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	47.6768			(33)
Party Wall 1			8.0100	0.0000	0.0000	20.0000	160.2000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		4274.7300	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							120.8575	(35)
Thermal bridges (User defined value 0.052 * total exposed area)							7.1490	(36)
Total fabric heat loss					(33) + (36) =		54.8258	(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	21.9764	21.4924	21.1492	20.3173	20.1282	19.8588	19.5260	19.6063	20.1282	20.6151	21.1492	20.9299	(38)
Heat transfer coeff	76.8022	76.3182	75.9750	75.1430	74.9540	74.6845	74.3518	74.4321	74.9540	75.4408	75.9750	75.7557	(39)
Average = Sum(39)m / 12 =												75.3989	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1714	2.1577	2.1480	2.1245	2.1191	2.1115	2.1021	2.1044	2.1191	2.1329	2.1480	2.1418	(40)
HLP (average)												2.1317	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895	(42)
Average daily hot water use (litres/day)	64.8244	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0500	(48)

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

Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.5670	(55)
Total storage loss													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(56)
If cylinder contains dedicated solar storage													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(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													
	146.5855	129.3734	134.8811	115.9731	107.8819	95.8084	91.6521	101.9999	108.2509	125.8372	133.8273	143.2488	(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												1091.0709	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1832.9992	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.7972	(H8)
Utilisation factor												0.4267	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												64.8244	(H14)
Volume ratio Veff/V												1.1570	(H15)
Solar storage volume factor												1.0000	(H16)
Solar input												-687.8113	(H17)
Solar input	-19.2686	-32.1683	-57.3554	-77.8632	-96.3853	-91.3308	-91.0993	-80.3442	-62.3188	-41.3797	-22.3236	-15.9741	(63)
								Solar input (sum of months) = Sum(63)m =				-687.8113	(63)
Output from w/h													
	127.3169	97.2050	77.5257	38.1099	11.4966	4.4776	0.5528	21.6557	45.9322	84.4575	111.5037	127.2747	(64)
								Total per year (kWh/year) = Sum(64)m =				747.5082	(64)
Heat gains from water heating, kWh/month													
	67.8321	60.2614	63.2879	53.8803	48.9818	44.4392	43.4766	47.3523	51.9441	60.2808	62.9741	66.7226	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.5364	21.7931	17.7233	13.4177	10.0299	8.4676	9.1496	11.8930	15.9627	20.2684	23.6562	25.2184	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	164.3130	166.0181	161.7214	152.5743	141.0276	130.1755	122.9255	121.2205	125.5172	134.6643	146.2109	157.0631	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	91.1722	89.6747	85.0643	74.8337	65.8358	61.7211	58.4363	63.6455	72.1446	81.0225	87.4640	89.6810	(72)
Total internal gains													
	352.8368	350.3010	337.3242	313.6408	289.7085	273.1794	263.3266	269.5742	286.4397	308.7703	330.1462	344.7776	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.1200	19.0327	0.7200	0.7000	0.7700	20.7404	(76)
South	9.1400	46.2981	0.7200	0.7000	0.7700	147.7996	(78)
West	4.3300	19.0327	0.7200	0.7000	0.7700	28.7840	(80)

Solar gains	197.3240	339.6308	491.5717	618.5759	690.7157	658.1417	642.6356	597.9534	527.3562	379.4219	231.5438	166.7843	(83)
Total gains	550.1608	689.9318	828.8959	932.2167	980.4241	931.3210	905.9623	867.5275	813.7959	688.1922	561.6900	511.5619	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	15.4608	15.5589	15.6292	15.8022	15.8421	15.8992	15.9704	15.9531	15.8421	15.7398	15.6292	15.6744	
alpha	2.0307	2.0373	2.0419	2.0535	2.0561	2.0599	2.0647	2.0635	2.0561	2.0493	2.0419	2.0450	
util living area													
	0.9004	0.8534	0.7884	0.7076	0.6194	0.5305	0.4433	0.4636	0.5919	0.7562	0.8686	0.9122	(86)
MIT	17.9980	18.4684	19.0705	19.6973	20.1973	20.5643	20.7682	20.7427	20.4369	19.7001	18.6844	17.8902	(87)
Th 2	19.9143	19.9211	19.9260	19.9378	19.9404	19.9442	19.9489	19.9478	19.9404	19.9335	19.9260	19.9291	(88)
util rest of house													
	0.8903	0.8394	0.7691	0.6813	0.5843	0.4828	0.3842	0.4040	0.5453	0.7278	0.8538	0.9032	(89)
MIT 2	17.1779	17.6386	18.2217	18.8262	19.2934	19.6277	19.8024	19.7829	19.5206	18.8434	17.8620	17.0824	(90)
Living area fraction									fLA = Living area / (4) =			0.5900	(91)
MIT	17.6618	18.1282	18.7225	19.3402	19.8267	20.1803	20.3722	20.3493	20.0613	19.3489	18.3473	17.5590	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.6618	18.1282	18.7225	19.3402	19.8267	20.1803	20.3722	20.3493	20.0613	19.3489	18.3473	17.5590	(93)

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8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8638	0.8117	0.7445	0.6652	0.5803	0.4939	0.4087	0.4276	0.5509	0.7103	0.8275	0.8779	(94)
Useful gains	475.2516	560.0416	617.1407	620.1076	568.9525	459.9979	370.3118	370.9456	448.3232	488.8257	464.8062	449.1237	(95)
Ext temp.	3.1000	3.6000	5.0000	7.2000	9.8000	12.7000	14.7000	14.6000	12.4000	9.1000	5.7000	2.9000	(96)
Heat loss rate W	1118.3761	1108.7664	1042.5693	912.2485	751.5424	558.6638	421.7404	427.9304	574.2442	773.1845	960.8751	1110.5048	(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	478.4846	368.7431	316.5189	210.3415	135.8469	0.0000	0.0000	0.0000	0.0000	211.5629	357.1696	492.0675	(98)
Space heating												2570.7350	(98)
Space heating per m2											(98) / (4) =	72.6812	(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 %)	175.1000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1468.1525	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	478.4846	368.7431	316.5189	210.3415	135.8469	0.0000	0.0000	0.0000	0.0000	211.5629	357.1696	492.0675	(98)
Space heating efficiency (main heating system 1)	175.1000	175.1000	175.1000	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175.1000	175.1000	(210)
Space heating fuel (main heating system)	273.2636	210.5900	180.7646	120.1265	77.5825	0.0000	0.0000	0.0000	0.0000	120.8241	203.9804	281.0208	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	127.3169	97.2050	77.5257	38.1099	11.4966	4.4776	0.5528	21.6557	45.9322	84.4575	111.5037	127.2747	(64)
Efficiency of water heater												175.1000	(216)
(217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(217)
Fuel for water heating, kWh/month	72.7109	55.5140	44.2751	21.7646	6.5657	2.5572	0.3157	12.3676	26.2320	48.2338	63.6800	72.6869	(219)
Water heating fuel used												426.9036	(219)
Annual totals kWh/year													
Space heating fuel - main system												1468.1525	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												80.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1091 * 0.80) =										-1745.7135		-1745.7135	(233)
Total delivered energy for all uses												402.6711	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1468.1525	18.7000	274.5445	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	426.9036	18.7000	79.8310	(247)
Pumps and fans for heating	30.0000	18.7000	5.6100	(249)
Pump for solar water heating	50.0000	18.7000	9.3500	(249)
Energy for lighting	173.3285	18.7000	32.4124	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-1745.7135	18.7000	-326.4484	(252)
Total energy cost			75.2995	(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	1468.1525	0.5190	761.9711	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	426.9036	0.5190	221.5630	(264)
Space and water heating			983.5341	(265)
Pumps and fans	80.0000	0.5190	41.5200	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Energy saving/generation technologies				
PV Unit	-1745.7135	0.5190	-906.0253	(269)
Total kg/year			208.9863	(272)

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

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	1468.1525	3.0700	4507.2281	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	426.9036	3.0700	1310.5940	(264)
Space and water heating			5817.8221	(265)
Pumps and fans	80.0000	3.0700	245.6000	(267)
Energy for lighting	173.3285	3.0700	532.1186	(268)
Energy saving/generation technologies				
PV Unit	-1745.7135	3.0700	-5359.3404	(269)
Primary energy kWh/year			1236.2003	(272)
Primary energy kWh/m2/year			34.9505	(273)

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

Overheating Calculation Input Data

Dwelling type	SemiDetached Bungalow
Number of storeys	1
Cross ventilation possible	Yes
SAP Region	North East England
Front of dwelling faces	East
Overshading	Average or unknown
Thermal mass parameter	120.9 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	6.00 (Windows fully open)

Overheating Calculation

Summer ventilation heat loss coefficient		214.30 (P1)
Transmission heat loss coefficient		54.83 (37)
Summer heat loss coefficient		269.13 (P2)

Overhangs

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

Solar shading

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

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
East	3.1200	111.2086	0.7200	0.7000	0.9000	141.6474
South	9.1400	110.4126	0.7200	0.7000	0.9000	411.9841
West	4.3300	111.2086	0.7200	0.7000	0.9000	196.5811
total:						750.2126

	Jun	Jul	Aug	
Solar gains	765	750	685	(P3)
Internal gains	284	274	280	
Total summer gains	1049	1025	964	(P5)
Summer gain/loss ratio	3.90	3.81	3.58	(P6)
Summer external temperature	13.80	15.80	15.60	
Thermal mass temperature increment (TMP = 120.9)	1.15	1.15	1.15	
Threshold temperature	18.85	20.76	20.34	(P7)
Likelihood of high internal temperature	Not significant	Slight	Not significant	

Assessment of likelihood of high internal temperature: Slight

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

Anderson Goddard Ltd

Property Reference	73940-WR06	**Issued on Date**	07/10/2020
Assessment Reference	001	**Prop Type Ref**	Semi
Property	Woodlands Room 6, Raithwaite Bay, WHITBY, YO21 3ST		

SAP Rating	78 C	**DER**	35.10	**TER**	41.12
Environmental	80 C	**% DER<TER**	14.65		
CO_2 Emissions (t/year)	1.31	**DFEE**	76.66	**TFEE**	77.55
General Requirements Compliance	Pass	**% DFEE<TFEE**	1.14		

Assessor Details	Mr. Paul Goddard, Anderson Goddard Limited, Tel: 0161 7757770, paul.goddard@andersongoddard.com	**Assessor ID**	B342-0001
Client			

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

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

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DWELLING AS DESIGNED

Semi-Detached Bungalow, total floor area 35 m²

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

1a TER and DER
Fuel for main heating:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 41.12 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 35.10 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)77.6 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)76.7 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.23 (max. 0.30)	0.23 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.22 (max. 0.25)	0.22 (max. 0.70)	OK
Roof	0.18 (max. 0.20)	0.18 (max. 0.35)	OK
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated using user-specified y-value of 0.052

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

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4 Heating efficiency
Main heating system: Heat pump with radiators or underfloor - Electric
Air-to-water heat pump

Secondary heating system: None

---

5 Cylinder insulation
Hot water storage Measured cylinder loss: 1.05 kWh/day
Permitted by DBSCG 1.70 OK
Primary pipework insulated: Yes OK

---

6 Controls
Space heating controls: Programmer and room thermostat OK

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

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

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8 Mechanical ventilation
Not applicable

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9 Summertime temperature
Overheating risk (North East England): Slight OK
Based on:
Overshading: Average
Windows facing East: 3.12 m², No overhang
Windows facing South: 9.14 m², No overhang
Windows facing West: 4.33 m², No overhang
Air change rate: 8.00 ach
Blinds/curtains: None

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10 Key features
Party wall U-value 0.00 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3424	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2910	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3711	0.3638	0.3565	0.3201	0.3129	0.2765	0.2765	0.2692	0.2910	0.3129	0.3274	0.3420	(22b)
Effective ac	0.5688	0.5662	0.5636	0.5512	0.5489	0.5382	0.5382	0.5362	0.5424	0.5489	0.5536	0.5585	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	66.7400	16.5900	50.1500	0.2300	11.5345	9.0000	451.3500	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			137.4800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	47.6768			(33)
Party Wall 1			8.0100	0.0000	0.0000	20.0000	160.2000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		4274.7300	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							120.8575	(35)
Thermal bridges (User defined value 0.052 * total exposed area)							7.1490	(36)
Total fabric heat loss					(33) + (36) =		54.8258	(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	20.3173	20.2218	20.1282	19.6886	19.6063	19.2235	19.2235	19.1526	19.3709	19.6063	19.7727	19.9467	(38)
Heat transfer coeff	75.1430	75.0476	74.9540	74.5144	74.4321	74.0492	74.0492	73.9783	74.1967	74.4321	74.5985	74.7725	(39)
Average = Sum(39)m / 12 =												74.5140	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1245	2.1218	2.1191	2.1067	2.1044	2.0936	2.0936	2.0916	2.0977	2.1044	2.1091	2.1140	(40)
HLP (average)												2.1067	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895	(42)
Average daily hot water use (litres/day)	64.8244	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0500	(48)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.5670	(55)
Total storage loss													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(56)
If cylinder contains dedicated solar storage													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(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													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(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													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
								Total per year (kWh/year) = Sum(64)m =				1500.7919	(64)
Heat gains from water heating, kWh/month													
	67.8321	60.2614	64.4045	59.2832	59.2173	54.5246	53.8982	57.0294	56.2664	61.3974	62.9741	66.7226	(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	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	9.8146	8.7172	7.0893	5.3671	4.0119	3.3871	3.6598	4.7572	6.3851	8.1073	9.4625	10.0874	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	110.0897	111.2321	108.3533	102.2247	94.4885	87.2176	82.3601	81.2177	84.0965	90.2251	97.9613	105.2323	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	91.1722	89.6747	86.5651	82.3377	79.5931	75.7286	72.4438	76.6525	78.1478	82.5233	87.4640	89.6810	(72)
Total internal gains													
	256.4182	254.9658	247.3495	235.2713	223.4353	211.6749	203.8055	207.9691	213.9712	226.1975	240.2295	250.3424	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.1200	19.6403	0.7200	0.7000	0.7700	21.4026	(76)
South	9.1400	46.7521	0.7200	0.7000	0.7700	149.2488	(78)
West	4.3300	19.6403	0.7200	0.7000	0.7700	29.7029	(80)

Solar gains	200.3542	344.4042	476.0033	592.0262	660.9841	654.1505	631.6077	581.2134	516.7390	382.2683	240.6332	170.9913	(83)
Total gains	456.7724	599.3700	723.3528	827.2975	884.4194	865.8254	835.4132	789.1826	730.7102	608.4658	480.8627	421.3337	(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	15.8022	15.8223	15.8421	15.9355	15.9531	16.0356	16.0356	16.0510	16.0037	15.9531	15.9175	15.8805	
alpha	2.0535	2.0548	2.0561	2.0624	2.0635	2.0690	2.0690	2.0701	2.0669	2.0635	2.0612	2.0587	
util living area													
	0.9163	0.8648	0.7966	0.7019	0.5884	0.4629	0.3541	0.3847	0.5493	0.7505	0.8784	0.9273	(86)
MIT	18.1128	18.6166	19.2350	19.8875	20.4039	20.7456	20.8957	20.8723	20.6157	19.8988	18.8707	18.0047	(87)
Th 2	19.9378	19.9391	19.9404	19.9466	19.9478	19.9532	19.9532	19.9542	19.9511	19.9478	19.9455	19.9430	(88)
util rest of house													
	0.9070	0.8507	0.7759	0.6718	0.5457	0.4036	0.2798	0.3095	0.4910	0.7175	0.8632	0.9191	(89)
MIT 2	17.3114	17.8015	18.3981	19.0196	19.4923	19.7899	19.9027	19.8893	19.6894	19.0488	18.0633	17.2092	(90)
Living area fraction										fLA = Living area / (4) =		0.5900	(91)
MIT	17.7843	18.2825	18.8919	19.5317	20.0302	20.3538	20.4886	20.4693	20.2360	19.5503	18.5397	17.6786	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.7843	18.2825	18.8919	19.5317	20.0302	20.3538	20.4886	20.4693	20.2360	19.5503	18.5397	17.6786	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8828	0.8240	0.7524	0.6588	0.5492	0.4271	0.3188	0.3476	0.5077	0.7036	0.8382	0.8962	(94)
Useful gains	403.2176	493.9072	544.2247	544.9877	485.7219	369.7795	266.2961	274.3290	370.9738	428.1000	403.0773	377.5820	(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													
	1013.2492	1004.3233	928.8220	792.2138	620.0334	426.0651	287.9484	301.0407	455.2692	666.1901	853.3862	1007.8290	(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													
	453.8635	342.9996	286.1404	178.0027	99.9277	0.0000	0.0000	0.0000	0.0000	177.1390	324.2224	468.9038	(98)
Space heating												2331.1991	(98)
Space heating per m2											(98) / (4) =	65.9089	(99)

8c. Space cooling requirement

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												175.1000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												1331.3530	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	453.8635	342.9996	286.1404	178.0027	99.9277	0.0000	0.0000	0.0000	0.0000	177.1390	324.2224	468.9038	(98)
Space heating efficiency (main heating system 1)													
	175.1000	175.1000	175.1000	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175.1000	175.1000	(210)
Space heating fuel (main heating system)													
	259.2024	195.8879	163.4154	101.6578	57.0689	0.0000	0.0000	0.0000	0.0000	101.1645	185.1641	267.7920	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
Efficiency of water heater												175.1000	(216)
(217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(217)
Fuel for water heating, kWh/month													
	83.7153	73.8854	77.8280	70.0895	68.9185	61.9161	59.7824	65.1607	64.9080	72.6630	76.4290	81.8097	(219)
Water heating fuel used												857.1056	(219)
Annual totals kWh/year													
Space heating fuel - main system												1331.3530	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
Total electricity for the above, kWh/year												30.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Total delivered energy for all uses												2391.7871	(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	1331.3530	0.5190	690.9722	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	857.1056	0.5190	444.8378	(264)
Space and water heating			1135.8100	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Total CO2, kg/year			1241.3375	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			35.1000	(273)

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

DER		35.1000	ZC1
Total Floor Area	TFA	35.3700	
Assumed number of occupants	N	1.2895	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		18.4441	ZC2
CO2 emissions from cooking, equation (L16)		4.2394	ZC3
Total CO2 emissions		57.7835	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		57.7835	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1848	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4348	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3696	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4712	0.4620	0.4527	0.4065	0.3973	0.3511	0.3511	0.3419	0.3696	0.3973	0.4158	0.4342	(22b)
Effective ac	0.6110	0.6067	0.6025	0.5826	0.5789	0.5616	0.5616	0.5584	0.5683	0.5789	0.5864	0.5943	(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 Opening Type (Uw = 1.40)			8.8400	1.3258	11.7197			(27)
GF			35.3700	0.1300	4.5981			(28b)
Main	66.7400	8.8400	57.9000	0.1800	10.4220			(29a)
Flat	35.3700		35.3700	0.1300	4.5981			(30)
Total net area of external elements Aum(A, m2)			137.4800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	31.3379			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.1326	(36)
Total fabric heat loss					(33) + (36) =		39.4705	(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	21.8234	21.6694	21.5185	20.8096	20.6770	20.0596	20.0596	19.9453	20.2974	20.6770	20.9453	21.2258	(38)
Heat transfer coeff	61.2939	61.1399	60.9890	60.2801	60.1475	59.5301	59.5301	59.4158	59.7679	60.1475	60.4158	60.6963	(39)
Average = Sum(39)m / 12 =												60.2795	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.7329	1.7286	1.7243	1.7043	1.7005	1.6831	1.6831	1.6798	1.6898	1.7005	1.7081	1.7160	(40)
HLP (average)												1.7043	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.2895	(42)
Average daily hot water use (litres/day)												64.8244	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.2538	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.6770	(55)
Total storage loss													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	20.9878	18.9567	20.9878	20.3108	20.9878	20.3108	20.9878	20.9878	20.3108	20.9878	20.3108	20.9878	(56)
If cylinder contains dedicated solar storage													
	20.9878	18.9567	20.9878	20.3108	20.9878	20.3108	20.9878	20.9878	20.3108	20.9878	20.3108	20.9878	(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													
	149.9962	132.4541	139.6876	126.0274	124.0870	111.7159	108.0898	117.5071	116.9546	130.6437	137.1280	146.6596	(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													
	149.9962	132.4541	139.6876	126.0274	124.0870	111.7159	108.0898	117.5071	116.9546	130.6437	137.1280	146.6596	(64)
								Total per year (kWh/year) = Sum(64)m =				1540.9510	(64)
Heat gains from water heating, kWh/month													
	70.5607	62.7260	67.1331	61.9238	61.9459	57.1652	56.6268	59.7581	58.9070	64.1260	65.6147	69.4513	(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	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	9.8146	8.7172	7.0893	5.3671	4.0119	3.3871	3.6598	4.7572	6.3851	8.1073	9.4625	10.0874	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	110.0897	111.2321	108.3533	102.2247	94.4885	87.2176	82.3601	81.2177	84.0965	90.2251	97.9613	105.2323	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	94.8397	93.3422	90.2326	86.0052	83.2606	79.3961	76.1113	80.3200	81.8153	86.1908	91.1315	93.3485	(72)
Total internal gains													
	260.0857	258.6333	251.0170	238.9388	227.1028	215.3424	207.4730	211.6366	217.6387	229.8650	243.8970	254.0099	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	1.6600	19.6403	0.6300	0.7000	0.7700	9.9639	(76)
South	4.8700	46.7521	0.6300	0.7000	0.7700	69.5827	(78)
West	2.3100	19.6403	0.6300	0.7000	0.7700	13.8654	(80)

Solar gains	93.4120	160.5736	221.9313	276.0277	308.1802	304.9946	294.4839	270.9869	240.9246	178.2277	112.1915	79.7219	(83)
Total gains	353.4977	419.2069	472.9484	514.9665	535.2830	520.3371	501.9569	482.6235	458.5633	408.0927	356.0886	333.7317	(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	40.0733	40.1742	40.2736	40.7472	40.8371	41.2606	41.2606	41.3400	41.0965	40.8371	40.6557	40.4679	
alpha	3.6716	3.6783	3.6849	3.7165	3.7225	3.7507	3.7507	3.7560	3.7398	3.7225	3.7104	3.6979	
util living area													
	0.9867	0.9747	0.9510	0.9000	0.8052	0.6534	0.4990	0.5352	0.7453	0.9182	0.9757	0.9891	(86)
MIT	19.3802	19.6170	19.9554	20.3587	20.6903	20.9007	20.9723	20.9637	20.8292	20.3947	19.8133	19.3401	(87)
Th 2	19.5173	19.5204	19.5235	19.5378	19.5405	19.5530	19.5530	19.5553	19.5482	19.5405	19.5350	19.5294	(88)
util rest of house													
	0.9822	0.9663	0.9343	0.8648	0.7357	0.5354	0.3457	0.3816	0.6388	0.8815	0.9660	0.9854	(89)
MIT 2	17.4588	17.8006	18.2828	18.8457	19.2656	19.4953	19.5450	19.5435	19.4324	18.9112	18.0973	17.4085	(90)
Living area fraction										fLA = Living area / (4) =		0.5900	(91)
MIT	18.5925	18.8723	19.2697	19.7384	20.1062	20.3246	20.3872	20.3815	20.2566	19.7865	19.1098	18.5482	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5925	18.8723	19.2697	19.7384	20.1062	20.3246	20.3872	20.3815	20.2566	19.7865	19.1098	18.5482	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9784	0.9615	0.9308	0.8704	0.7652	0.6016	0.4366	0.4724	0.6950	0.8888	0.9624	0.9820	(94)
Useful gains	345.8560	403.0630	440.2274	448.2018	409.6063	313.0237	219.1409	227.9886	318.6876	362.7151	342.6931	327.7343	(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													
	876.0435	854.2679	778.8129	653.3428	505.6133	340.7836	225.4519	236.5621	367.9673	552.5479	725.5840	870.8849	(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													
	394.4595	303.2097	251.9076	147.7015	71.4292	0.0000	0.0000	0.0000	0.0000	141.2356	275.6814	404.1041	(98)
Space heating												1989.7285	(98)
Space heating per m2											(98) / (4) =	56.2547	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2128.0519	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	394.4595	303.2097	251.9076	147.7015	71.4292	0.0000	0.0000	0.0000	0.0000	141.2356	275.6814	404.1041	(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)													
	421.8818	324.2885	269.4199	157.9695	76.3948	0.0000	0.0000	0.0000	0.0000	151.0541	294.8464	432.1969	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	149.9962	132.4541	139.6876	126.0274	124.0870	111.7159	108.0898	117.5071	116.9546	130.6437	137.1280	146.6596	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.2760	86.9552	86.3690	85.2379	83.4025	79.8000	79.8000	79.8000	79.8000	85.0220	86.6409	87.3801	(217)
Fuel for water heating, kWh/month													
	171.8642	152.3245	161.7336	147.8537	148.7809	139.9949	135.4509	147.2520	146.5596	153.6587	158.2716	167.8409	(219)
Water heating fuel used												1831.5855	(219)
Annual totals kWh/year													
Space heating fuel - main system												2128.0519	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Total delivered energy for all uses												4207.9659	(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	2128.0519	0.2160	459.6592	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1831.5855	0.2160	395.6225	(264)
Space and water heating			855.2817	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Total CO2, kg/m2/year			984.1642	(272)
Emissions per m2 for space and water heating			24.1810	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			2.5433	(272b)
Emissions per m2 for pumps and fans			1.1005	(272c)
Target Carbon Dioxide Emission Rate (TER) = (24.1810 * 1.55) + 2.5433 + 1.1005, rounded to 2 d.p.			41.1200	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1848	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4348	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3696	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4712	0.4620	0.4527	0.4065	0.3973	0.3511	0.3511	0.3419	0.3696	0.3973	0.4158	0.4342	(22b)
Effective ac	0.6110	0.6067	0.6025	0.5826	0.5789	0.5616	0.5616	0.5584	0.5683	0.5789	0.5864	0.5943	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	66.7400	16.5900	50.1500	0.2300	11.5345	9.0000	451.3500	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			137.4800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	47.6768			(33)
Party Wall 1			8.0100	0.0000	0.0000	20.0000	160.2000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	4274.7300 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		120.8575 (35)
Thermal bridges (User defined value 0.052 * total exposed area)		7.1490 (36)
Total fabric heat loss	(33) + (36) =	54.8258 (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	21.8234	21.6694	21.5185	20.8096	20.6770	20.0596	20.0596	19.9453	20.2974	20.6770	20.9453	21.2258	(38)
Heat transfer coeff	76.6492	76.4952	76.3443	75.6354	75.5028	74.8854	74.8854	74.7711	75.1232	75.5028	75.7711	76.0516	(39)
Average = Sum(39)m / 12 =												75.6348	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1671	2.1627	2.1584	2.1384	2.1347	2.1172	2.1172	2.1140	2.1239	2.1347	2.1422	2.1502	(40)
HLP (average)												2.1384	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895 (42)
Average daily hot water use (litres/day)	64.8244 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage

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

Heat gains from water heating, kWh/month

	22.4710	19.6533	20.2805	17.6810	16.9653	14.6398	13.5659	15.5671	15.7530	18.3586	20.0399	21.7620 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	(66)

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

	9.8146	8.7172	7.0893	5.3671	4.0119	3.3871	3.6598	4.7572	6.3851	8.1073	9.4625	10.0874 (67)

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

	110.0897	111.2321	108.3533	102.2247	94.4885	87.2176	82.3601	81.2177	84.0965	90.2251	97.9613	105.2323 (68)

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

	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473 (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)

	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780 (71)

Water heating gains (Table 5)

	30.2030	29.2460	27.2587	24.5569	22.8029	20.3330	18.2338	20.9235	21.8792	24.6756	27.8331	29.2500 (72)

Total internal gains

	192.4491	191.5371	185.0431	174.4905	163.6451	153.2794	146.5955	149.2402	154.7025	165.3497	177.5987	186.9114 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.1200	19.6403	0.7200	0.7000	0.7700	21.4026	(76)
South	9.1400	46.7521	0.7200	0.7000	0.7700	149.2488	(78)
West	4.3300	19.6403	0.7200	0.7000	0.7700	29.7029	(80)

Solar gains	200.3542	344.4042	476.0033	592.0262	660.9841	654.1505	631.6077	581.2134	516.7390	382.2683	240.6332	170.9913 (83)
Total gains	392.8033	535.9412	661.0464	766.5167	824.6292	807.4299	778.2032	730.4536	671.4416	547.6181	418.2319	357.9027 (84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	15.4917	15.5229	15.5536	15.6993	15.7269	15.8566	15.8566	15.8808	15.8064	15.7269	15.6712	15.6134	
alpha	2.0328	2.0349	2.0369	2.0466	2.0485	2.0571	2.0571	2.0587	2.0538	2.0485	2.0447	2.0409	
util living area	0.9354	0.8871	0.8218	0.7292	0.6167	0.4901	0.3785	0.4122	0.5826	0.7831	0.9029	0.9452	(86)
MIT	17.8814	18.4133	19.0696	19.7742	20.3331	20.7110	20.8791	20.8516	20.5610	19.7726	18.6776	17.7769	(87)
Th 2	19.2243	19.2271	19.2298	19.2427	19.2451	19.2563	19.2563	19.2584	19.2520	19.2451	19.2402	19.2351	(88)
util rest of house	0.9222	0.8655	0.7885	0.6786	0.5428	0.3846	0.2439	0.2757	0.4797	0.7289	0.8803	0.9339	(89)
MIT 2	16.5530	17.0647	17.6868	18.3407	18.8246	19.1244	19.2249	19.2158	19.0277	18.3717	17.3437	16.4586	(90)
Living area fraction									fLA = Living area / (4) =			0.5900	(91)
MIT	17.3368	17.8604	18.5027	19.1865	19.7147	20.0606	20.2010	20.1810	19.9324	19.1983	18.1308	17.2365	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.3368	17.8604	18.5027	19.1865	19.7147	20.0606	20.2010	20.1810	19.9324	19.1983	18.1308	17.2365	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9034	0.8446	0.7723	0.6768	0.5642	0.4360	0.3199	0.3515	0.5230	0.7272	0.8620	0.9164	(94)
Useful gains	354.8398	452.6330	510.5128	518.7479	465.2227	352.0146	248.9318	256.7324	351.1756	398.2099	360.4951	327.9649	(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	999.2613	991.4116	916.3395	778.0256	605.1322	408.9160	269.6603	282.7068	438.1486	649.1961	835.8137	991.4469	(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	479.4496	362.0592	301.9351	186.6800	104.0926	0.0000	0.0000	0.0000	0.0000	186.7338	342.2294	493.6306	(98)
Space heating												2456.8103	(98)
Space heating per m2											(98) / (4) =	69.4603	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	703.9227	554.1519	568.2601	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7797	0.8318	0.8114	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	548.8220	460.9496	461.1117	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	993.3828	958.3668	903.1925	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	320.0838	370.0784	328.9081	0.0000	0.0000	0.0000	0.0000	(104)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling											1019.0703	(104)
Cooled fraction									fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	80.0209	92.5196	82.2270	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling											254.7676	(107)
Space cooling per m2											7.2029	(108)
Energy for space heating											69.4603	(99)
Energy for space cooling											7.2029	(108)
Total											76.6632	(109)
Dwelling Fabric Energy Efficiency (DFEE)											76.7	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1848	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4348	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3696	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4712	0.4620	0.4527	0.4065	0.3973	0.3511	0.3511	0.3419	0.3696	0.3973	0.4158	0.4342	(22b)
Effective ac	0.6110	0.6067	0.6025	0.5826	0.5789	0.5616	0.5616	0.5584	0.5683	0.5789	0.5864	0.5943	(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 Opening Type (Uw = 1.40)			8.8400	1.3258	11.7197			(27)
GF			35.3700	0.1300	4.5981			(28b)
Main	66.7400	8.8400	57.9000	0.1800	10.4220			(29a)
Flat	35.3700		35.3700	0.1300	4.5981			(30)
Total net area of external elements Aum(A, m2)			137.4800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		31.3379			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.1326	(36)
Total fabric heat loss					(33) + (36) =		39.4705	(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	21.8234	21.6694	21.5185	20.8096	20.6770	20.0596	20.0596	19.9453	20.2974	20.6770	20.9453	21.2258	(38)
Heat transfer coeff	61.2939	61.1399	60.9890	60.2801	60.1475	59.5301	59.5301	59.4158	59.7679	60.1475	60.4158	60.6963	(39)
Average = Sum(39)m / 12 =												60.2795	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.7329	1.7286	1.7243	1.7043	1.7005	1.6831	1.6831	1.6798	1.6898	1.7005	1.7081	1.7160	(40)
HLP (average)												1.7043	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895	(42)
Average daily hot water use (litres/day)	64.8244	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(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)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Heat gains from water heating, kWh/month

	22.4710	19.6533	20.2805	17.6810	16.9653	14.6398	13.5659	15.5671	15.7530	18.3586	20.0399	21.7620 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	9.8146	8.7172	7.0893	5.3671	4.0119	3.3871	3.6598	4.7572	6.3851	8.1073	9.4625	10.0874	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	110.0897	111.2321	108.3533	102.2247	94.4885	87.2176	82.3601	81.2177	84.0965	90.2251	97.9613	105.2323	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	30.2030	29.2460	27.2587	24.5569	22.8029	20.3330	18.2338	20.9235	21.8792	24.6756	27.8331	29.2500	(72)
Total internal gains													
	192.4491	191.5371	185.0431	174.4905	163.6451	153.2794	146.5955	149.2402	154.7025	165.3497	177.5987	186.9114	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	1.6600	19.6403	0.6300	0.7000	0.7700	9.9639	(76)
South	4.8700	46.7521	0.6300	0.7000	0.7700	69.5827	(78)
West	2.3100	19.6403	0.6300	0.7000	0.7700	13.8654	(80)

Solar gains	93.4120	160.5736	221.9313	276.0277	308.1802	304.9946	294.4839	270.9869	240.9246	178.2277	112.1915	79.7219	(83)
Total gains	285.8610	352.1107	406.9744	450.5182	471.8253	458.2740	441.0794	420.2271	395.6271	343.5774	289.7902	266.6333	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	40.0733	40.1742	40.2736	40.7472	40.8371	41.2606	41.2606	41.3400	41.0965	40.8371	40.6557	40.4679	
alpha	3.6716	3.6783	3.6849	3.7165	3.7225	3.7507	3.7507	3.7560	3.7398	3.7225	3.7104	3.6979	
util living area													
	0.9933	0.9852	0.9682	0.9289	0.8496	0.7113	0.5566	0.5985	0.8051	0.9485	0.9873	0.9948	(86)
MIT	19.2245	19.4688	19.8214	20.2501	20.6175	20.8668	20.9602	20.9472	20.7730	20.2769	19.6655	19.1840	(87)
Th 2	19.5173	19.5204	19.5235	19.5378	19.5405	19.5530	19.5530	19.5553	19.5482	19.5405	19.5350	19.5294	(88)
util rest of house													
	0.9909	0.9801	0.9566	0.9012	0.7880	0.5934	0.3908	0.4339	0.7064	0.9225	0.9819	0.9930	(89)
MIT 2	17.9584	18.2021	18.5500	18.9704	19.2997	19.4975	19.5448	19.5429	19.4366	19.0076	18.4101	17.9270	(90)
Living area fraction									fLA = Living area / (4) =			0.5900	(91)
MIT	18.7055	18.9495	19.3002	19.7255	20.0773	20.3055	20.3799	20.3715	20.2251	19.7565	19.1508	18.6687	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7055	18.9495	19.3002	19.7255	20.0773	20.3055	20.3799	20.3715	20.2251	19.7565	19.1508	18.6687	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9892	0.9775	0.9544	0.9054	0.8133	0.6590	0.4893	0.5314	0.7574	0.9272	0.9800	0.9915	(94)
Useful gains	282.7692	344.1726	388.4312	407.8951	383.7549	301.9886	215.8137	223.3143	299.6405	318.5705	283.9973	264.3630	(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													
	882.9676	858.9874	780.6722	652.5647	503.8723	339.6473	225.0199	235.9702	366.0872	550.7437	728.0618	878.1961	(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													
	446.5477	345.9556	291.8273	176.1621	89.3674	0.0000	0.0000	0.0000	0.0000	172.7369	319.7265	456.6919	(98)
Space heating												2299.0152	(98)
Space heating per m2											(98) / (4) =	64.9990	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	559.5831	440.5229	451.5599	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8069	0.8747	0.8543	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	451.5009	385.3361	385.7769	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	585.2785	564.3260	540.5900	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	96.3199	133.1685	115.1809	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												344.6693	(104)
Cooled fraction									fC = cooled area / (4) =			1.0000	(105)
Intermittency factor (Table 10b)													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	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	24.0800	33.2921	28.7952	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												86.1673 (107)
Space cooling per m2												2.4362 (108)
Energy for space heating												64.9990 (99)
Energy for space cooling												2.4362 (108)
Total												67.4352 (109)
Target Fabric Energy Efficiency (TFEE)												77.6 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3424	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2910	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	6.6000	6.2000	5.9000	5.1000	4.9000	4.6000	4.2000	4.3000	4.9000	5.4000	5.9000	5.7000	(22)
Wind factor	1.6500	1.5500	1.4750	1.2750	1.2250	1.1500	1.0500	1.0750	1.2250	1.3500	1.4750	1.4250	(22a)
Adj infilt rate	0.4802	0.4511	0.4293	0.3711	0.3565	0.3347	0.3056	0.3129	0.3565	0.3929	0.4293	0.4147	(22b)
Effective ac	0.6153	0.6017	0.5921	0.5688	0.5636	0.5560	0.5467	0.5489	0.5636	0.5772	0.5921	0.5860	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	66.7400	16.5900	50.1500	0.2300	11.5345	9.0000	451.3500	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			137.4800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	47.6768			(33)
Party Wall 1			8.0100	0.0000	0.0000	20.0000	160.2000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		4274.7300	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							120.8575	(35)
Thermal bridges (User defined value 0.052 * total exposed area)							7.1490	(36)
Total fabric heat loss					(33) + (36) =		54.8258	(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	21.9764	21.4924	21.1492	20.3173	20.1282	19.8588	19.5260	19.6063	20.1282	20.6151	21.1492	20.9299	(38)
Heat transfer coeff	76.8022	76.3182	75.9750	75.1430	74.9540	74.6845	74.3518	74.4321	74.9540	75.4408	75.9750	75.7557	(39)
Average = Sum(39)m / 12 =												75.3989	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1714	2.1577	2.1480	2.1245	2.1191	2.1115	2.1021	2.1044	2.1191	2.1329	2.1480	2.1418	(40)
HLP (average)												2.1317	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895	(42)
Average daily hot water use (litres/day)	64.8244	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0500	(48)

CALCULATION OF HEAT DEMAND 09 Jan 2014

```
  Temperature factor from Table 2b                                                                                0.5400 (49)
Enter (49) or (54) in (55)                                                                                        0.5670 (55)
Total storage loss
              17.5770    15.8760    17.5770    17.0100    17.5770    17.0100    17.5770    17.5770    17.0100    17.5770    17.0100    17.5770 (56)
If cylinder contains dedicated solar storage
              17.5770    15.8760    17.5770    17.0100    17.5770    17.0100    17.5770    17.5770    17.0100    17.5770    17.0100    17.5770 (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
              146.5855   129.3734   136.2768   122.7267   120.6763   108.4151   104.6790   114.0963   113.6538   127.2329   133.8273   143.2488 (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
              146.5855   129.3734   136.2768   122.7267   120.6763   108.4151   104.6790   114.0963   113.6538   127.2329   133.8273   143.2488 (64)
                                                                                    Total per year (kWh/year) = Sum(64)m =   1500.7919 (64)
RHI water heating demand                                                                                          1501 (64)
Heat gains from water heating, kWh/month
              67.8321    60.2614    64.4045    59.2832    59.2173    54.5246    53.8982    57.0294    56.2664    61.3974    62.9741    66.7226 (65)


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5. Internal gains (see Table 5 and 5a)
------------------------------------------------------------------------------------------------------------------------
Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m         77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              24.5364    21.7931    17.7233    13.4177    10.0299     8.4676     9.1496    11.8930    15.9627    20.2684    23.6562    25.2184 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              164.3130   166.0181   161.7214   152.5743   141.0276   130.1755   122.9255   121.2205   125.5172   134.6643   146.2109   157.0631 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262 (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)
              -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780 (71)
Water heating gains (Table 5)
              91.1722    89.6747    86.5651    82.3377    79.5931    75.7286    72.4438    76.6525    78.1478    82.5233    87.4640    89.6810 (72)
Total internal gains
              352.8368   350.3010   338.8250   321.1448   303.4658   287.1868   277.3341   282.5811   292.4429   310.2711   330.1462   344.7776 (73)


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6. Solar gains
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[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
------------------------------------------------------------------------------------------------------------------------
East                                    3.1200           19.0327            0.7200           0.7000           0.7700           20.7404 (76)
South                                   9.1400           46.2981            0.7200           0.7000           0.7700          147.7996 (78)
West                                    4.3300           19.0327            0.7200           0.7000           0.7700           28.7840 (80)
------------------------------------------------------------------------------------------------------------------------

Solar gains   197.3240   339.6308   491.5717   618.5759   690.7157   658.1417   642.6356   597.9534   527.3562   379.4219   231.5438   166.7843 (83)
Total gains   550.1608   689.9318   830.3967   939.7207   994.1815   945.3285   919.9697   880.5344   819.7991   689.6930   561.6900   511.5619 (84)


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7. Mean internal temperature (heating season)
------------------------------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                     21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau           15.4608    15.5589    15.6292    15.8022    15.8421    15.8992    15.9704    15.9531    15.8421    15.7398    15.6292    15.6744
alpha          2.0307     2.0373     2.0419     2.0535     2.0561     2.0599     2.0647     2.0635     2.0561     2.0493     2.0419     2.0450
util living area
               0.9004     0.8534     0.7879     0.7050     0.6145     0.5252     0.4382     0.4585     0.5893     0.7556     0.8686     0.9122 (86)

MIT           17.9980    18.4684    19.0732    19.7072    20.2099    20.5727    20.7733    20.7482    20.4419    19.7025    18.6844    17.8902 (87)
Th 2          19.9143    19.9211    19.9260    19.9378    19.9404    19.9442    19.9489    19.9478    19.9404    19.9335    19.9260    19.9291 (88)
util rest of house
               0.8903     0.8394     0.7686     0.6787     0.5794     0.4776     0.3794     0.3993     0.5427     0.7271     0.8538     0.9032 (89)
MIT 2         17.1779    17.6386    18.2242    18.8351    19.3042    19.6342    19.8058    19.7867    19.5245    18.8456    17.8620    17.0824 (90)
Living area fraction                                                                                fLA = Living area / (4) =      0.5900 (91)
MIT           17.6618    18.1282    18.7251    19.3497    19.8386    20.1880    20.3767    20.3540    20.0658    19.3512    18.3473    17.5590 (92)
Temperature adjustment                                                                                            0.0000
adjusted MIT  17.6618    18.1282    18.7251    19.3497    19.8386    20.1880    20.3767    20.3540    20.0658    19.3512    18.3473    17.5590 (93)


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8. Space heating requirement
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                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation    0.8638     0.8117     0.7440     0.6627     0.5758     0.4891     0.4041     0.4230     0.5485     0.7097     0.8275     0.8779 (94)
Useful gains 475.2516   560.0416   617.8534   622.7948   572.4369   462.3395   371.7319   372.4334   449.6622   489.4599   464.8062   449.1237 (95)
Ext temp.      3.1000     3.6000     5.0000     7.2000     9.8000    12.7000    14.7000    14.6000    12.4000     9.1000     5.7000     2.9000 (96)
Heat loss rate W
             1118.3761  1108.7664  1042.7666   912.9660   752.4338   559.2355   422.0725   428.2817   574.5819   773.3573   960.8751  1110.5048 (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
              478.4846   368.7431   316.1354   208.9233   133.9177     0.0000     0.0000     0.0000     0.0000   211.2197   357.1696   492.0675 (98)
Space heating                                                                                                    2566.6608 (98)
RHI space heating demand                                                                                            2567 (98)


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CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3424	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2910	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3711	0.3638	0.3565	0.3201	0.3129	0.2765	0.2765	0.2692	0.2910	0.3129	0.3274	0.3420	(22b)
Effective ac	0.5688	0.5662	0.5636	0.5512	0.5489	0.5382	0.5382	0.5362	0.5424	0.5489	0.5536	0.5585	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	66.7400	16.5900	50.1500	0.2300	11.5345	9.0000	451.3500	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			137.4800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	47.6768			(33)
Party Wall 1			8.0100	0.0000	0.0000	20.0000	160.2000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		4274.7300	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							120.8575	(35)
Thermal bridges (User defined value 0.052 * total exposed area)							7.1490	(36)
Total fabric heat loss					(33) + (36) =		54.8258	(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	20.3173	20.2218	20.1282	19.6886	19.6063	19.2235	19.2235	19.1526	19.3709	19.6063	19.7727	19.9467	(38)
Heat transfer coeff	75.1430	75.0476	74.9540	74.5144	74.4321	74.0492	74.0492	73.9783	74.1967	74.4321	74.5985	74.7725	(39)
Average = Sum(39)m / 12 =												74.5140	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1245	2.1218	2.1191	2.1067	2.1044	2.0936	2.0936	2.0916	2.0977	2.1044	2.1091	2.1140	(40)
HLP (average)												2.1067	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895	(42)
Average daily hot water use (litres/day)	64.8244	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0500	(48)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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  Temperature factor from Table 2b                                                                                0.5400 (49)
Enter (49) or (54) in (55)                                                                                        0.5670 (55)
Total storage loss
              17.5770    15.8760    17.5770    17.0100    17.5770    17.0100    17.5770    17.5770    17.0100    17.5770    17.0100    17.5770 (56)
If cylinder contains dedicated solar storage
              17.5770    15.8760    17.5770    17.0100    17.5770    17.0100    17.5770    17.5770    17.0100    17.5770    17.0100    17.5770 (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
             146.5855   129.3734   136.2768   122.7267   120.6763   108.4151   104.6790   114.0963   113.6538   127.2329   133.8273   143.2488 (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
             146.5855   129.3734   136.2768   122.7267   120.6763   108.4151   104.6790   114.0963   113.6538   127.2329   133.8273   143.2488 (64)
                                                                                  Total per year (kWh/year) = Sum(64)m =   1500.7919 (64)
Heat gains from water heating, kWh/month
              67.8321    60.2614    64.4045    59.2832    59.2173    54.5246    53.8982    57.0294    56.2664    61.3974    62.9741    66.7226 (65)


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5. Internal gains (see Table 5 and 5a)
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Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m         77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              24.5364    21.7931    17.7233    13.4177    10.0299     8.4676     9.1496    11.8930    15.9627    20.2684    23.6562    25.2184 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             164.3130   166.0181   161.7214   152.5743   141.0276   130.1755   122.9255   121.2205   125.5172   134.6643   146.2109   157.0631 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262 (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)
             -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780 (71)
Water heating gains (Table 5)
              91.1722    89.6747    86.5651    82.3377    79.5931    75.7286    72.4438    76.6525    78.1478    82.5233    87.4640    89.6810 (72)
Total internal gains
             352.8368   350.3010   338.8250   321.1448   303.4658   287.1868   277.3341   282.5811   292.4429   310.2711   330.1462   344.7776 (73)


-------------------------------------------------------------------------------------------------------------
6. Solar gains
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[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
-------------------------------------------------------------------------------------------------------------
East                                   3.1200             19.6403            0.7200           0.7000         0.7700            21.4026 (76)
South                                  9.1400             46.7521            0.7200           0.7000         0.7700           149.2488 (78)
West                                   4.3300             19.6403            0.7200           0.7000         0.7700            29.7029 (80)
-------------------------------------------------------------------------------------------------------------

Solar gains   200.3542   344.4042   476.0033   592.0262   660.9841   654.1505   631.6077   581.2134   516.7390   382.2683   240.6332   170.9913 (83)
Total gains   553.1910   694.7052   814.8283   913.1710   964.4499   941.3373   908.9418   863.7945   809.1819   692.5395   570.7794   515.7689 (84)


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7. Mean internal temperature (heating season)
-------------------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                     21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau           15.8022    15.8223    15.8421    15.9355    15.9531    16.0356    16.0356    16.0510    16.0037    15.9531    15.9175    15.8805
alpha          2.0535     2.0548     2.0561     2.0624     2.0635     2.0690     2.0690     2.0701     2.0669     2.0635     2.0612     2.0587
util living area
               0.8867     0.8329     0.7635     0.6692     0.5576     0.4346     0.3297     0.3571     0.5131     0.7103     0.8435     0.8991 (86)

MIT           18.3612    18.8249    19.3937    19.9926    20.4641    20.7748    20.9091    20.8893    20.6638    20.0211    19.0754    18.2574 (87)
Th 2          19.9378    19.9391    19.9404    19.9466    19.9478    19.9532    19.9532    19.9542    19.9511    19.9478    19.9455    19.9430 (88)
util rest of house
               0.8748     0.8165     0.7410     0.6379     0.5150     0.3773     0.2594     0.2859     0.4559     0.6751     0.8252     0.8883 (89)
MIT 2         17.5518    17.9997    18.5452    19.1125    19.5412    19.8098    19.9096    19.8985    19.7246    19.1562    18.2573    17.4547 (90)
Living area fraction                                                                                fLA = Living area / (4) =      0.5900 (91)
MIT           18.0294    18.4866    19.0459    19.6318    20.0858    20.3792    20.4993    20.4831    20.2787    19.6665    18.7400    17.9283 (92)
Temperature adjustment                                                                                           0.0000
adjusted MIT  18.0294    18.4866    19.0459    19.6318    20.0858    20.3792    20.4993    20.4831    20.2787    19.6665    18.7400    17.9283 (93)


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8. Space heating requirement
-------------------------------------------------------------------------------------------------------------

                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation    0.8484     0.7902     0.7196     0.6279     0.5208     0.4013     0.2968     0.3228     0.4746     0.6648     0.8004     0.8626 (94)
Useful gains 469.3374   548.9322   586.3611   573.3392   502.3200   377.8007   269.8136   278.8247   384.0088   460.4153   456.8792   444.9164 (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
            1031.6687  1019.6396   940.3633   799.6758   624.1702   427.9436   288.7427   302.0643   458.4425   674.8393   868.3251  1026.4995 (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
              418.3745   316.3154   263.3777   162.9623    90.6566     0.0000     0.0000     0.0000     0.0000   159.5315   296.2411   432.6978 (98)
Space heating                                                                                                   2140.1568 (98)
Space heating per m2                                                                                 (98) / (4) =     60.5077 (99)


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8c. Space cooling requirement
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CALCULATION OF ENERGY RATINGS 09 Jan 2014

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	175.1000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1222.2483	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	418.3745	316.3154	263.3777	162.9623	90.6566	0.0000	0.0000	0.0000	0.0000	159.5315	296.2411	432.6978	(98)
Space heating efficiency (main heating system 1)	175.1000	175.1000	175.1000	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175.1000	175.1000	(210)
Space heating fuel (main heating system)	238.9346	180.6484	150.4156	93.0681	51.7742	0.0000	0.0000	0.0000	0.0000	91.1088	169.1839	247.1147	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
Efficiency of water heater												175.1000	(216)
(217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(217)
Fuel for water heating, kWh/month	83.7153	73.8854	77.8280	70.0895	68.9185	61.9161	59.7824	65.1607	64.9080	72.6630	76.4290	81.8097	(219)
Water heating fuel used												857.1056	(219)
Annual totals kWh/year													
Space heating fuel - main system												1222.2483	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
Total electricity for the above, kWh/year												30.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Total delivered energy for all uses												2282.6824	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1222.2483	13.1900	161.2145	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	857.1056	13.1900	113.0522	(247)
Pumps and fans for heating	30.0000	13.1900	3.9570	(249)
Energy for lighting	173.3285	13.1900	22.8620	(250)
Additional standing charges			0.0000	(251)
Total energy cost			301.0858	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.5734	(257)
SAP value		78.0507	
SAP rating (Section 12)		78	(258)
SAP band		C	

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	1222.2483	0.5190	634.3469	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	857.1056	0.5190	444.8378	(264)
Space and water heating			1079.1847	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Total kg/year			1184.7122	(272)
CO2 emissions per m2			33.4900	(273)
EI value			80.2474	
EI rating			80	(274)
EI band			C	

Calculation of stars for heating and DHW

Main heating energy efficiency	13.19 × (1 + 0.29 × 0.00) / 1.7510 = 7.533, stars = 2
Main heating environmental impact	0.519 × (1 + 0.29 × 0.00) / 1.7510 = 0.2964, stars = 4
Water heating energy efficiency	13.19 / 1.7510 = 7.533, stars = 2
Water heating environmental impact	0.519 / 1.7510 = 0.2964, stars = 4

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3424	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2910	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	6.6000	6.2000	5.9000	5.1000	4.9000	4.6000	4.2000	4.3000	4.9000	5.4000	5.9000	5.7000	(22)
Wind factor	1.6500	1.5500	1.4750	1.2750	1.2250	1.1500	1.0500	1.0750	1.2250	1.3500	1.4750	1.4250	(22a)
Adj infilt rate	0.4802	0.4511	0.4293	0.3711	0.3565	0.3347	0.3056	0.3129	0.3565	0.3929	0.4293	0.4147	(22b)
Effective ac	0.6153	0.6017	0.5921	0.5688	0.5636	0.5560	0.5467	0.5489	0.5636	0.5772	0.5921	0.5860	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	66.7400	16.5900	50.1500	0.2300	11.5345	9.0000	451.3500	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			137.4800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	47.6768			(33)
Party Wall 1			8.0100	0.0000	0.0000	20.0000	160.2000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		4274.7300	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							120.8575	(35)
Thermal bridges (User defined value 0.052 * total exposed area)							7.1490	(36)
Total fabric heat loss					(33) + (36) =		54.8258	(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	21.9764	21.4924	21.1492	20.3173	20.1282	19.8588	19.5260	19.6063	20.1282	20.6151	21.1492	20.9299	(38)
Heat transfer coeff	76.8022	76.3182	75.9750	75.1430	74.9540	74.6845	74.3518	74.4321	74.9540	75.4408	75.9750	75.7557	(39)
Average = Sum(39)m / 12 =												75.3989	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1714	2.1577	2.1480	2.1245	2.1191	2.1115	2.1021	2.1044	2.1191	2.1329	2.1480	2.1418	(40)
HLP (average)												2.1317	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895	(42)
Average daily hot water use (litres/day)	64.8244	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0500	(48)

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

Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.5670	(55)
Total storage loss													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(56)
If cylinder contains dedicated solar storage													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(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													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(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													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
								Total per year (kWh/year) = Sum(64)m =				1500.7919	(64)
Heat gains from water heating, kWh/month													
	67.8321	60.2614	64.4045	59.2832	59.2173	54.5246	53.8982	57.0294	56.2664	61.3974	62.9741	66.7226	(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	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.5364	21.7931	17.7233	13.4177	10.0299	8.4676	9.1496	11.8930	15.9627	20.2684	23.6562	25.2184	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	164.3130	166.0181	161.7214	152.5743	141.0276	130.1755	122.9255	121.2205	125.5172	134.6643	146.2109	157.0631	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	91.1722	89.6747	86.5651	82.3377	79.5931	75.7286	72.4438	76.6525	78.1478	82.5233	87.4640	89.6810	(72)
Total internal gains													
	352.8368	350.3010	338.8250	321.1448	303.4658	287.1868	277.3341	282.5811	292.4429	310.2711	330.1462	344.7776	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.1200	19.0327	0.7200	0.7000	0.7700	20.7404	(76)
South	9.1400	46.2981	0.7200	0.7000	0.7700	147.7996	(78)
West	4.3300	19.0327	0.7200	0.7000	0.7700	28.7840	(80)

Solar gains	197.3240	339.6308	491.5717	618.5759	690.7157	658.1417	642.6356	597.9534	527.3562	379.4219	231.5438	166.7843	(83)
Total gains	550.1608	689.9318	830.3967	939.7207	994.1815	945.3285	919.9697	880.5344	819.7991	689.6930	561.6900	511.5619	(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	15.4608	15.5589	15.6292	15.8022	15.8421	15.8992	15.9704	15.9531	15.8421	15.7398	15.6292	15.6744	
alpha	2.0307	2.0373	2.0419	2.0535	2.0561	2.0599	2.0647	2.0635	2.0561	2.0493	2.0419	2.0450	
util living area													
	0.9004	0.8534	0.7879	0.7050	0.6145	0.5252	0.4382	0.4585	0.5893	0.7556	0.8686	0.9122	(86)
MIT	17.9980	18.4684	19.0732	19.7072	20.2099	20.5727	20.7733	20.7482	20.4419	19.7025	18.6844	17.8902	(87)
Th 2	19.9143	19.9211	19.9260	19.9378	19.9404	19.9442	19.9489	19.9478	19.9404	19.9335	19.9260	19.9291	(88)
util rest of house													
	0.8903	0.8394	0.7686	0.6787	0.5794	0.4776	0.3794	0.3993	0.5427	0.7271	0.8538	0.9032	(89)
MIT 2	17.1779	17.6386	18.2242	18.8351	19.3042	19.6342	19.8058	19.7867	19.5245	18.8456	17.8620	17.0824	(90)
Living area fraction										fLA = Living area / (4) =		0.5900	(91)
MIT	17.6618	18.1282	18.7251	19.3497	19.8386	20.1880	20.3767	20.3540	20.0658	19.3512	18.3473	17.5590	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.6618	18.1282	18.7251	19.3497	19.8386	20.1880	20.3767	20.3540	20.0658	19.3512	18.3473	17.5590	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8638	0.8117	0.7440	0.6627	0.5758	0.4891	0.4041	0.4230	0.5485	0.7097	0.8275	0.8779	(94)
Useful gains	475.2516	560.0416	617.8534	622.7948	572.4369	462.3395	371.7319	372.4334	449.6622	489.4599	464.8062	449.1237	(95)
Ext temp.	3.1000	3.6000	5.0000	7.2000	9.8000	12.7000	14.7000	14.6000	12.4000	9.1000	5.7000	2.9000	(96)
Heat loss rate W													
	1118.3761	1108.7664	1042.7666	912.9660	752.4338	559.2355	422.0725	428.2817	574.5819	773.3573	960.8751	1110.5048	(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													
	478.4846	368.7431	316.1354	208.9233	133.9177	0.0000	0.0000	0.0000	0.0000	211.2197	357.1696	492.0675	(98)
Space heating												2566.6608	(98)
Space heating per m2											(98) / (4) =	72.5660	(99)

8c. Space cooling requirement

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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 %)	175.1000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1465.8257	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	478.4846	368.7431	316.1354	208.9233	133.9177	0.0000	0.0000	0.0000	0.0000	211.2197	357.1696	492.0675	(98)
Space heating efficiency (main heating system 1)													
	175.1000	175.1000	175.1000	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175.1000	175.1000	(210)
Space heating fuel (main heating system)													
	273.2636	210.5900	180.5456	119.3165	76.4807	0.0000	0.0000	0.0000	0.0000	120.6280	203.9804	281.0208	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
Efficiency of water heater												175.1000	(216)
(217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(217)
Fuel for water heating, kWh/month													
	83.7153	73.8854	77.8280	70.0895	68.9185	61.9161	59.7824	65.1607	64.9080	72.6630	76.4290	81.8097	(219)
Water heating fuel used												857.1056	(219)
Annual totals kWh/year													
Space heating fuel - main system												1465.8257	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
Total electricity for the above, kWh/year												30.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Total delivered energy for all uses												2526.2598	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1465.8257	18.7000	274.1094	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	857.1056	18.7000	160.2787	(247)
Pumps and fans for heating	30.0000	18.7000	5.6100	(249)
Energy for lighting	173.3285	18.7000	32.4124	(250)
Additional standing charges			0.0000	(251)
Total energy cost			472.4106	(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	1465.8257	0.5190	760.7635	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	857.1056	0.5190	444.8378	(264)
Space and water heating			1205.6013	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Total kg/year			1311.1288	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	1465.8257	3.0700	4500.0849	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	857.1056	3.0700	2631.3142	(264)
Space and water heating			7131.3991	(265)
Pumps and fans	30.0000	3.0700	92.1000	(267)
Energy for lighting	173.3285	3.0700	532.1186	(268)
Primary energy kWh/year			7755.6177	(272)
Primary energy kWh/m2/year			219.2711	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating:	C 78
Current environmental impact rating:	C 80

(For testing purposes):

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 3.6	-£ 71	-196 kg (15.0%)
U Solar photovoltaic panels	+ 16.6	-£ 326	-906 kg (81.3%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£71	5.54 kg/m²	B 82	B 84
Solar photovoltaic panels	£326	25.62 kg/m²	A 98	A 98
Total Savings	£397	31.16 kg/m²		

Potential energy efficiency rating: A 98
Potential environmental impact rating: A 98

Fuel prices for cost data on this page from database revision number 465 TEST (04 Sep 2020)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£472	£402	£71
Space heating	£280	£280	-£0
Water heating	£160	£89	£71
Lighting	£32	£32	£0
Generated (PV)	-£0	-£326	£326
Total cost of fuels	£472	£76	£397
Total cost of uses	£472	£75	£397
Delivered energy	71 kWh/m²	11 kWh/m²	60 kWh/m²
Carbon dioxide emissions	1.3 tonnes	0.2 tonnes	1.1 tonnes
CO2 emissions per m²	37 kg/m²	6 kg/m²	31 kg/m²
Primary energy	219 kWh/m²	35 kWh/m²	184 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3424	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2910	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3711	0.3638	0.3565	0.3201	0.3129	0.2765	0.2765	0.2692	0.2910	0.3129	0.3274	0.3420	(22b)
Effective ac	0.5688	0.5662	0.5636	0.5512	0.5489	0.5382	0.5382	0.5362	0.5424	0.5489	0.5536	0.5585	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	66.7400	16.5900	50.1500	0.2300	11.5345	9.0000	451.3500	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			137.4800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	47.6768			(33)
Party Wall 1			8.0100	0.0000	0.0000	20.0000	160.2000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		4274.7300	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							120.8575	(35)
Thermal bridges (User defined value 0.052 * total exposed area)							7.1490	(36)
Total fabric heat loss					(33) + (36) =		54.8258	(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	20.3173	20.2218	20.1282	19.6886	19.6063	19.2235	19.2235	19.1526	19.3709	19.6063	19.7727	19.9467	(38)
Heat transfer coeff	75.1430	75.0476	74.9540	74.5144	74.4321	74.0492	74.0492	73.9783	74.1967	74.4321	74.5985	74.7725	(39)
Average = Sum(39)m / 12 =												74.5140	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1245	2.1218	2.1191	2.1067	2.1044	2.0936	2.0936	2.0916	2.0977	2.1044	2.1091	2.1140	(40)
HLP (average)												2.1067	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895	(42)
Average daily hot water use (litres/day)	64.8244	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0500	(48)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.5670	(55)
Total storage loss													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(56)
If cylinder contains dedicated solar storage													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(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													
	146.5855	129.3734	134.8811	115.9731	107.8819	95.8084	91.6521	101.9999	108.2509	125.8372	133.8273	143.2488	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.7781	(H8)
Utilisation factor												0.4302	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												64.8244	(H14)
Volume ratio Veff/V												1.1570	(H15)
Solar storage volume factor												1.0000	(H16)
Solar input												-685.9569	(H17)
Solar input	-19.8914	-33.1930	-56.5315	-75.7633	-93.5992	-92.0229	-90.8068	-79.3384	-62.1378	-42.4328	-23.5940	-16.6457	(63)
								Solar input (sum of months) = Sum(63)m =				-685.9569	(63)
Output from w/h													
	126.6941	96.1804	78.3496	40.2098	14.2827	3.7855	0.8453	22.6615	46.1131	83.4043	110.2332	126.6031	(64)
								Total per year (kWh/year) = Sum(64)m =				749.3626	(64)
Heat gains from water heating, kWh/month													
	67.8321	60.2614	63.2879	53.8803	48.9818	44.4392	43.4766	47.3523	51.9441	60.2808	62.9741	66.7226	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.5364	21.7931	17.7233	13.4177	10.0299	8.4676	9.1496	11.8930	15.9627	20.2684	23.6562	25.2184	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	164.3130	166.0181	161.7214	152.5743	141.0276	130.1755	122.9255	121.2205	125.5172	134.6643	146.2109	157.0631	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	91.1722	89.6747	85.0643	74.8337	65.8358	61.7211	58.4363	63.6455	72.1446	81.0225	87.4640	89.6810	(72)
Total internal gains													
	352.8368	350.3010	337.3242	313.6408	289.7085	273.1794	263.3266	269.5742	286.4397	308.7703	330.1462	344.7776	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.1200	19.6403	0.7200	0.7000	0.7700	21.4026	(76)
South	9.1400	46.7521	0.7200	0.7000	0.7700	149.2488	(78)
West	4.3300	19.6403	0.7200	0.7000	0.7700	29.7029	(80)

Solar gains	200.3542	344.4042	476.0033	592.0262	660.9841	654.1505	631.6077	581.2134	516.7390	382.2683	240.6332	170.9913	(83)
Total gains	553.1910	694.7052	813.3275	905.6670	950.6926	927.3299	894.9343	850.7876	803.1787	691.0387	570.7794	515.7689	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	15.8022	15.8223	15.8421	15.9355	15.9531	16.0356	16.0356	16.0510	16.0037	15.9531	15.9175	15.8805	
alpha	2.0535	2.0548	2.0561	2.0624	2.0635	2.0690	2.0690	2.0701	2.0669	2.0635	2.0612	2.0587	
util living area													
	0.8867	0.8329	0.7641	0.6719	0.5627	0.4396	0.3341	0.3617	0.5157	0.7110	0.8435	0.8991	(86)
MIT	18.3612	18.8249	19.3913	19.9840	20.4544	20.7697	20.9067	20.8866	20.6604	20.0190	19.0754	18.2574	(87)
Th 2	19.9378	19.9391	19.9404	19.9466	19.9478	19.9532	19.9532	19.9542	19.9511	19.9478	19.9455	19.9430	(88)
util rest of house													
	0.8748	0.8165	0.7415	0.6408	0.5201	0.3819	0.2630	0.2897	0.4584	0.6759	0.8252	0.8883	(89)
MIT 2	17.5518	17.9997	18.5429	19.1049	19.5333	19.8064	19.9084	19.8971	19.7221	19.1544	18.2573	17.4547	(90)
Living area fraction									fLA = Living area / (4) =			0.5900	(91)
MIT	18.0294	18.4866	19.0435	19.6236	20.0768	20.3748	20.4975	20.4809	20.2758	19.6646	18.7400	17.9283	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0294	18.4866	19.0435	19.6236	20.0768	20.3748	20.4975	20.4809	20.2758	19.6646	18.7400	17.9283	(93)

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8. Space heating requirement

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8484	0.7902	0.7201	0.6305	0.5255	0.4059	0.3008	0.3269	0.4770	0.6655	0.8004	0.8626	(94)
Useful gains	469.3374	548.9322	585.7060	570.9942	499.6240	376.4104	269.1950	278.1041	383.0896	459.8770	456.8792	444.9164	(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	1031.6687	1019.6396	940.1848	799.0626	623.5024	427.6196	288.6034	301.9009	458.2205	674.6963	868.3251	1026.4995	(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	418.3745	316.3154	263.7322	164.2093	92.1656	0.0000	0.0000	0.0000	0.0000	159.8256	296.2411	432.6978	(98)
Space heating												2143.5614	(98)
Space heating per m2											(98) / (4) =	60.6039	(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 %)	175.1000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1224.1927	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	418.3745	316.3154	263.7322	164.2093	92.1656	0.0000	0.0000	0.0000	0.0000	159.8256	296.2411	432.6978	(98)
Space heating efficiency (main heating system 1)	175.1000	175.1000	175.1000	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175.1000	175.1000	(210)
Space heating fuel (main heating system)	238.9346	180.6484	150.6181	93.7803	52.6360	0.0000	0.0000	0.0000	0.0000	91.2768	169.1839	247.1147	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	126.6941	96.1804	78.3496	40.2098	14.2827	3.7855	0.8453	22.6615	46.1131	83.4043	110.2332	126.6031	(64)
Efficiency of water heater												175.1000	(216)
(217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(217)
Fuel for water heating, kWh/month	72.3553	54.9288	44.7456	22.9639	8.1569	2.1619	0.4827	12.9420	26.3353	47.6324	62.9544	72.3033	(219)
Water heating fuel used												427.9626	(219)
Annual totals kWh/year													
Space heating fuel - main system												1224.1927	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												80.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =										-1727.2394		-1727.2394	(233)
Total delivered energy for all uses												178.2445	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1224.1927	13.1900	161.4710	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	427.9626	13.1900	56.4483	(247)
Pumps and fans for heating	30.0000	13.1900	3.9570	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	173.3285	13.1900	22.8620	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			23.5104	(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] =	0.1229	(257)
SAP value	98.2861	
SAP rating (Section 12)	98	(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	1224.1927	0.5190	635.3560	(261)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	427.9626	0.5190	222.1126 (264)
Space and water heating			857.4686 (265)
Pumps and fans	80.0000	0.5190	41.5200 (267)
Energy for lighting	173.3285	0.5190	89.9575 (268)
Energy saving/generation technologies			
PV Unit	-1727.2394	0.5190	-896.4372 (269)
Total kg/year			92.5089 (272)
CO2 emissions per m2			2.6200 (273)
EI value			98.4576
EI rating			98 (274)
EI band			A

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3424	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2910	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	6.6000	6.2000	5.9000	5.1000	4.9000	4.6000	4.2000	4.3000	4.9000	5.4000	5.9000	5.7000	(22)
Wind factor	1.6500	1.5500	1.4750	1.2750	1.2250	1.1500	1.0500	1.0750	1.2250	1.3500	1.4750	1.4250	(22a)
Adj infilt rate	0.4802	0.4511	0.4293	0.3711	0.3565	0.3347	0.3056	0.3129	0.3565	0.3929	0.4293	0.4147	(22b)
Effective ac	0.6153	0.6017	0.5921	0.5688	0.5636	0.5560	0.5467	0.5489	0.5636	0.5772	0.5921	0.5860	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	66.7400	16.5900	50.1500	0.2300	11.5345	9.0000	451.3500	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			137.4800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	47.6768			(33)
Party Wall 1			8.0100	0.0000	0.0000	20.0000	160.2000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		4274.7300	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							120.8575	(35)
Thermal bridges (User defined value 0.052 * total exposed area)							7.1490	(36)
Total fabric heat loss					(33) + (36) =		54.8258	(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	21.9764	21.4924	21.1492	20.3173	20.1282	19.8588	19.5260	19.6063	20.1282	20.6151	21.1492	20.9299	(38)
Heat transfer coeff	76.8022	76.3182	75.9750	75.1430	74.9540	74.6845	74.3518	74.4321	74.9540	75.4408	75.9750	75.7557	(39)
Average = Sum(39)m / 12 =												75.3989	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1714	2.1577	2.1480	2.1245	2.1191	2.1115	2.1021	2.1044	2.1191	2.1329	2.1480	2.1418	(40)
HLP (average)												2.1317	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895	(42)
Average daily hot water use (litres/day)	64.8244	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0500	(48)

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

Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.5670	(55)
Total storage loss													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(56)
If cylinder contains dedicated solar storage													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(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													
	146.5855	129.3734	134.8811	115.9731	107.8819	95.8084	91.6521	101.9999	108.2509	125.8372	133.8273	143.2488	(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												1091.0709	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1832.9992	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.7972	(H8)
Utilisation factor												0.4267	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												64.8244	(H14)
Volume ratio Veff/V												1.1570	(H15)
Solar storage volume factor												1.0000	(H16)
Solar input												-687.8113	(H17)
Solar input	-19.2686	-32.1683	-57.3554	-77.8632	-96.3853	-91.3308	-91.0993	-80.3442	-62.3188	-41.3797	-22.3236	-15.9741	(63)
								Solar input (sum of months) = Sum(63)m =				-687.8113	(63)
Output from w/h													
	127.3169	97.2050	77.5257	38.1099	11.4966	4.4776	0.5528	21.6557	45.9322	84.4575	111.5037	127.2747	(64)
								Total per year (kWh/year) = Sum(64)m =				747.5082	(64)
Heat gains from water heating, kWh/month													
	67.8321	60.2614	63.2879	53.8803	48.9818	44.4392	43.4766	47.3523	51.9441	60.2808	62.9741	66.7226	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.5364	21.7931	17.7233	13.4177	10.0299	8.4676	9.1496	11.8930	15.9627	20.2684	23.6562	25.2184	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	164.3130	166.0181	161.7214	152.5743	141.0276	130.1755	122.9255	121.2205	125.5172	134.6643	146.2109	157.0631	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	91.1722	89.6747	85.0643	74.8337	65.8358	61.7211	58.4363	63.6455	72.1446	81.0225	87.4640	89.6810	(72)
Total internal gains													
	352.8368	350.3010	337.3242	313.6408	289.7085	273.1794	263.3266	269.5742	286.4397	308.7703	330.1462	344.7776	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.1200	19.0327	0.7200	0.7000	0.7700	20.7404	(76)
South	9.1400	46.2981	0.7200	0.7000	0.7700	147.7996	(78)
West	4.3300	19.0327	0.7200	0.7000	0.7700	28.7840	(80)

Solar gains	197.3240	339.6308	491.5717	618.5759	690.7157	658.1417	642.6356	597.9534	527.3562	379.4219	231.5438	166.7843	(83)
Total gains	550.1608	689.9318	828.8959	932.2167	980.4241	931.3210	905.9623	867.5275	813.7959	688.1922	561.6900	511.5619	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	15.4608	15.5589	15.6292	15.8022	15.8421	15.8992	15.9704	15.9531	15.8421	15.7398	15.6292	15.6744	
alpha	2.0307	2.0373	2.0419	2.0535	2.0561	2.0599	2.0647	2.0635	2.0561	2.0493	2.0419	2.0450	
util living area													
	0.9004	0.8534	0.7884	0.7076	0.6194	0.5305	0.4433	0.4636	0.5919	0.7562	0.8686	0.9122	(86)
MIT	17.9980	18.4684	19.0705	19.6973	20.1973	20.5643	20.7682	20.7427	20.4369	19.7001	18.6844	17.8902	(87)
Th 2	19.9143	19.9211	19.9260	19.9378	19.9404	19.9442	19.9489	19.9478	19.9404	19.9335	19.9260	19.9291	(88)
util rest of house													
	0.8903	0.8394	0.7691	0.6813	0.5843	0.4828	0.3842	0.4040	0.5453	0.7278	0.8538	0.9032	(89)
MIT 2	17.1779	17.6386	18.2217	18.8262	19.2934	19.6277	19.8024	19.7829	19.5206	18.8434	17.8620	17.0824	(90)
Living area fraction									fLA = Living area / (4) =			0.5900	(91)
MIT	17.6618	18.1282	18.7225	19.3402	19.8267	20.1803	20.3722	20.3493	20.0613	19.3489	18.3473	17.5590	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.6618	18.1282	18.7225	19.3402	19.8267	20.1803	20.3722	20.3493	20.0613	19.3489	18.3473	17.5590	(93)

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8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8638	0.8117	0.7445	0.6652	0.5803	0.4939	0.4087	0.4276	0.5509	0.7103	0.8275	0.8779	(94)
Useful gains	475.2516	560.0416	617.1407	620.1076	568.9525	459.9979	370.3118	370.9456	448.3232	488.8257	464.8062	449.1237	(95)
Ext temp.	3.1000	3.6000	5.0000	7.2000	9.8000	12.7000	14.7000	14.6000	12.4000	9.1000	5.7000	2.9000	(96)
Heat loss rate W	1118.3761	1108.7664	1042.5693	912.2485	751.5424	558.6638	421.7404	427.9304	574.2442	773.1845	960.8751	1110.5048	(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	478.4846	368.7431	316.5189	210.3415	135.8469	0.0000	0.0000	0.0000	0.0000	211.5629	357.1696	492.0675	(98)
Space heating												2570.7350	(98)
Space heating per m2											(98) / (4) =	72.6812	(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 %)	175.1000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1468.1525	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	478.4846	368.7431	316.5189	210.3415	135.8469	0.0000	0.0000	0.0000	0.0000	211.5629	357.1696	492.0675	(98)
Space heating efficiency (main heating system 1)	175.1000	175.1000	175.1000	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175.1000	175.1000	(210)
Space heating fuel (main heating system)	273.2636	210.5900	180.7646	120.1265	77.5825	0.0000	0.0000	0.0000	0.0000	120.8241	203.9804	281.0208	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	127.3169	97.2050	77.5257	38.1099	11.4966	4.4776	0.5528	21.6557	45.9322	84.4575	111.5037	127.2747	(64)
Efficiency of water heater												175.1000	(216)
(217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(217)
Fuel for water heating, kWh/month	72.7109	55.5140	44.2751	21.7646	6.5657	2.5572	0.3157	12.3676	26.2320	48.2338	63.6800	72.6869	(219)
Water heating fuel used												426.9036	(219)
Annual totals kWh/year													
Space heating fuel - main system												1468.1525	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												80.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1091 * 0.80) =										-1745.7135		-1745.7135	(233)
Total delivered energy for all uses												402.6711	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1468.1525	18.7000	274.5445	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	426.9036	18.7000	79.8310	(247)
Pumps and fans for heating	30.0000	18.7000	5.6100	(249)
Pump for solar water heating	50.0000	18.7000	9.3500	(249)
Energy for lighting	173.3285	18.7000	32.4124	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-1745.7135	18.7000	-326.4484	(252)
Total energy cost			75.2995	(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	1468.1525	0.5190	761.9711	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	426.9036	0.5190	221.5630	(264)
Space and water heating			983.5341	(265)
Pumps and fans	80.0000	0.5190	41.5200	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Energy saving/generation technologies				
PV Unit	-1745.7135	0.5190	-906.0253	(269)
Total kg/year			208.9863	(272)

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

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	1468.1525	3.0700	4507.2281	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	426.9036	3.0700	1310.5940	(264)
Space and water heating			5817.8221	(265)
Pumps and fans	80.0000	3.0700	245.6000	(267)
Energy for lighting	173.3285	3.0700	532.1186	(268)
Energy saving/generation technologies				
PV Unit	-1745.7135	3.0700	-5359.3404	(269)
Primary energy kWh/year			1236.2003	(272)
Primary energy kWh/m2/year			34.9505	(273)

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

Overheating Calculation Input Data

Dwelling type	SemiDetached Bungalow
Number of storeys	1
Cross ventilation possible	Yes
SAP Region	North East England
Front of dwelling faces	East
Overshading	Average or unknown
Thermal mass parameter	120.9 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	6.00 (Windows fully open)

Overheating Calculation

Summer ventilation heat loss coefficient		214.30 (P1)
Transmission heat loss coefficient		54.83 (37)
Summer heat loss coefficient		269.13 (P2)

Overhangs

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

Solar shading

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

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
East	3.1200	111.2086	0.7200	0.7000	0.9000	141.6474
South	9.1400	110.4126	0.7200	0.7000	0.9000	411.9841
West	4.3300	111.2086	0.7200	0.7000	0.9000	196.5811
total:						750.2126

	Jun	Jul	Aug	
Solar gains	765	750	685	(P3)
Internal gains	284	274	280	
Total summer gains	1049	1025	964	(P5)
Summer gain/loss ratio	3.90	3.81	3.58	(P6)
Summer external temperature	13.80	15.80	15.60	
Thermal mass temperature increment (TMP = 120.9)	1.15	1.15	1.15	
Threshold temperature	18.85	20.76	20.34	(P7)
Likelihood of high internal temperature	Not significant	Slight	Not significant	

Assessment of likelihood of high internal temperature: Slight

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

Anderson Goddard Ltd

Property Reference	73940-WR07	**Issued on Date**	07/10/2020
Assessment Reference	001	**Prop Type Ref**	Semi
Property	Woodlands Room 7, Raithwaite Bay, WHITBY, YO21 3ST		

SAP Rating	78 C	**DER**	35.14	**TER**	40.98
Environmental	80 C	**% DER<TER**	14.25		
CO_2 Emissions (t/year)	1.31	**DFEE**	76.81	**TFEE**	77.07
General Requirements Compliance	Pass	**% DFEE<TFEE**	0.33		

Assessor Details	Mr. Paul Goddard, Anderson Goddard Limited, Tel: 0161 7757770, paul.goddard@andersongoddard.com	**Assessor ID**	B342-0001
Client			

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

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

Semi-Detached Bungalow, total floor area 35 m²

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

1a TER and DER
Fuel for main heating:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 40.98 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 35.14 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)77.1 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)76.8 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.23 (max. 0.30)	0.23 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.22 (max. 0.25)	0.22 (max. 0.70)	OK
Roof	0.18 (max. 0.20)	0.18 (max. 0.35)	OK
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated using user-specified y-value of 0.056

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

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4 Heating efficiency
Main heating system: Heat pump with radiators or underfloor - Electric
Air-to-water heat pump

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage Measured cylinder loss: 1.05 kWh/day
Permitted by DBSCG 1.70 OK
Primary pipework insulated: Yes OK

---
6 Controls
Space heating controls: Programmer and room thermostat OK

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

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

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8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (North East England): Slight OK
Based on:
Overshading: Average
Windows facing East: 3.12 m², No overhang
Windows facing South: 9.14 m², No overhang
Windows facing West: 4.33 m², No overhang
Air change rate: 8.00 ach
Blinds/curtains: None

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10 Key features
Party wall U-value 0.00 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3424	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2910	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3711	0.3638	0.3565	0.3201	0.3129	0.2765	0.2765	0.2692	0.2910	0.3129	0.3274	0.3420	(22b)
Effective ac	0.5688	0.5662	0.5636	0.5512	0.5489	0.5382	0.5382	0.5362	0.5424	0.5489	0.5536	0.5585	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	65.2400	16.5900	48.6500	0.2300	11.1895	9.0000	437.8500	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			135.9800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	47.3318			(33)
Party Wall 1			9.4900	0.0000	0.0000	20.0000	189.8000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	4290.8300 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		121.3127 (35)
Thermal bridges (User defined value 0.056 * total exposed area)		7.6149 (36)
Total fabric heat loss	(33) + (36) =	54.9467 (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	20.3173	20.2218	20.1282	19.6886	19.6063	19.2235	19.2235	19.1526	19.3709	19.6063	19.7727	19.9467	(38)
Heat transfer coeff	75.2640	75.1685	75.0749	74.6353	74.5530	74.1702	74.1702	74.0992	74.3176	74.5530	74.7194	74.8934	(39)
Average = Sum(39)m / 12 =												74.6349	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1279	2.1252	2.1226	2.1101	2.1078	2.0970	2.0970	2.0950	2.1011	2.1078	2.1125	2.1174	(40)
HLP (average)												2.1101	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895 (42)
Average daily hot water use (litres/day)	64.8244 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0500	(48)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.5670	(55)
Total storage loss													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(56)
If cylinder contains dedicated solar storage													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(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													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(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													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
								Total per year (kWh/year) = Sum(64)m =				1500.7919	(64)
Heat gains from water heating, kWh/month													
	67.8321	60.2614	64.4045	59.2832	59.2173	54.5246	53.8982	57.0294	56.2664	61.3974	62.9741	66.7226	(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	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	9.8146	8.7172	7.0893	5.3671	4.0119	3.3871	3.6598	4.7572	6.3851	8.1073	9.4625	10.0874	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	110.0897	111.2321	108.3533	102.2247	94.4885	87.2176	82.3601	81.2177	84.0965	90.2251	97.9613	105.2323	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	91.1722	89.6747	86.5651	82.3377	79.5931	75.7286	72.4438	76.6525	78.1478	82.5233	87.4640	89.6810	(72)
Total internal gains													
	256.4182	254.9658	247.3495	235.2713	223.4353	211.6749	203.8055	207.9691	213.9712	226.1975	240.2295	250.3424	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.1200	19.6403	0.7200	0.7000	0.7700	21.4026	(76)
South	9.1400	46.7521	0.7200	0.7000	0.7700	149.2488	(78)
West	4.3300	19.6403	0.7200	0.7000	0.7700	29.7029	(80)

Solar gains	200.3542	344.4042	476.0033	592.0262	660.9841	654.1505	631.6077	581.2134	516.7390	382.2683	240.6332	170.9913	(83)
Total gains	456.7724	599.3700	723.3528	827.2975	884.4194	865.8254	835.4132	789.1826	730.7102	608.4658	480.8627	421.3337	(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	15.8362	15.8563	15.8761	15.9696	15.9872	16.0698	16.0698	16.0851	16.0379	15.9872	15.9516	15.9146	
alpha	2.0557	2.0571	2.0584	2.0646	2.0658	2.0713	2.0713	2.0723	2.0692	2.0658	2.0634	2.0610	
util living area													
	0.9168	0.8654	0.7973	0.7027	0.5891	0.4636	0.3547	0.3853	0.5500	0.7512	0.8789	0.9277	(86)
MIT	18.1142	18.6175	19.2354	19.8876	20.4040	20.7457	20.8958	20.8724	20.6158	19.8989	18.8715	18.0063	(87)
Th 2	19.9360	19.9374	19.9387	19.9449	19.9461	19.9515	19.9515	19.9525	19.9494	19.9461	19.9437	19.9413	(88)
util rest of house													
	0.9074	0.8512	0.7765	0.6725	0.5464	0.4041	0.2802	0.3099	0.4917	0.7182	0.8637	0.9195	(89)
MIT 2	17.3113	17.8009	18.3971	19.0183	19.4909	19.7884	19.9011	19.8877	19.6880	19.0475	18.0626	17.2093	(90)
Living area fraction										fLA = Living area / (4) =		0.5900	(91)
MIT	17.7851	18.2827	18.8917	19.5313	20.0297	20.3532	20.4880	20.4687	20.2354	19.5499	18.5399	17.6796	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.7851	18.2827	18.8917	19.5313	20.0297	20.3532	20.4880	20.4687	20.2354	19.5499	18.5399	17.6796	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8833	0.8247	0.7531	0.6595	0.5499	0.4277	0.3192	0.3481	0.5084	0.7043	0.8389	0.8967	(94)
Useful gains	403.4597	494.2976	544.7578	545.6302	486.3769	370.3207	266.6907	274.7344	371.4879	428.5647	403.3789	377.7905	(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													
	1014.9392	1005.9579	930.3055	793.4666	621.0025	426.7194	288.3736	301.4884	455.9704	667.2416	854.7831	1009.5294	(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													
	454.9408	343.8358	286.8475	178.4422	100.1614	0.0000	0.0000	0.0000	0.0000	177.5756	325.0110	470.0138	(98)
Space heating												2336.8281	(98)
Space heating per m2											(98) / (4) =	66.0681	(99)

8c. Space cooling requirement

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	175.1000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1334.5677	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	454.9408	343.8358	286.8475	178.4422	100.1614	0.0000	0.0000	0.0000	0.0000	177.5756	325.0110	470.0138	(98)
Space heating efficiency (main heating system 1)													
	175.1000	175.1000	175.1000	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175.1000	175.1000	(210)
Space heating fuel (main heating system)													
	259.8177	196.3654	163.8193	101.9087	57.2024	0.0000	0.0000	0.0000	0.0000	101.4138	185.6145	268.4259	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
Efficiency of water heater												175.1000	(216)
(217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(217)
Fuel for water heating, kWh/month													
	83.7153	73.8854	77.8280	70.0895	68.9185	61.9161	59.7824	65.1607	64.9080	72.6630	76.4290	81.8097	(219)
Water heating fuel used												857.1056	(219)
Annual totals kWh/year													
Space heating fuel - main system												1334.5677	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
Total electricity for the above, kWh/year												30.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Total delivered energy for all uses												2395.0018	(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	1334.5677	0.5190	692.6407	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	857.1056	0.5190	444.8378	(264)
Space and water heating			1137.4785	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Total CO2, kg/year			1243.0060	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			35.1400	(273)

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

DER		35.1400	ZC1
Total Floor Area	TFA	35.3700	
Assumed number of occupants	N	1.2895	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		18.4441	ZC2
CO2 emissions from cooking, equation (L16)		4.2394	ZC3
Total CO2 emissions		57.8235	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		57.8235	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1848	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4348	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3696	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4712	0.4620	0.4527	0.4065	0.3973	0.3511	0.3511	0.3419	0.3696	0.3973	0.4158	0.4342	(22b)
Effective ac	0.6110	0.6067	0.6025	0.5826	0.5789	0.5616	0.5616	0.5584	0.5683	0.5789	0.5864	0.5943	(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 Opening Type (Uw = 1.40)			8.8400	1.3258	11.7197			(27)
GF			35.3700	0.1300	4.5981			(28b)
Main	65.2400	8.8400	56.4000	0.1800	10.1520			(29a)
Flat	35.3700		35.3700	0.1300	4.5981			(30)
Total net area of external elements Aum(A, m2)			135.9800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	31.0679			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.1326	(36)
Total fabric heat loss					(33) + (36) =		39.2005	(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	21.8234	21.6694	21.5185	20.8096	20.6770	20.0596	20.0596	19.9453	20.2974	20.6770	20.9453	21.2258	(38)
Heat transfer coeff	61.0239	60.8699	60.7190	60.0101	59.8775	59.2601	59.2601	59.1458	59.4979	59.8775	60.1458	60.4263	(39)
Average = Sum(39)m / 12 =												60.0095	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.7253	1.7209	1.7167	1.6966	1.6929	1.6754	1.6754	1.6722	1.6822	1.6929	1.7005	1.7084	(40)
HLP (average)												1.6966	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		1.2895 (42)
Average daily hot water use (litres/day)		64.8244 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.2538	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.6770	(55)
Total storage loss													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	20.9878	18.9567	20.9878	20.3108	20.9878	20.3108	20.9878	20.9878	20.3108	20.9878	20.3108	20.9878	(56)
If cylinder contains dedicated solar storage													
	20.9878	18.9567	20.9878	20.3108	20.9878	20.3108	20.9878	20.9878	20.3108	20.9878	20.3108	20.9878	(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													
	149.9962	132.4541	139.6876	126.0274	124.0870	111.7159	108.0898	117.5071	116.9546	130.6437	137.1280	146.6596	(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													
	149.9962	132.4541	139.6876	126.0274	124.0870	111.7159	108.0898	117.5071	116.9546	130.6437	137.1280	146.6596	(64)
								Total per year (kWh/year) = Sum(64)m =				1540.9510	(64)
Heat gains from water heating, kWh/month													
	70.5607	62.7260	67.1331	61.9238	61.9459	57.1652	56.6268	59.7581	58.9070	64.1260	65.6147	69.4513	(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	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	9.8146	8.7172	7.0893	5.3671	4.0119	3.3871	3.6598	4.7572	6.3851	8.1073	9.4625	10.0874	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	110.0897	111.2321	108.3533	102.2247	94.4885	87.2176	82.3601	81.2177	84.0965	90.2251	97.9613	105.2323	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	94.8397	93.3422	90.2326	86.0052	83.2606	79.3961	76.1113	80.3200	81.8153	86.1908	91.1315	93.3485	(72)
Total internal gains													
	260.0857	258.6333	251.0170	238.9388	227.1028	215.3424	207.4730	211.6366	217.6387	229.8650	243.8970	254.0099	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	1.6600	19.6403	0.6300	0.7000	0.7700	9.9639	(76)
South	4.8700	46.7521	0.6300	0.7000	0.7700	69.5827	(78)
West	2.3100	19.6403	0.6300	0.7000	0.7700	13.8654	(80)

Solar gains	93.4120	160.5736	221.9313	276.0277	308.1802	304.9946	294.4839	270.9869	240.9246	178.2277	112.1915	79.7219	(83)
Total gains	353.4977	419.2069	472.9484	514.9665	535.2830	520.3371	501.9569	482.6235	458.5633	408.0927	356.0886	333.7317	(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	40.2506	40.3524	40.4527	40.9306	41.0212	41.4486	41.4486	41.5287	41.2829	41.0212	40.8382	40.6487	
alpha	3.6834	3.6902	3.6968	3.7287	3.7347	3.7632	3.7632	3.7686	3.7522	3.7347	3.7225	3.7099	
util living area													
	0.9867	0.9746	0.9508	0.8994	0.8041	0.6516	0.4973	0.5334	0.7439	0.9178	0.9756	0.9891	(86)
MIT	19.3890	19.6256	19.9633	20.3651	20.6945	20.9026	20.9730	20.9645	20.8319	20.4003	19.8208	19.3489	(87)
Th 2	19.5228	19.5259	19.5289	19.5432	19.5459	19.5585	19.5585	19.5608	19.5536	19.5459	19.5405	19.5348	(88)
util rest of house													
	0.9822	0.9662	0.9341	0.8641	0.7346	0.5341	0.3449	0.3806	0.6376	0.8809	0.9659	0.9854	(89)
MIT 2	17.4749	17.8165	18.2974	18.8581	19.2749	19.5019	19.5507	19.5493	19.4398	18.9225	18.1115	17.4247	(90)
Living area fraction										fLA = Living area / (4) =		0.5900	(91)
MIT	18.6043	18.8839	19.2804	19.7473	20.1125	20.3284	20.3899	20.3843	20.2612	19.7945	19.1201	18.5601	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6043	18.8839	19.2804	19.7473	20.1125	20.3284	20.3899	20.3843	20.2612	19.7945	19.1201	18.5601	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9784	0.9614	0.9306	0.8698	0.7642	0.6001	0.4352	0.4709	0.6937	0.8884	0.9623	0.9820	(94)
Useful gains	345.8549	403.0363	440.1308	447.9308	409.0583	312.2569	218.4408	227.2908	318.1095	362.5425	342.6712	327.7360	(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													
	872.9039	851.2017	776.0117	650.9472	503.7197	339.4651	224.5912	235.6566	366.5793	550.5416	722.9584	867.7274	(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													
	392.1245	301.1671	249.8954	146.1718	70.4281	0.0000	0.0000	0.0000	0.0000	139.8714	273.8067	401.7536	(98)
Space heating												1975.2185	(98)
Space heating per m2											(98) / (4) =	55.8445	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2112.5332	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	392.1245	301.1671	249.8954	146.1718	70.4281	0.0000	0.0000	0.0000	0.0000	139.8714	273.8067	401.7536	(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)	419.3844	322.1039	267.2678	156.3335	75.3241	0.0000	0.0000	0.0000	0.0000	149.5950	292.8414	429.6829	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	149.9962	132.4541	139.6876	126.0274	124.0870	111.7159	108.0898	117.5071	116.9546	130.6437	137.1280	146.6596	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.2626	86.9392	86.3486	85.2101	83.3689	79.8000	79.8000	79.8000	79.8000	84.9960	86.6241	87.3672	(217)
Fuel for water heating, kWh/month	171.8906	152.3526	161.7717	147.9020	148.8410	139.9949	135.4509	147.2520	146.5596	153.7056	158.3024	167.8657	(219)
Water heating fuel used												1831.8890	(219)
Annual totals kWh/year													
Space heating fuel - main system												2112.5332	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Total delivered energy for all uses												4192.7507	(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	2112.5332	0.2160	456.3072	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1831.8890	0.2160	395.6880	(264)
Space and water heating			851.9952	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Total CO2, kg/m2/year			980.8777	(272)
Emissions per m2 for space and water heating			24.0881	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			2.5433	(272b)
Emissions per m2 for pumps and fans			1.1005	(272c)
Target Carbon Dioxide Emission Rate (TER) = (24.0881 * 1.55) + 2.5433 + 1.1005, rounded to 2 d.p.			40.9800	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000	/ (5) =	0.1848	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.4348	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3696	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4712	0.4620	0.4527	0.4065	0.3973	0.3511	0.3511	0.3419	0.3696	0.3973	0.4158	0.4342	(22b)
Effective ac	0.6110	0.6067	0.6025	0.5826	0.5789	0.5616	0.5616	0.5584	0.5683	0.5789	0.5864	0.5943	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	65.2400	16.5900	48.6500	0.2300	11.1895	9.0000	437.8500	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			135.9800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	47.3318			(33)
Party Wall 1			9.4900	0.0000	0.0000	20.0000	189.8000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		4290.8300	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							121.3127	(35)
Thermal bridges (User defined value 0.056 * total exposed area)							7.6149	(36)
Total fabric heat loss					(33) + (36) =		54.9467	(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	21.8234	21.6694	21.5185	20.8096	20.6770	20.0596	20.0596	19.9453	20.2974	20.6770	20.9453	21.2258	(38)
Heat transfer coeff	76.7701	76.6161	76.4652	75.7563	75.6237	75.0063	75.0063	74.8920	75.2441	75.6237	75.8920	76.1725	(39)
Average = Sum(39)m / 12 =												75.7557	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1705	2.1661	2.1619	2.1418	2.1381	2.1206	2.1206	2.1174	2.1273	2.1381	2.1457	2.1536	(40)
HLP (average)												2.1418	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		1.2895 (42)
Average daily hot water use (litres/day)		64.8244 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage

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

Heat gains from water heating, kWh/month

	22.4710	19.6533	20.2805	17.6810	16.9653	14.6398	13.5659	15.5671	15.7530	18.3586	20.0399	21.7620 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	(66)

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

	9.8146	8.7172	7.0893	5.3671	4.0119	3.3871	3.6598	4.7572	6.3851	8.1073	9.4625	10.0874 (67)

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

	110.0897	111.2321	108.3533	102.2247	94.4885	87.2176	82.3601	81.2177	84.0965	90.2251	97.9613	105.2323 (68)

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

	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473 (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)

	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780 (71)

Water heating gains (Table 5)

	30.2030	29.2460	27.2587	24.5569	22.8029	20.3330	18.2338	20.9235	21.8792	24.6756	27.8331	29.2500 (72)

Total internal gains

	192.4491	191.5371	185.0431	174.4905	163.6451	153.2794	146.5955	149.2402	154.7025	165.3497	177.5987	186.9114 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.1200	19.6403	0.7200	0.7000	0.7700	21.4026	(76)
South	9.1400	46.7521	0.7200	0.7000	0.7700	149.2488	(78)
West	4.3300	19.6403	0.7200	0.7000	0.7700	29.7029	(80)

Solar gains	200.3542	344.4042	476.0033	592.0262	660.9841	654.1505	631.6077	581.2134	516.7390	382.2683	240.6332	170.9913 (83)
Total gains	392.8033	535.9412	661.0464	766.5167	824.6292	807.4299	778.2032	730.4536	671.4416	547.6181	418.2319	357.9027 (84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	15.5255	15.5567	15.5874	15.7333	15.7609	15.8906	15.8906	15.9149	15.8404	15.7609	15.7052	15.6473	
alpha	2.0350	2.0371	2.0392	2.0489	2.0507	2.0594	2.0594	2.0610	2.0560	2.0507	2.0470	2.0432	
util living area	0.9358	0.8876	0.8225	0.7299	0.6175	0.4908	0.3791	0.4128	0.5834	0.7838	0.9034	0.9455	(86)
MIT	17.8831	18.4144	19.0702	19.7744	20.3333	20.7111	20.8792	20.8516	20.5610	19.7729	18.6787	17.7789	(87)
Th 2	19.2221	19.2249	19.2276	19.2405	19.2429	19.2541	19.2541	19.2562	19.2498	19.2429	19.2380	19.2329	(88)
util rest of house	0.9226	0.8660	0.7892	0.6793	0.5434	0.3851	0.2441	0.2760	0.4802	0.7295	0.8808	0.9342	(89)
MIT 2	16.5528	17.0638	17.6854	18.3391	18.8228	19.1225	19.2228	19.2137	19.0258	18.3701	17.3427	16.4585	(90)
Living area fraction									fLA = Living area / (4) =			0.5900	(91)
MIT	17.3378	17.8607	18.5025	19.1860	19.7140	20.0598	20.2002	20.1802	19.9317	19.1978	18.1310	17.2376	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.3378	17.8607	18.5025	19.1860	19.7140	20.0598	20.2002	20.1802	19.9317	19.1978	18.1310	17.2376	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9038	0.8452	0.7730	0.6775	0.5649	0.4366	0.3203	0.3520	0.5237	0.7279	0.8625	0.9168	(94)
Useful gains	355.0231	452.9580	510.9806	519.3315	465.8270	352.5116	249.2819	257.0936	351.6429	398.6149	360.7344	328.1180	(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	1000.9103	993.0002	917.7736	779.2276	606.0505	409.5199	270.0347	283.1038	438.7992	650.1974	837.1656	993.1077	(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	480.5401	362.9083	302.6540	187.1252	104.3263	0.0000	0.0000	0.0000	0.0000	187.1774	343.0305	494.7523	(98)
Space heating												2462.5141	(98)
Space heating per m2											(98) / (4) =	69.6215	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	705.0594	555.0467	569.1791	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7795	0.8317	0.8113	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	549.5778	461.6271	461.7738	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	993.3828	958.3668	903.1925	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	319.5396	369.5744	328.4155	0.0000	0.0000	0.0000	0.0000	(104)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling											1017.5295	(104)
Cooled fraction									fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	79.8849	92.3936	82.1039	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling											254.3824	(107)
Space cooling per m2											7.1920	(108)
Energy for space heating											69.6215	(99)
Energy for space cooling											7.1920	(108)
Total											76.8136	(109)
Dwelling Fabric Energy Efficiency (DFEE)											76.8	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000	/ (5) =	0.1848	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.4348	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3696	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4712	0.4620	0.4527	0.4065	0.3973	0.3511	0.3511	0.3419	0.3696	0.3973	0.4158	0.4342	(22b)
Effective ac	0.6110	0.6067	0.6025	0.5826	0.5789	0.5616	0.5616	0.5584	0.5683	0.5789	0.5864	0.5943	(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 Opening Type (Uw = 1.40)			8.8400	1.3258	11.7197			(27)
GF			35.3700	0.1300	4.5981			(28b)
Main	65.2400	8.8400	56.4000	0.1800	10.1520			(29a)
Flat	35.3700		35.3700	0.1300	4.5981			(30)
Total net area of external elements Aum(A, m2)			135.9800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		31.0679			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.1326	(36)
Total fabric heat loss					(33) + (36) =		39.2005	(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	21.8234	21.6694	21.5185	20.8096	20.6770	20.0596	20.0596	19.9453	20.2974	20.6770	20.9453	21.2258	(38)
Heat transfer coeff	61.0239	60.8699	60.7190	60.0101	59.8775	59.2601	59.2601	59.1458	59.4979	59.8775	60.1458	60.4263	(39)
Average = Sum(39)m / 12 =												60.0095	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.7253	1.7209	1.7167	1.6966	1.6929	1.6754	1.6754	1.6722	1.6822	1.6929	1.7005	1.7084	(40)
HLP (average)												1.6966	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895	(42)
Average daily hot water use (litres/day)	64.8244	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(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)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Heat gains from water heating, kWh/month

	22.4710	19.6533	20.2805	17.6810	16.9653	14.6398	13.5659	15.5671	15.7530	18.3586	20.0399	21.7620 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	9.8146	8.7172	7.0893	5.3671	4.0119	3.3871	3.6598	4.7572	6.3851	8.1073	9.4625	10.0874	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	110.0897	111.2321	108.3533	102.2247	94.4885	87.2176	82.3601	81.2177	84.0965	90.2251	97.9613	105.2323	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	30.2030	29.2460	27.2587	24.5569	22.8029	20.3330	18.2338	20.9235	21.8792	24.6756	27.8331	29.2500	(72)
Total internal gains													
	192.4491	191.5371	185.0431	174.4905	163.6451	153.2794	146.5955	149.2402	154.7025	165.3497	177.5987	186.9114	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	1.6600	19.6403	0.6300	0.7000	0.7700	9.9639	(76)
South	4.8700	46.7521	0.6300	0.7000	0.7700	69.5827	(78)
West	2.3100	19.6403	0.6300	0.7000	0.7700	13.8654	(80)

Solar gains	93.4120	160.5736	221.9313	276.0277	308.1802	304.9946	294.4839	270.9869	240.9246	178.2277	112.1915	79.7219	(83)
Total gains	285.8610	352.1107	406.9744	450.5182	471.8253	458.2740	441.0794	420.2271	395.6271	343.5774	289.7902	266.6333	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	40.2506	40.3524	40.4527	40.9306	41.0212	41.4486	41.4486	41.5287	41.2829	41.0212	40.8382	40.6487	
alpha	3.6834	3.6902	3.6968	3.7287	3.7347	3.7632	3.7632	3.7686	3.7522	3.7347	3.7225	3.7099	
util living area													
	0.9933	0.9852	0.9681	0.9285	0.8487	0.7097	0.5547	0.5967	0.8039	0.9483	0.9873	0.9948	(86)
MIT	19.2331	19.4773	19.8293	20.2567	20.6221	20.8691	20.9611	20.9483	20.7761	20.2825	19.6729	19.1926	(87)
Th 2	19.5228	19.5259	19.5289	19.5432	19.5459	19.5585	19.5585	19.5608	19.5536	19.5459	19.5405	19.5348	(88)
util rest of house													
	0.9909	0.9800	0.9565	0.9008	0.7871	0.5921	0.3900	0.4330	0.7053	0.9222	0.9819	0.9930	(89)
MIT 2	17.9709	18.2146	18.5617	18.9809	19.3081	19.5039	19.5504	19.5487	19.4436	19.0172	18.4214	17.9396	(90)
Living area fraction									fLA = Living area / (4) =			0.5900	(91)
MIT	18.7157	18.9597	19.3096	19.7337	20.0834	20.3095	20.3828	20.3745	20.2299	19.7638	19.1598	18.6790	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7157	18.9597	19.3096	19.7337	20.0834	20.3095	20.3828	20.3745	20.2299	19.7638	19.1598	18.6790	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9892	0.9774	0.9543	0.9050	0.8125	0.6576	0.4878	0.5299	0.7563	0.9270	0.9800	0.9915	(94)
Useful gains	282.7736	344.1678	388.3879	407.7319	383.3628	301.3586	215.1777	222.6989	299.2225	318.4879	283.9956	264.3677	(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													
	879.7021	855.8103	777.7890	650.1291	501.9779	338.3436	224.1686	235.0764	364.7146	548.7070	725.3488	874.9104	(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													
	444.1148	343.8237	289.7145	174.5260	88.2497	0.0000	0.0000	0.0000	0.0000	171.2830	317.7743	454.2438	(98)
Space heating												2283.7298	(98)
Space heating per m2											(98) / (4) =	64.5669	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	557.0451	438.5249	449.5079	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8091	0.8766	0.8563	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	450.7223	384.4087	384.9343	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	585.2785	564.3260	540.5900	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	96.8805	133.8585	115.8079	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												346.5469	(104)
Cooled fraction									fC = cooled area / (4) =			1.0000	(105)
Intermittency factor (Table 10b)													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	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	24.2201	33.4646	28.9520	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												86.6367 (107)
Space cooling per m2												2.4494 (108)
Energy for space heating												64.5669 (99)
Energy for space cooling												2.4494 (108)
Total												67.0163 (109)
Target Fabric Energy Efficiency (TFEE)												77.1 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3424	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2910	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	6.6000	6.2000	5.9000	5.1000	4.9000	4.6000	4.2000	4.3000	4.9000	5.4000	5.9000	5.7000	(22)
Wind factor	1.6500	1.5500	1.4750	1.2750	1.2250	1.1500	1.0500	1.0750	1.2250	1.3500	1.4750	1.4250	(22a)
Adj infilt rate	0.4802	0.4511	0.4293	0.3711	0.3565	0.3347	0.3056	0.3129	0.3565	0.3929	0.4293	0.4147	(22b)
Effective ac	0.6153	0.6017	0.5921	0.5688	0.5636	0.5560	0.5467	0.5489	0.5636	0.5772	0.5921	0.5860	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	65.2400	16.5900	48.6500	0.2300	11.1895	9.0000	437.8500	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			135.9800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	47.3318			(33)
Party Wall 1			9.4900	0.0000	0.0000	20.0000	189.8000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		4290.8300	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							121.3127	(35)
Thermal bridges (User defined value 0.056 * total exposed area)							7.6149	(36)
Total fabric heat loss					(33) + (36) =		54.9467	(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	21.9764	21.4924	21.1492	20.3173	20.1282	19.8588	19.5260	19.6063	20.1282	20.6151	21.1492	20.9299	(38)
Heat transfer coeff	76.9231	76.4391	76.0959	75.2640	75.0749	74.8055	74.4727	74.5530	75.0749	75.5618	76.0959	75.8766	(39)
Average = Sum(39)m / 12 =												75.5198	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1748	2.1611	2.1514	2.1279	2.1226	2.1149	2.1055	2.1078	2.1226	2.1363	2.1514	2.1452	(40)
HLP (average)												2.1351	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895	(42)
Average daily hot water use (litres/day)	64.8244	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0500	(48)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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  Temperature factor from Table 2b                                                                                0.5400 (49)
Enter (49) or (54) in (55)                                                                                        0.5670 (55)
Total storage loss
              17.5770    15.8760    17.5770    17.0100    17.5770    17.0100    17.5770    17.5770    17.0100    17.5770    17.0100    17.5770 (56)
If cylinder contains dedicated solar storage
              17.5770    15.8760    17.5770    17.0100    17.5770    17.0100    17.5770    17.5770    17.0100    17.5770    17.0100    17.5770 (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
             146.5855   129.3734   136.2768   122.7267   120.6763   108.4151   104.6790   114.0963   113.6538   127.2329   133.8273   143.2488 (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
             146.5855   129.3734   136.2768   122.7267   120.6763   108.4151   104.6790   114.0963   113.6538   127.2329   133.8273   143.2488 (64)
                                                                                  Total per year (kWh/year) = Sum(64)m =   1500.7919 (64)
RHI water heating demand                                                                                          1501 (64)
Heat gains from water heating, kWh/month
              67.8321    60.2614    64.4045    59.2832    59.2173    54.5246    53.8982    57.0294    56.2664    61.3974    62.9741    66.7226 (65)
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5. Internal gains (see Table 5 and 5a)

```
Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m         77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              24.5364    21.7931    17.7233    13.4177    10.0299     8.4676     9.1496    11.8930    15.9627    20.2684    23.6562    25.2184 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             164.3130   166.0181   161.7214   152.5743   141.0276   130.1755   122.9255   121.2205   125.5172   134.6643   146.2109   157.0631 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262 (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)
             -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780 (71)
Water heating gains (Table 5)
              91.1722    89.6747    86.5651    82.3377    79.5931    75.7286    72.4438    76.6525    78.1478    82.5233    87.4640    89.6810 (72)
Total internal gains
             352.8368   350.3010   338.8250   321.1448   303.4658   287.1868   277.3341   282.5811   292.4429   310.2711   330.1462   344.7776 (73)
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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.1200	19.0327	0.7200	0.7000	0.7700	20.7404	(76)
South	9.1400	46.2981	0.7200	0.7000	0.7700	147.7996	(78)
West	4.3300	19.0327	0.7200	0.7000	0.7700	28.7840	(80)

```
Solar gains   197.3240   339.6308   491.5717   618.5759   690.7157   658.1417   642.6356   597.9534   527.3562   379.4219   231.5438   166.7843 (83)
Total gains   550.1608   689.9318   830.3967   939.7207   994.1815   945.3285   919.9697   880.5344   819.7991   689.6930   561.6900   511.5619 (84)
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7. Mean internal temperature (heating season)

```
Temperature during heating periods in the living area from Table 9, Th1 (C)                                      21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau           15.4947    15.5928    15.6631    15.8362    15.8761    15.9333    16.0045    15.9872    15.8761    15.7738    15.6631    15.7084
alpha          2.0330     2.0395     2.0442     2.0557     2.0584     2.0622     2.0670     2.0658     2.0584     2.0516     2.0442     2.0472
util living area
               0.9009     0.8540     0.7886     0.7058     0.6153     0.5260     0.4388     0.4592     0.5901     0.7563     0.8691     0.9126 (86)

MIT           17.9993    18.4693    19.0736    19.7074    20.2101    20.5728    20.7734    20.7483    20.4420    19.7027    18.6852    17.8917 (87)
Th 2          19.9126    19.9194    19.9243    19.9360    19.9387    19.9425    19.9472    19.9461    19.9387    19.9318    19.9243    19.9274 (88)
util rest of house
               0.8907     0.8400     0.7693     0.6794     0.5801     0.4782     0.3799     0.3998     0.5433     0.7278     0.8544     0.9036 (89)
MIT 2         17.1778    17.6380    18.2232    18.8339    19.3028    19.6328    19.8043    19.7852    19.5231    18.8444    17.8614    17.0824 (90)
Living area fraction                                                                          fLA = Living area / (4) =      0.5900 (91)
MIT           17.6625    18.1285    18.7250    19.3493    19.8381    20.1875    20.3761    20.3534    20.0653    19.3508    18.3475    17.5599 (92)
Temperature adjustment                                                                                            0.0000
adjusted MIT  17.6625    18.1285    18.7250    19.3493    19.8381    20.1875    20.3761    20.3534    20.0653    19.3508    18.3475    17.5599 (93)
```

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8. Space heating requirement

```
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation    0.8644     0.8124     0.7448     0.6635     0.5765     0.4898     0.4047     0.4236     0.5492     0.7104     0.8282     0.8785 (94)
Useful gains 475.5649   560.5006   618.4672   623.5227   573.1880   462.9932   372.2806   372.9777   450.2643   489.9826   465.1662   449.4002 (95)
Ext temp.      3.1000     3.6000     5.0000     7.2000     9.8000    12.7000    14.7000    14.6000    12.4000     9.1000     5.7000     2.9000 (96)
Heat loss rate W
            1120.1955  1110.5432  1044.4155   914.4057   753.6120   560.1021   422.7174   428.9361   575.4705   774.5710   962.4232  1112.3440 (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
             479.6051   369.6286   316.9056   209.4358   134.2355     0.0000     0.0000     0.0000     0.0000   211.7337   358.0250   493.2302 (98)
Space heating                                                                                                    2572.7995 (98)
RHI space heating demand                                                                                           2573 (98)
```

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SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
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1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3424	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2910	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3711	0.3638	0.3565	0.3201	0.3129	0.2765	0.2765	0.2692	0.2910	0.3129	0.3274	0.3420	(22b)
Effective ac	0.5688	0.5662	0.5636	0.5512	0.5489	0.5382	0.5382	0.5362	0.5424	0.5489	0.5536	0.5585	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	65.2400	16.5900	48.6500	0.2300	11.1895	9.0000	437.8500	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			135.9800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	47.3318			(33)
Party Wall 1			9.4900	0.0000	0.0000	20.0000	189.8000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		4290.8300	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							121.3127	(35)
Thermal bridges (User defined value 0.056 * total exposed area)							7.6149	(36)
Total fabric heat loss					(33) + (36) =		54.9467	(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	20.3173	20.2218	20.1282	19.6886	19.6063	19.2235	19.2235	19.1526	19.3709	19.6063	19.7727	19.9467	(38)
Heat transfer coeff	75.2640	75.1685	75.0749	74.6353	74.5530	74.1702	74.1702	74.0992	74.3176	74.5530	74.7194	74.8934	(39)
Average = Sum(39)m / 12 =												74.6349	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1279	2.1252	2.1226	2.1101	2.1078	2.0970	2.0970	2.0950	2.1011	2.1078	2.1125	2.1174	(40)
HLP (average)												2.1101	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895	(42)
Average daily hot water use (litres/day)	64.8244	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0500	(48)

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Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.5670	(55)
Total storage loss													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(56)
If cylinder contains dedicated solar storage													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(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													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(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													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
								Total per year (kWh/year) = Sum(64)m =				1500.7919	(64)
Heat gains from water heating, kWh/month													
	67.8321	60.2614	64.4045	59.2832	59.2173	54.5246	53.8982	57.0294	56.2664	61.3974	62.9741	66.7226	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.5364	21.7931	17.7233	13.4177	10.0299	8.4676	9.1496	11.8930	15.9627	20.2684	23.6562	25.2184	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	164.3130	166.0181	161.7214	152.5743	141.0276	130.1755	122.9255	121.2205	125.5172	134.6643	146.2109	157.0631	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	91.1722	89.6747	86.5651	82.3377	79.5931	75.7286	72.4438	76.6525	78.1478	82.5233	87.4640	89.6810	(72)
Total internal gains													
	352.8368	350.3010	338.8250	321.1448	303.4658	287.1868	277.3341	282.5811	292.4429	310.2711	330.1462	344.7776	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.1200	19.6403	0.7200	0.7000	0.7700	21.4026	(76)
South	9.1400	46.7521	0.7200	0.7000	0.7700	149.2488	(78)
West	4.3300	19.6403	0.7200	0.7000	0.7700	29.7029	(80)

Solar gains	200.3542	344.4042	476.0033	592.0262	660.9841	654.1505	631.6077	581.2134	516.7390	382.2683	240.6332	170.9913	(83)
Total gains	553.1910	694.7052	814.8283	913.1710	964.4499	941.3373	908.9418	863.7945	809.1819	692.5395	570.7794	515.7689	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	15.8362	15.8563	15.8761	15.9696	15.9872	16.0698	16.0698	16.0851	16.0379	15.9872	15.9516	15.9146	
alpha	2.0557	2.0571	2.0584	2.0646	2.0658	2.0713	2.0713	2.0723	2.0692	2.0658	2.0634	2.0610	
util living area													
	0.8872	0.8335	0.7643	0.6699	0.5583	0.4353	0.3302	0.3577	0.5138	0.7110	0.8441	0.8995	(86)
MIT	18.3623	18.8255	19.3940	19.9928	20.4642	20.7749	20.9092	20.8894	20.6639	20.0212	19.0759	18.2586	(87)
Th 2	19.9360	19.9374	19.9387	19.9449	19.9461	19.9515	19.9515	19.9525	19.9494	19.9461	19.9437	19.9413	(88)
util rest of house													
	0.8753	0.8171	0.7417	0.6387	0.5156	0.3778	0.2597	0.2862	0.4565	0.6759	0.8258	0.8888	(89)
MIT 2	17.5514	17.9988	18.5441	19.1112	19.5398	19.8083	19.9080	19.8969	19.7231	19.1549	18.2564	17.4544	(90)
Living area fraction										fLA = Living area / (4) =		0.5900	(91)
MIT	18.0298	18.4866	19.0456	19.6314	20.0853	20.3786	20.4987	20.4825	20.2782	19.6660	18.7399	17.9289	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0298	18.4866	19.0456	19.6314	20.0853	20.3786	20.4987	20.4825	20.2782	19.6660	18.7399	17.9289	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8490	0.7909	0.7204	0.6286	0.5216	0.4019	0.2973	0.3233	0.4752	0.6656	0.8011	0.8632	(94)
Useful gains	469.6734	549.4180	586.9796	574.0473	503.0162	378.3615	270.2154	279.2398	384.5553	460.9508	457.2711	445.2151	(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													
	1033.3624	1021.2835	941.8585	800.9391	625.1461	428.6009	289.1689	302.5134	459.1489	675.9015	869.7300	1028.2018	(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													
	419.3846	317.0936	264.0299	163.3621	90.8646	0.0000	0.0000	0.0000	0.0000	159.9233	296.9703	433.7420	(98)
Space heating												2145.3705	(98)
Space heating per m2											(98) / (4) =	60.6551	(99)

8c. Space cooling requirement

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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 %)	175.1000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1225.2259	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	419.3846	317.0936	264.0299	163.3621	90.8646	0.0000	0.0000	0.0000	0.0000	159.9233	296.9703	433.7420	(98)
Space heating efficiency (main heating system 1)	175.1000	175.1000	175.1000	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175.1000	175.1000	(210)
Space heating fuel (main heating system)	239.5115	181.0929	150.7881	93.2964	51.8930	0.0000	0.0000	0.0000	0.0000	91.3325	169.6004	247.7110	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
Efficiency of water heater												175.1000	(216)
(217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(217)
Fuel for water heating, kWh/month	83.7153	73.8854	77.8280	70.0895	68.9185	61.9161	59.7824	65.1607	64.9080	72.6630	76.4290	81.8097	(219)
Water heating fuel used												857.1056	(219)
Annual totals kWh/year													
Space heating fuel - main system												1225.2259	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
Total electricity for the above, kWh/year												30.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Total delivered energy for all uses												2285.6600	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1225.2259	13.1900	161.6073	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	857.1056	13.1900	113.0522	(247)
Pumps and fans for heating	30.0000	13.1900	3.9570	(249)
Energy for lighting	173.3285	13.1900	22.8620	(250)
Additional standing charges			0.0000	(251)
Total energy cost			301.4786	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.5755	(257)
SAP value		78.0221	
SAP rating (Section 12)		78	(258)
SAP band		C	

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	1225.2259	0.5190	635.8922	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	857.1056	0.5190	444.8378	(264)
Space and water heating			1080.7300	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Total kg/year			1186.2575	(272)
CO2 emissions per m2			33.5400	(273)
EI value			80.2217	
EI rating			80	(274)
EI band			C	

Calculation of stars for heating and DHW

Main heating energy efficiency	13.19 × (1 + 0.29 × 0.00) / 1.7510 = 7.533, stars = 2
Main heating environmental impact	0.519 × (1 + 0.29 × 0.00) / 1.7510 = 0.2964, stars = 4
Water heating energy efficiency	13.19 / 1.7510 = 7.533, stars = 2
Water heating environmental impact	0.519 / 1.7510 = 0.2964, stars = 4

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3424	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2910	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	6.6000	6.2000	5.9000	5.1000	4.9000	4.6000	4.2000	4.3000	4.9000	5.4000	5.9000	5.7000	(22)
Wind factor	1.6500	1.5500	1.4750	1.2750	1.2250	1.1500	1.0500	1.0750	1.2250	1.3500	1.4750	1.4250	(22a)
Adj infilt rate	0.4802	0.4511	0.4293	0.3711	0.3565	0.3347	0.3056	0.3129	0.3565	0.3929	0.4293	0.4147	(22b)
Effective ac	0.6153	0.6017	0.5921	0.5688	0.5636	0.5560	0.5467	0.5489	0.5636	0.5772	0.5921	0.5860	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	65.2400	16.5900	48.6500	0.2300	11.1895	9.0000	437.8500	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			135.9800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	47.3318			(33)
Party Wall 1			9.4900	0.0000	0.0000	20.0000	189.8000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		4290.8300	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							121.3127	(35)
Thermal bridges (User defined value 0.056 * total exposed area)							7.6149	(36)
Total fabric heat loss					(33) + (36) =		54.9467	(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	21.9764	21.4924	21.1492	20.3173	20.1282	19.8588	19.5260	19.6063	20.1282	20.6151	21.1492	20.9299	(38)
Heat transfer coeff	76.9231	76.4391	76.0959	75.2640	75.0749	74.8055	74.4727	74.5530	75.0749	75.5618	76.0959	75.8766	(39)
Average = Sum(39)m / 12 =												75.5198	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1748	2.1611	2.1514	2.1279	2.1226	2.1149	2.1055	2.1078	2.1226	2.1363	2.1514	2.1452	(40)
HLP (average)												2.1351	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895	(42)
Average daily hot water use (litres/day)	64.8244	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0500	(48)

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

Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.5670	(55)
Total storage loss													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(56)
If cylinder contains dedicated solar storage													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(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													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(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													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
								Total per year (kWh/year) = Sum(64)m =				1500.7919	(64)
Heat gains from water heating, kWh/month													
	67.8321	60.2614	64.4045	59.2832	59.2173	54.5246	53.8982	57.0294	56.2664	61.3974	62.9741	66.7226	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.5364	21.7931	17.7233	13.4177	10.0299	8.4676	9.1496	11.8930	15.9627	20.2684	23.6562	25.2184	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	164.3130	166.0181	161.7214	152.5743	141.0276	130.1755	122.9255	121.2205	125.5172	134.6643	146.2109	157.0631	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	91.1722	89.6747	86.5651	82.3377	79.5931	75.7286	72.4438	76.6525	78.1478	82.5233	87.4640	89.6810	(72)
Total internal gains													
	352.8368	350.3010	338.8250	321.1448	303.4658	287.1868	277.3341	282.5811	292.4429	310.2711	330.1462	344.7776	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.1200	19.0327	0.7200	0.7000	0.7700	20.7404	(76)
South	9.1400	46.2981	0.7200	0.7000	0.7700	147.7996	(78)
West	4.3300	19.0327	0.7200	0.7000	0.7700	28.7840	(80)

Solar gains	197.3240	339.6308	491.5717	618.5759	690.7157	658.1417	642.6356	597.9534	527.3562	379.4219	231.5438	166.7843	(83)
Total gains	550.1608	689.9318	830.3967	939.7207	994.1815	945.3285	919.9697	880.5344	819.7991	689.6930	561.6900	511.5619	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	15.4947	15.5928	15.6631	15.8362	15.8761	15.9333	16.0045	15.9872	15.8761	15.7738	15.6631	15.7084	
alpha	2.0330	2.0395	2.0442	2.0557	2.0584	2.0622	2.0670	2.0658	2.0584	2.0516	2.0442	2.0472	
util living area													
	0.9009	0.8540	0.7886	0.7058	0.6153	0.5260	0.4388	0.4592	0.5901	0.7563	0.8691	0.9126	(86)
MIT	17.9993	18.4693	19.0736	19.7074	20.2101	20.5728	20.7734	20.7483	20.4420	19.7027	18.6852	17.8917	(87)
Th 2	19.9126	19.9194	19.9243	19.9360	19.9387	19.9425	19.9472	19.9461	19.9387	19.9318	19.9243	19.9274	(88)
util rest of house													
	0.8907	0.8400	0.7693	0.6794	0.5801	0.4782	0.3799	0.3998	0.5433	0.7278	0.8544	0.9036	(89)
MIT 2	17.1778	17.6380	18.2232	18.8339	19.3028	19.6328	19.8043	19.7852	19.5231	18.8444	17.8614	17.0824	(90)
Living area fraction										fLA = Living area / (4) =		0.5900	(91)
MIT	17.6625	18.1285	18.7250	19.3493	19.8381	20.1875	20.3761	20.3534	20.0653	19.3508	18.3475	17.5599	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.6625	18.1285	18.7250	19.3493	19.8381	20.1875	20.3761	20.3534	20.0653	19.3508	18.3475	17.5599	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8644	0.8124	0.7448	0.6635	0.5765	0.4898	0.4047	0.4236	0.5492	0.7104	0.8282	0.8785	(94)
Useful gains	475.5649	560.5006	618.4672	623.5227	573.1880	462.9932	372.2806	372.9777	450.2643	489.9826	465.1662	449.4002	(95)
Ext temp.	3.1000	3.6000	5.0000	7.2000	9.8000	12.7000	14.7000	14.6000	12.4000	9.1000	5.7000	2.9000	(96)
Heat loss rate W													
	1120.1955	1110.5432	1044.4155	914.4057	753.6120	560.1021	422.7174	428.9361	575.4705	774.5710	962.4232	1112.3440	(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													
	479.6051	369.6286	316.9056	209.4358	134.2355	0.0000	0.0000	0.0000	0.0000	211.7337	358.0250	493.2302	(98)
Space heating												2572.7995	(98)
Space heating per m2											(98) / (4) =	72.7396	(99)

8c. Space cooling requirement

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

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	175.1000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1469.3315	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	479.6051	369.6286	316.9056	209.4358	134.2355	0.0000	0.0000	0.0000	0.0000	211.7337	358.0250	493.2302	(98)
Space heating efficiency (main heating system 1)	175.1000	175.1000	175.1000	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175.1000	175.1000	(210)
Space heating fuel (main heating system)	273.9036	211.0957	180.9855	119.6092	76.6622	0.0000	0.0000	0.0000	0.0000	120.9216	204.4689	281.6849	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
Efficiency of water heater												175.1000	(216)
(217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(217)
Fuel for water heating, kWh/month	83.7153	73.8854	77.8280	70.0895	68.9185	61.9161	59.7824	65.1607	64.9080	72.6630	76.4290	81.8097	(219)
Water heating fuel used												857.1056	(219)

Annual totals kWh/year		
Space heating fuel - main system	1469.3315	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
Total electricity for the above, kWh/year	30.0000	(231)
Electricity for lighting (calculated in Appendix L)	173.3285	(232)
Total delivered energy for all uses	2529.7656	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1469.3315	18.7000	274.7650	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	857.1056	18.7000	160.2787	(247)
Pumps and fans for heating	30.0000	18.7000	5.6100	(249)
Energy for lighting	173.3285	18.7000	32.4124	(250)
Additional standing charges			0.0000	(251)
Total energy cost			473.0662	(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	1469.3315	0.5190	762.5831	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	857.1056	0.5190	444.8378	(264)
Space and water heating			1207.4209	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Total kg/year			1312.9484	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	1469.3315	3.0700	4510.8478	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	857.1056	3.0700	2631.3142	(264)
Space and water heating			7142.1619	(265)
Pumps and fans	30.0000	3.0700	92.1000	(267)
Energy for lighting	173.3285	3.0700	532.1186	(268)
Primary energy kWh/year			7766.3805	(272)
Primary energy kWh/m2/year			219.5754	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating:	C 78
Current environmental impact rating:	C 80

(For testing purposes):

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

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 3.6	-£ 71	-196 kg (14.9%)
U Solar photovoltaic panels	+ 16.6	-£ 326	-906 kg (81.1%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£71	5.54 kg/m²	B 82	B 83
Solar photovoltaic panels	£326	25.62 kg/m²	A 98	A 98
Total Savings	£397	31.16 kg/m²		

Potential energy efficiency rating: A 98
Potential environmental impact rating: A 98

Fuel prices for cost data on this page from database revision number 465 TEST (04 Sep 2020)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£473	£402	£71
Space heating	£280	£281	-£0
Water heating	£160	£89	£71
Lighting	£32	£32	£0
Generated (PV)	-£0	-£326	£326
Total cost of fuels	£473	£76	£397
Total cost of uses	£472	£76	£397
Delivered energy	72 kWh/m²	11 kWh/m²	60 kWh/m²
Carbon dioxide emissions	1.3 tonnes	0.2 tonnes	1.1 tonnes
CO2 emissions per m²	37 kg/m²	6 kg/m²	31 kg/m²
Primary energy	220 kWh/m²	35 kWh/m²	184 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3424	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2910	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3711	0.3638	0.3565	0.3201	0.3129	0.2765	0.2765	0.2692	0.2910	0.3129	0.3274	0.3420	(22b)
Effective ac	0.5688	0.5662	0.5636	0.5512	0.5489	0.5382	0.5382	0.5362	0.5424	0.5489	0.5536	0.5585	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	65.2400	16.5900	48.6500	0.2300	11.1895	9.0000	437.8500	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			135.9800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	47.3318			(33)
Party Wall 1			9.4900	0.0000	0.0000	20.0000	189.8000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	4290.8300 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		121.3127 (35)
Thermal bridges (User defined value 0.056 * total exposed area)		7.6149 (36)
Total fabric heat loss	(33) + (36) =	54.9467 (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	20.3173	20.2218	20.1282	19.6886	19.6063	19.2235	19.2235	19.1526	19.3709	19.6063	19.7727	19.9467	(38)
Heat transfer coeff	75.2640	75.1685	75.0749	74.6353	74.5530	74.1702	74.1702	74.0992	74.3176	74.5530	74.7194	74.8934	(39)
Average = Sum(39)m / 12 =												74.6349	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1279	2.1252	2.1226	2.1101	2.1078	2.0970	2.0970	2.0950	2.1011	2.1078	2.1125	2.1174	(40)
HLP (average)												2.1101	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895 (42)
Average daily hot water use (litres/day)	64.8244 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0500	(48)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.5670	(55)
Total storage loss													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(56)
If cylinder contains dedicated solar storage													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(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													
	146.5855	129.3734	134.8811	115.9731	107.8819	95.8084	91.6521	101.9999	108.2509	125.8372	133.8273	143.2488	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.7781	(H8)
Utilisation factor												0.4302	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												64.8244	(H14)
Volume ratio Veff/V												1.1570	(H15)
Solar storage volume factor												1.0000	(H16)
Solar input												-685.9569	(H17)
Solar input	-19.8914	-33.1930	-56.5315	-75.7633	-93.5992	-92.0229	-90.8068	-79.3384	-62.1378	-42.4328	-23.5940	-16.6457	(63)
								Solar input (sum of months) = Sum(63)m =				-685.9569	(63)
Output from w/h													
	126.6941	96.1804	78.3496	40.2098	14.2827	3.7855	0.8453	22.6615	46.1131	83.4043	110.2332	126.6031	(64)
								Total per year (kWh/year) = Sum(64)m =				749.3626	(64)
Heat gains from water heating, kWh/month													
	67.8321	60.2614	63.2879	53.8803	48.9818	44.4392	43.4766	47.3523	51.9441	60.2808	62.9741	66.7226	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.5364	21.7931	17.7233	13.4177	10.0299	8.4676	9.1496	11.8930	15.9627	20.2684	23.6562	25.2184	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	164.3130	166.0181	161.7214	152.5743	141.0276	130.1755	122.9255	121.2205	125.5172	134.6643	146.2109	157.0631	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	91.1722	89.6747	85.0643	74.8337	65.8358	61.7211	58.4363	63.6455	72.1446	81.0225	87.4640	89.6810	(72)
Total internal gains													
	352.8368	350.3010	337.3242	313.6408	289.7085	273.1794	263.3266	269.5742	286.4397	308.7703	330.1462	344.7776	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	3.1200	19.6403	0.7200	0.7000	0.7700	21.4026	(76)
South	9.1400	46.7521	0.7200	0.7000	0.7700	149.2488	(78)
West	4.3300	19.6403	0.7200	0.7000	0.7700	29.7029	(80)

Solar gains	200.3542	344.4042	476.0033	592.0262	660.9841	654.1505	631.6077	581.2134	516.7390	382.2683	240.6332	170.9913	(83)
Total gains	553.1910	694.7052	813.3275	905.6670	950.6926	927.3299	894.9343	850.7876	803.1787	691.0387	570.7794	515.7689	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	15.8362	15.8563	15.8761	15.9696	15.9872	16.0698	16.0698	16.0851	16.0379	15.9872	15.9516	15.9146	
alpha	2.0557	2.0571	2.0584	2.0646	2.0658	2.0713	2.0713	2.0723	2.0692	2.0658	2.0634	2.0610	
util living area													
	0.8872	0.8335	0.7648	0.6727	0.5634	0.4403	0.3346	0.3623	0.5165	0.7117	0.8441	0.8995	(86)
MIT	18.3623	18.8255	19.3916	19.9841	20.4545	20.7698	20.9068	20.8867	20.6605	20.0192	19.0759	18.2586	(87)
Th 2	19.9360	19.9374	19.9387	19.9449	19.9461	19.9515	19.9515	19.9525	19.9494	19.9461	19.9437	19.9413	(88)
util rest of house													
	0.8753	0.8171	0.7423	0.6415	0.5207	0.3824	0.2634	0.2901	0.4590	0.6766	0.8258	0.8888	(89)
MIT 2	17.5514	17.9988	18.5418	19.1036	19.5319	19.8049	19.9068	19.8955	19.7207	19.1531	18.2564	17.4544	(90)
Living area fraction									fLA = Living area / (4) =			0.5900	(91)
MIT	18.0298	18.4866	19.0432	19.6231	20.0763	20.3742	20.4968	20.4803	20.2752	19.6641	18.7399	17.9289	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0298	18.4866	19.0432	19.6231	20.0763	20.3742	20.4968	20.4803	20.2752	19.6641	18.7399	17.9289	(93)

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8. Space heating requirement

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8490	0.7909	0.7209	0.6312	0.5263	0.4065	0.3012	0.3274	0.4776	0.6663	0.8011	0.8632	(94)
Useful gains	469.6734	549.4180	586.3232	571.6967	500.3135	376.9678	269.5955	278.5177	383.6338	460.4113	457.2711	445.2151	(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	1033.3624	1021.2835	941.6799	800.3250	624.4772	428.2764	289.0295	302.3498	458.9266	675.7584	869.7300	1028.2018	(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	419.3846	317.0936	264.3853	164.6124	92.3778	0.0000	0.0000	0.0000	0.0000	160.2182	296.9703	433.7420	(98)
Space heating												2148.7843	(98)
Space heating per m2											(98) / (4) =	60.7516	(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 %)	175.1000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1227.1755	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	419.3846	317.0936	264.3853	164.6124	92.3778	0.0000	0.0000	0.0000	0.0000	160.2182	296.9703	433.7420	(98)
Space heating efficiency (main heating system 1)	175.1000	175.1000	175.1000	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175.1000	175.1000	(210)
Space heating fuel (main heating system)	239.5115	181.0929	150.9911	94.0105	52.7572	0.0000	0.0000	0.0000	0.0000	91.5010	169.6004	247.7110	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	126.6941	96.1804	78.3496	40.2098	14.2827	3.7855	0.8453	22.6615	46.1131	83.4043	110.2332	126.6031	(64)
Efficiency of water heater												175.1000	(216)
(217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(217)
Fuel for water heating, kWh/month	72.3553	54.9288	44.7456	22.9639	8.1569	2.1619	0.4827	12.9420	26.3353	47.6324	62.9544	72.3033	(219)
Water heating fuel used												427.9626	(219)

Annual totals kWh/year		
Space heating fuel - main system	1227.1755	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
pump for solar water heating	50.0000	(230g)
Total electricity for the above, kWh/year	80.0000	(231)
Electricity for lighting (calculated in Appendix L)	173.3285	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =	-1727.2394	-1727.2394 (233)
Total delivered energy for all uses	181.2273	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1227.1755	13.1900	161.8645	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	427.9626	13.1900	56.4483	(247)
Pumps and fans for heating	30.0000	13.1900	3.9570	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	173.3285	13.1900	22.8620	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			23.9039	(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] =	0.1249	(257)
SAP value	98.2574	
SAP rating (Section 12)	98	(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	1227.1755	0.5190	636.9041	(261)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	427.9626	0.5190	222.1126 (264)
Space and water heating			859.0167 (265)
Pumps and fans	80.0000	0.5190	41.5200 (267)
Energy for lighting	173.3285	0.5190	89.9575 (268)
Energy saving/generation technologies			
PV Unit	-1727.2394	0.5190	-896.4372 (269)
Total kg/year			94.0570 (272)
CO2 emissions per m2			2.6600 (273)
EI value			98.4318
EI rating			98 (274)
EI band			A

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3424	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2910	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	6.6000	6.2000	5.9000	5.1000	4.9000	4.6000	4.2000	4.3000	4.9000	5.4000	5.9000	5.7000	(22)
Wind factor	1.6500	1.5500	1.4750	1.2750	1.2250	1.1500	1.0500	1.0750	1.2250	1.3500	1.4750	1.4250	(22a)
Adj infilt rate	0.4802	0.4511	0.4293	0.3711	0.3565	0.3347	0.3056	0.3129	0.3565	0.3929	0.4293	0.4147	(22b)
Effective ac	0.6153	0.6017	0.5921	0.5688	0.5636	0.5560	0.5467	0.5489	0.5636	0.5772	0.5921	0.5860	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	65.2400	16.5900	48.6500	0.2300	11.1895	9.0000	437.8500	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			135.9800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	47.3318			(33)
Party Wall 1			9.4900	0.0000	0.0000	20.0000	189.8000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		4290.8300	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							121.3127	(35)
Thermal bridges (User defined value 0.056 * total exposed area)							7.6149	(36)
Total fabric heat loss					(33) + (36) =		54.9467	(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	21.9764	21.4924	21.1492	20.3173	20.1282	19.8588	19.5260	19.6063	20.1282	20.6151	21.1492	20.9299	(38)
Heat transfer coeff	76.9231	76.4391	76.0959	75.2640	75.0749	74.8055	74.4727	74.5530	75.0749	75.5618	76.0959	75.8766	(39)
Average = Sum(39)m / 12 =												75.5198	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1748	2.1611	2.1514	2.1279	2.1226	2.1149	2.1055	2.1078	2.1226	2.1363	2.1514	2.1452	(40)
HLP (average)												2.1351	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895	(42)
Average daily hot water use (litres/day)	64.8244	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0500	(48)

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

Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.5670	(55)
Total storage loss													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(56)
If cylinder contains dedicated solar storage													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(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													
	146.5855	129.3734	134.8811	115.9731	107.8819	95.8084	91.6521	101.9999	108.2509	125.8372	133.8273	143.2488	(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												1091.0709	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1832.9992	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.7972	(H8)
Utilisation factor												0.4267	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												64.8244	(H14)
Volume ratio Veff/V												1.1570	(H15)
Solar storage volume factor												1.0000	(H16)
Solar input												-687.8113	(H17)
Solar input	-19.2686	-32.1683	-57.3554	-77.8632	-96.3853	-91.3308	-91.0993	-80.3442	-62.3188	-41.3797	-22.3236	-15.9741	(63)
								Solar input (sum of months) = Sum(63)m =				-687.8113	(63)
Output from w/h													
	127.3169	97.2050	77.5257	38.1099	11.4966	4.4776	0.5528	21.6557	45.9322	84.4575	111.5037	127.2747	(64)
								Total per year (kWh/year) = Sum(64)m =				747.5082	(64)
Heat gains from water heating, kWh/month													
	67.8321	60.2614	63.2879	53.8803	48.9818	44.4392	43.4766	47.3523	51.9441	60.2808	62.9741	66.7226	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.5364	21.7931	17.7233	13.4177	10.0299	8.4676	9.1496	11.8930	15.9627	20.2684	23.6562	25.2184	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	164.3130	166.0181	161.7214	152.5743	141.0276	130.1755	122.9255	121.2205	125.5172	134.6643	146.2109	157.0631	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	91.1722	89.6747	85.0643	74.8337	65.8358	61.7211	58.4363	63.6455	72.1446	81.0225	87.4640	89.6810	(72)
Total internal gains													
	352.8368	350.3010	337.3242	313.6408	289.7085	273.1794	263.3266	269.5742	286.4397	308.7703	330.1462	344.7776	(73)

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6. Solar gains

[Jan]		Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East		3.1200	19.0327	0.7200	0.7000	0.7700	20.7404	(76)
South		9.1400	46.2981	0.7200	0.7000	0.7700	147.7996	(78)
West		4.3300	19.0327	0.7200	0.7000	0.7700	28.7840	(80)

Solar gains	197.3240	339.6308	491.5717	618.5759	690.7157	658.1417	642.6356	597.9534	527.3562	379.4219	231.5438	166.7843	(83)
Total gains	550.1608	689.9318	828.8959	932.2167	980.4241	931.3210	905.9623	867.5275	813.7959	688.1922	561.6900	511.5619	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	15.4947	15.5928	15.6631	15.8362	15.8761	15.9333	16.0045	15.9872	15.8761	15.7738	15.6631	15.7084	
alpha	2.0330	2.0395	2.0442	2.0557	2.0584	2.0622	2.0670	2.0658	2.0584	2.0516	2.0442	2.0472	
util living area													
	0.9009	0.8540	0.7891	0.7083	0.6202	0.5312	0.4440	0.4643	0.5927	0.7570	0.8691	0.9126	(86)
MIT	17.9993	18.4693	19.0709	19.6975	20.1974	20.5644	20.7683	20.7428	20.4371	19.7003	18.6852	17.8917	(87)
Th 2	19.9126	19.9194	19.9243	19.9360	19.9387	19.9425	19.9472	19.9461	19.9387	19.9318	19.9243	19.9274	(88)
util rest of house													
	0.8907	0.8400	0.7698	0.6821	0.5850	0.4834	0.3847	0.4046	0.5459	0.7285	0.8544	0.9036	(89)
MIT 2	17.1778	17.6380	18.2207	18.8249	19.2920	19.6263	19.8009	19.7815	19.5192	18.8422	17.8614	17.0824	(90)
Living area fraction									fLA = Living area / (4) =			0.5900	(91)
MIT	17.6625	18.1285	18.7224	19.3398	19.8262	20.1798	20.3717	20.3487	20.0608	19.3485	18.3475	17.5599	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.6625	18.1285	18.7224	19.3398	19.8262	20.1798	20.3717	20.3487	20.0608	19.3485	18.3475	17.5599	(93)

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8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8644	0.8124	0.7453	0.6660	0.5811	0.4946	0.4094	0.4282	0.5516	0.7111	0.8282	0.8785	(94)
Useful gains	475.5649	560.5006	617.7531	620.8295	569.6950	460.6458	370.8571	371.4863	448.9220	489.3471	465.1662	449.4002	(95)
Ext temp.	3.1000	3.6000	5.0000	7.2000	9.8000	12.7000	14.7000	14.6000	12.4000	9.1000	5.7000	2.9000	(96)
Heat loss rate W	1120.1955	1110.5432	1044.2181	913.6874	752.7192	559.5294	422.3848	428.5843	575.1323	774.3979	962.4232	1112.3440	(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	479.6051	369.6286	317.2899	210.8577	136.1700	0.0000	0.0000	0.0000	0.0000	212.0778	358.0250	493.2302	(98)
Space heating												2576.8844	(98)
Space heating per m2											(98) / (4) =	72.8551	(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 %)	175.1000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1471.6644	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	479.6051	369.6286	317.2899	210.8577	136.1700	0.0000	0.0000	0.0000	0.0000	212.0778	358.0250	493.2302	(98)
Space heating efficiency (main heating system 1)	175.1000	175.1000	175.1000	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175.1000	175.1000	(210)
Space heating fuel (main heating system)	273.9036	211.0957	181.2050	120.4213	77.7670	0.0000	0.0000	0.0000	0.0000	121.1181	204.4689	281.6849	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	127.3169	97.2050	77.5257	38.1099	11.4966	4.4776	0.5528	21.6557	45.9322	84.4575	111.5037	127.2747	(64)
Efficiency of water heater												175.1000	(216)
(217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(217)
Fuel for water heating, kWh/month	72.7109	55.5140	44.2751	21.7646	6.5657	2.5572	0.3157	12.3676	26.2320	48.2338	63.6800	72.6869	(219)
Water heating fuel used												426.9036	(219)
Annual totals kWh/year													
Space heating fuel - main system												1471.6644	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												80.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1091 * 0.80) =										-1745.7135		-1745.7135	(233)
Total delivered energy for all uses												406.1830	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1471.6644	18.7000	275.2012	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	426.9036	18.7000	79.8310	(247)
Pumps and fans for heating	30.0000	18.7000	5.6100	(249)
Pump for solar water heating	50.0000	18.7000	9.3500	(249)
Energy for lighting	173.3285	18.7000	32.4124	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-1745.7135	18.7000	-326.4484	(252)
Total energy cost			75.9562	(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	1471.6644	0.5190	763.7938	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	426.9036	0.5190	221.5630	(264)
Space and water heating			985.3568	(265)
Pumps and fans	80.0000	0.5190	41.5200	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Energy saving/generation technologies				
PV Unit	-1745.7135	0.5190	-906.0253	(269)
Total kg/year			210.8090	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	1471.6644	3.0700	4518.0097	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	426.9036	3.0700	1310.5940	(264)
Space and water heating			5828.6037	(265)
Pumps and fans	80.0000	3.0700	245.6000	(267)
Energy for lighting	173.3285	3.0700	532.1186	(268)
Energy saving/generation technologies				
PV Unit	-1745.7135	3.0700	-5359.3404	(269)
Primary energy kWh/year			1246.9818	(272)
Primary energy kWh/m2/year			35.2554	(273)

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

Overheating Calculation Input Data

Dwelling type	SemiDetached Bungalow
Number of storeys	1
Cross ventilation possible	Yes
SAP Region	North East England
Front of dwelling faces	East
Overshading	Average or unknown
Thermal mass parameter	121.3 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	6.00 (Windows fully open)

Overheating Calculation

Summer ventilation heat loss coefficient	214.30	(P1)
Transmission heat loss coefficient	54.95	(37)
Summer heat loss coefficient	269.25	(P2)

Overhangs

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

Solar shading

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

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
East	3.1200	111.2086	0.7200	0.7000	0.9000	141.6474
South	9.1400	110.4126	0.7200	0.7000	0.9000	411.9841
West	4.3300	111.2086	0.7200	0.7000	0.9000	196.5811
total:						750.2126

	Jun	Jul	Aug	
Solar gains	765	750	685	(P3)
Internal gains	284	274	280	
Total summer gains	1049	1025	964	(P5)
Summer gain/loss ratio	3.89	3.81	3.58	(P6)
Summer external temperature	13.80	15.80	15.60	
Thermal mass temperature increment (TMP = 121.3)	1.15	1.15	1.15	
Threshold temperature	18.85	20.76	20.33	(P7)
Likelihood of high internal temperature	Not significant	Slight	Not significant	

Assessment of likelihood of high internal temperature: Slight

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

Anderson Goddard Ltd

Property Reference	73940-WR08	**Issued on Date**	07/10/2020
Assessment Reference	001	**Prop Type Ref**	Semi
Property	Woodlands Room 8, Raithwaite Bay, WHITBY, YO21 3ST		

SAP Rating	76 C	**DER**	38.15	**TER**	43.60
Environmental	79 C	**% DER<TER**	12.49		
CO_2 Emissions (t/year)	1.42	**DFEE**	85.89	**TFEE**	85.92
General Requirements Compliance	Pass	**% DFEE<TFEE**	0.03		

Assessor Details	Mr. Paul Goddard, Anderson Goddard Limited, Tel: 0161 7757770, paul.goddard@andersongoddard.com	**Assessor ID**	B342-0001
Client			

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

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

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DWELLING AS DESIGNED

Semi-Detached Bungalow, total floor area 35 m²

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

1a TER and DER
Fuel for main heating:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 43.60 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 38.15 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)85.9 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)85.9 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.23 (max. 0.30)	0.23 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.22 (max. 0.25)	0.22 (max. 0.70)	OK
Roof	0.18 (max. 0.20)	0.18 (max. 0.35)	OK
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated using user-specified y-value of 0.056

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3 Air permeability
Air permeability at 50 pascals: 4.95 (design value)
Maximum 10.0 OK

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4 Heating efficiency
Main heating system: Heat pump with radiators or underfloor - Electric
Air-to-water heat pump

Secondary heating system: None

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5 Cylinder insulation
Hot water storage Measured cylinder loss: 1.05 kWh/day
Permitted by DBSCG 1.70 OK
Primary pipework insulated: Yes OK

---

6 Controls
Space heating controls: Programmer and room thermostat OK

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

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

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8 Mechanical ventilation
Not applicable

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9 Summertime temperature
Overheating risk (North East England): Not significant OK
Based on:
Overshading: Average
Windows facing North: 9.14 m², No overhang
Windows facing East: 3.12 m², No overhang
Windows facing West: 4.33 m², No overhang
Air change rate: 8.00 ach
Blinds/curtains: None

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10 Key features
Party wall U-value 0.00 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		4.9500	
Infiltration rate		0.3399	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2889	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3684	0.3611	0.3539	0.3178	0.3106	0.2745	0.2745	0.2672	0.2889	0.3106	0.3250	0.3395	(22b)
Effective ac	0.5678	0.5652	0.5626	0.5505	0.5482	0.5377	0.5377	0.5357	0.5417	0.5482	0.5528	0.5576	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	65.2400	16.5900	48.6500	0.2300	11.1895	9.0000	437.8500	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			135.9800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	47.3318			(33)
Party Wall 1			9.4900	0.0000	0.0000	20.0000	189.8000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	4290.8300 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		121.3127 (35)
Thermal bridges (User defined value 0.056 * total exposed area)		7.6149 (36)
Total fabric heat loss	(33) + (36) =	54.9467 (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	20.2815	20.1874	20.0952	19.6620	19.5809	19.2036	19.2036	19.1337	19.3489	19.5809	19.7449	19.9163	(38)
Heat transfer coeff	75.2282	75.1341	75.0419	74.6087	74.5276	74.1503	74.1503	74.0804	74.2956	74.5276	74.6916	74.8630	(39)
Average = Sum(39)m / 12 =												74.6083	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1269	2.1242	2.1216	2.1094	2.1071	2.0964	2.0964	2.0944	2.1005	2.1071	2.1117	2.1166	(40)
HLP (average)												2.1094	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895 (42)
Average daily hot water use (litres/day)	64.8244 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0500	(48)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.5670	(55)
Total storage loss													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(56)
If cylinder contains dedicated solar storage													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(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													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(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													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
								Total per year (kWh/year) = Sum(64)m =				1500.7919	(64)
Heat gains from water heating, kWh/month													
	67.8321	60.2614	64.4045	59.2832	59.2173	54.5246	53.8982	57.0294	56.2664	61.3974	62.9741	66.7226	(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	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	9.8146	8.7172	7.0893	5.3671	4.0119	3.3871	3.6598	4.7572	6.3851	8.1073	9.4625	10.0874	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	110.0897	111.2321	108.3533	102.2247	94.4885	87.2176	82.3601	81.2177	84.0965	90.2251	97.9613	105.2323	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	91.1722	89.6747	86.5651	82.3377	79.5931	75.7286	72.4438	76.6525	78.1478	82.5233	87.4640	89.6810	(72)
Total internal gains													
	256.4182	254.9658	247.3495	235.2713	223.4353	211.6749	203.8055	207.9691	213.9712	226.1975	240.2295	250.3424	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	9.1400	10.6334	0.7200	0.7000	0.7700	33.9455	(74)
East	3.1200	19.6403	0.7200	0.7000	0.7700	21.4026	(76)
West	4.3300	19.6403	0.7200	0.7000	0.7700	29.7029	(80)

Solar gains	85.0509	164.8447	274.8741	417.1816	532.7943	556.5848	525.1898	435.4886	324.0202	195.8476	105.5986	70.3253	(83)
Total gains	341.4691	419.8105	522.2236	652.4529	756.2296	768.2597	728.9953	643.4578	537.9913	422.0451	345.8282	320.6676	(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	15.8438	15.8636	15.8831	15.9753	15.9927	16.0741	16.0741	16.0892	16.0426	15.9927	15.9576	15.9210	
alpha	2.0563	2.0576	2.0589	2.0650	2.0662	2.0716	2.0716	2.0726	2.0695	2.0662	2.0638	2.0614	
util living area													
	0.9491	0.9230	0.8717	0.7751	0.6441	0.5050	0.3965	0.4518	0.6578	0.8465	0.9286	0.9548	(86)
MIT	17.7895	18.1667	18.8177	19.6268	20.2871	20.6996	20.8708	20.8264	20.4499	19.5542	18.5215	17.7150	(87)
Th 2	19.9366	19.9379	19.9392	19.9453	19.9465	19.9518	19.9518	19.9528	19.9497	19.9465	19.9441	19.9417	(88)
util rest of house													
	0.9429	0.9139	0.8564	0.7485	0.6020	0.4434	0.3158	0.3685	0.6001	0.8217	0.9186	0.9493	(89)
MIT 2	16.9944	17.3665	18.0039	18.7843	19.3950	19.7568	19.8883	19.8623	19.5625	18.7362	17.7263	16.9242	(90)
Living area fraction										fLA = Living area / (4) =		0.5900	(91)
MIT	17.4635	17.8387	18.4841	19.2814	19.9214	20.3131	20.4681	20.4312	20.0861	19.2189	18.1955	17.3908	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.4635	17.8387	18.4841	19.2814	19.9214	20.3131	20.4681	20.4312	20.0861	19.2189	18.1955	17.3908	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9237	0.8907	0.8310	0.7295	0.6009	0.4655	0.3568	0.4081	0.6083	0.8011	0.8970	0.9314	(94)
Useful gains	315.4077	373.9063	433.9744	475.9551	454.3978	357.6595	260.1053	262.6255	327.2531	338.1190	310.1927	298.6547	(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													
	990.2699	972.1348	899.3090	774.5429	612.7200	423.6283	286.8172	298.6311	444.7405	642.3435	828.7425	987.5047	(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													
	502.0975	402.0095	346.2089	214.9832	117.7918	0.0000	0.0000	0.0000	0.0000	226.3430	373.3559	512.5044	(98)
Space heating												2695.2942	(98)
Space heating per m2											(98) / (4) =	76.2028	(99)

8c. Space cooling requirement

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												175.1000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												1539.2885	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	502.0975	402.0095	346.2089	214.9832	117.7918	0.0000	0.0000	0.0000	0.0000	226.3430	373.3559	512.5044	(98)
Space heating efficiency (main heating system 1)													
	175.1000	175.1000	175.1000	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175.1000	175.1000	(210)
Space heating fuel (main heating system)													
	286.7490	229.5885	197.7207	122.7774	67.2711	0.0000	0.0000	0.0000	0.0000	129.2650	213.2244	292.6924	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
Efficiency of water heater												175.1000	(216)
(217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(217)
Fuel for water heating, kWh/month													
	83.7153	73.8854	77.8280	70.0895	68.9185	61.9161	59.7824	65.1607	64.9080	72.6630	76.4290	81.8097	(219)
Water heating fuel used												857.1056	(219)
Annual totals kWh/year													
Space heating fuel - main system												1539.2885	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
Total electricity for the above, kWh/year												30.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Total delivered energy for all uses												2599.7226	(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	1539.2885	0.5190	798.8907	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	857.1056	0.5190	444.8378	(264)
Space and water heating			1243.7285	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Total CO2, kg/year			1349.2561	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			38.1500	(273)

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

DER		38.1500	ZC1
Total Floor Area	TFA	35.3700	
Assumed number of occupants	N	1.2895	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		18.4441	ZC2
CO2 emissions from cooking, equation (L16)		4.2394	ZC3
Total CO2 emissions		60.8335	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		60.8335	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1848	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4348	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3696	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4712	0.4620	0.4527	0.4065	0.3973	0.3511	0.3511	0.3419	0.3696	0.3973	0.4158	0.4342	(22b)
Effective ac	0.6110	0.6067	0.6025	0.5826	0.5789	0.5616	0.5616	0.5584	0.5683	0.5789	0.5864	0.5943	(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 Opening Type (Uw = 1.40)			8.8400	1.3258	11.7197			(27)
GF			35.3700	0.1300	4.5981			(28b)
Main	65.2400	8.8400	56.4000	0.1800	10.1520			(29a)
Flat	35.3700		35.3700	0.1300	4.5981			(30)
Total net area of external elements Aum(A, m2)			135.9800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	31.0679			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.1326	(36)
Total fabric heat loss					(33) + (36) =		39.2005	(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	21.8234	21.6694	21.5185	20.8096	20.6770	20.0596	20.0596	19.9453	20.2974	20.6770	20.9453	21.2258	(38)
Heat transfer coeff	61.0239	60.8699	60.7190	60.0101	59.8775	59.2601	59.2601	59.1458	59.4979	59.8775	60.1458	60.4263	(39)
Average = Sum(39)m / 12 =												60.0095	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.7253	1.7209	1.7167	1.6966	1.6929	1.6754	1.6754	1.6722	1.6822	1.6929	1.7005	1.7084	(40)
HLP (average)												1.6966	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		1.2895 (42)
Average daily hot water use (litres/day)		64.8244 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.2538	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.6770	(55)
Total storage loss													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	20.9878	18.9567	20.9878	20.3108	20.9878	20.3108	20.9878	20.9878	20.3108	20.9878	20.3108	20.9878	(56)
If cylinder contains dedicated solar storage													
	20.9878	18.9567	20.9878	20.3108	20.9878	20.3108	20.9878	20.9878	20.3108	20.9878	20.3108	20.9878	(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													
	149.9962	132.4541	139.6876	126.0274	124.0870	111.7159	108.0898	117.5071	116.9546	130.6437	137.1280	146.6596	(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													
	149.9962	132.4541	139.6876	126.0274	124.0870	111.7159	108.0898	117.5071	116.9546	130.6437	137.1280	146.6596	(64)
								Total per year (kWh/year) = Sum(64)m =				1540.9510	(64)
Heat gains from water heating, kWh/month													
	70.5607	62.7260	67.1331	61.9238	61.9459	57.1652	56.6268	59.7581	58.9070	64.1260	65.6147	69.4513	(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	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	9.8146	8.7172	7.0893	5.3671	4.0119	3.3871	3.6598	4.7572	6.3851	8.1073	9.4625	10.0874	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	110.0897	111.2321	108.3533	102.2247	94.4885	87.2176	82.3601	81.2177	84.0965	90.2251	97.9613	105.2323	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	94.8397	93.3422	90.2326	86.0052	83.2606	79.3961	76.1113	80.3200	81.8153	86.1908	91.1315	93.3485	(72)
Total internal gains													
	260.0857	258.6333	251.0170	238.9388	227.1028	215.3424	207.4730	211.6366	217.6387	229.8650	243.8970	254.0099	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.8700	10.6334	0.6300	0.7000	0.7700	15.8261	(74)
East	1.6600	19.6403	0.6300	0.7000	0.7700	9.9639	(76)
West	2.3100	19.6403	0.6300	0.7000	0.7700	13.8654	(80)

Solar gains	39.6553	76.8594	128.1609	194.5116	248.4156	259.5075	244.8698	203.0471	151.0752	91.3146	49.2357	32.7894	(83)
Total gains	299.7410	335.4927	379.1779	433.4504	475.5184	474.8500	452.3428	414.6837	368.7139	321.1796	293.1327	286.7992	(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	40.2506	40.3524	40.4527	40.9306	41.0212	41.4486	41.4486	41.5287	41.2829	41.0212	40.8382	40.6487	
alpha	3.6834	3.6902	3.6968	3.7287	3.7347	3.7632	3.7632	3.7686	3.7522	3.7347	3.7225	3.7099	
util living area													
	0.9922	0.9873	0.9742	0.9355	0.8462	0.6937	0.5433	0.6029	0.8298	0.9573	0.9868	0.9934	(86)
MIT	19.2655	19.4396	19.7701	20.2257	20.6267	20.8792	20.9637	20.9465	20.7468	20.2382	19.6805	19.2400	(87)
Th 2	19.5228	19.5259	19.5289	19.5432	19.5459	19.5585	19.5585	19.5608	19.5536	19.5459	19.5405	19.5348	(88)
util rest of house													
	0.9894	0.9828	0.9645	0.9099	0.7840	0.5757	0.3808	0.4382	0.7364	0.9350	0.9812	0.9911	(89)
MIT 2	17.2967	17.5512	18.0294	18.6791	19.2027	19.4858	19.5476	19.5423	19.3659	18.7129	17.9124	17.2672	(90)
Living area fraction										fLA = Living area / (4) =		0.5900	(91)
MIT	18.4584	18.6655	19.0565	19.5917	20.0429	20.3080	20.3832	20.3708	20.1807	19.6129	18.9556	18.4312	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.4584	18.6655	19.0565	19.5917	20.0429	20.3080	20.3832	20.3708	20.1807	19.6129	18.9556	18.4312	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9867	0.9793	0.9605	0.9109	0.8078	0.6410	0.4772	0.5355	0.7820	0.9363	0.9781	0.9886	(94)
Useful gains	295.7482	328.5322	364.2042	394.8254	384.1199	304.3711	215.8396	222.0554	288.3430	300.7053	286.7275	283.5287	(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													
	863.9990	837.9041	762.4167	641.6106	499.5535	338.2541	224.1912	234.8581	361.7907	539.6721	713.0676	859.9414	(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													
	422.7787	342.2980	296.2701	177.6853	85.8826	0.0000	0.0000	0.0000	0.0000	177.7913	306.9649	428.8510	(98)
Space heating												2238.5220	(98)
Space heating per m2											(98) / (4) =	63.2887	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2394.1412	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	422.7787	342.2980	296.2701	177.6853	85.8826	0.0000	0.0000	0.0000	0.0000	177.7913	306.9649	428.8510	(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)													
	452.1697	366.0941	316.8664	190.0378	91.8531	0.0000	0.0000	0.0000	0.0000	190.1512	328.3047	458.6642	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	149.9962	132.4541	139.6876	126.0274	124.0870	111.7159	108.0898	117.5071	116.9546	130.6437	137.1280	146.6596	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.4300	87.2365	86.7720	85.7300	83.8552	79.8000	79.8000	79.8000	79.8000	85.6363	86.9020	87.5098	(217)
Fuel for water heating, kWh/month													
	171.5615	151.8332	160.9823	147.0050	147.9777	139.9949	135.4509	147.2520	146.5596	152.5564	157.7962	167.5921	(219)
Water heating fuel used												1826.5618	(219)
Annual totals kWh/year													
Space heating fuel - main system												2394.1412	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Total delivered energy for all uses												4469.0315	(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	2394.1412	0.2160	517.1345	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1826.5618	0.2160	394.5373	(264)
Space and water heating			911.6718	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Total CO2, kg/m2/year			1040.5543	(272)
Emissions per m2 for space and water heating			25.7753	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			2.5433	(272b)
Emissions per m2 for pumps and fans			1.1005	(272c)
Target Carbon Dioxide Emission Rate (TER) = (25.7753 * 1.55) + 2.5433 + 1.1005, rounded to 2 d.p.			43.6000	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1848	(8)
Pressure test		Yes	
Measured/design AP50		4.9500	
Infiltration rate		0.4323	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3674	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4685	0.4593	0.4501	0.4042	0.3950	0.3491	0.3491	0.3399	0.3674	0.3950	0.4134	0.4317	(22b)
Effective ac	0.6097	0.6055	0.6013	0.5817	0.5780	0.5609	0.5609	0.5578	0.5675	0.5780	0.5854	0.5932	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	65.2400	16.5900	48.6500	0.2300	11.1895	9.0000	437.8500	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			135.9800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	47.3318			(33)
Party Wall 1			9.4900	0.0000	0.0000	20.0000	189.8000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		4290.8300	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							121.3127	(35)
Thermal bridges (User defined value 0.056 * total exposed area)							7.6149	(36)
Total fabric heat loss					(33) + (36) =		54.9467	(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	21.7779	21.6257	21.4765	20.7758	20.6447	20.0344	20.0344	19.9214	20.2695	20.6447	20.9099	21.1872	(38)
Heat transfer coeff	76.7246	76.5724	76.4232	75.7225	75.5914	74.9811	74.9811	74.8681	75.2162	75.5914	75.8566	76.1339	(39)
Average = Sum(39)m / 12 =												75.7219	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1692	2.1649	2.1607	2.1409	2.1372	2.1199	2.1199	2.1167	2.1266	2.1372	2.1447	2.1525	(40)
HLP (average)												2.1409	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895	(42)
Average daily hot water use (litres/day)	64.8244	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage

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

Heat gains from water heating, kWh/month

	22.4710	19.6533	20.2805	17.6810	16.9653	14.6398	13.5659	15.5671	15.7530	18.3586	20.0399	21.7620 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	(66)

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

	9.8146	8.7172	7.0893	5.3671	4.0119	3.3871	3.6598	4.7572	6.3851	8.1073	9.4625	10.0874 (67)

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

	110.0897	111.2321	108.3533	102.2247	94.4885	87.2176	82.3601	81.2177	84.0965	90.2251	97.9613	105.2323 (68)

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

	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473 (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)

	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780 (71)

Water heating gains (Table 5)

	30.2030	29.2460	27.2587	24.5569	22.8029	20.3330	18.2338	20.9235	21.8792	24.6756	27.8331	29.2500 (72)

Total internal gains

	192.4491	191.5371	185.0431	174.4905	163.6451	153.2794	146.5955	149.2402	154.7025	165.3497	177.5987	186.9114 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	9.1400	10.6334	0.7200	0.7000	0.7700	33.9455	(74)
East	3.1200	19.6403	0.7200	0.7000	0.7700	21.4026	(76)
West	4.3300	19.6403	0.7200	0.7000	0.7700	29.7029	(80)

Solar gains	85.0509	164.8447	274.8741	417.1816	532.7943	556.5848	525.1898	435.4886	324.0202	195.8476	105.5986	70.3253 (83)
Total gains	277.5000	356.3817	459.9172	591.6721	696.4394	709.8642	671.7853	584.7288	478.7227	361.1974	283.1973	257.2366 (84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	15.5347	15.5656	15.5960	15.7403	15.7676	15.8960	15.8960	15.9200	15.8463	15.7676	15.7125	15.6553	
alpha	2.0356	2.0377	2.0397	2.0494	2.0512	2.0597	2.0597	2.0613	2.0564	2.0512	2.0475	2.0437	
util living area	0.9649	0.9420	0.8955	0.8037	0.6754	0.5360	0.4259	0.4876	0.6996	0.8791	0.9495	0.9696	(86)
MIT	17.5445	17.9383	18.6213	19.4873	20.2008	20.6571	20.8490	20.7954	20.3660	19.3900	18.3062	17.4757	(87)
Th 2	19.2229	19.2257	19.2284	19.2411	19.2435	19.2546	19.2546	19.2567	19.2503	19.2435	19.2386	19.2336	(88)
util rest of house	0.9571	0.9294	0.8725	0.7605	0.6032	0.4263	0.2788	0.3352	0.5995	0.8414	0.9363	0.9629	(89)
MIT 2	16.2249	16.6123	17.2761	18.0977	18.7276	19.0946	19.2142	19.1949	18.9046	18.0430	16.9903	16.1637	(90)
Living area fraction									fLA = Living area / (4) =			0.5900	(91)
MIT	17.0035	17.3947	18.0698	18.9176	19.5969	20.0165	20.1788	20.1393	19.7669	18.8378	17.7668	16.9378	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.0035	17.3947	18.0698	18.9176	19.5969	20.0165	20.1788	20.1393	19.7669	18.8378	17.7668	16.9378	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9433	0.9117	0.8534	0.7511	0.6193	0.4775	0.3609	0.4177	0.6331	0.8304	0.9210	0.9503	(94)
Useful gains	261.7676	324.9203	392.4937	444.4142	431.2738	338.9510	242.4369	244.2363	303.0556	299.9386	260.8328	244.4626	(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	974.6712	956.7504	884.2046	758.5604	596.9375	406.1370	268.3414	279.9544	426.2402	622.7070	809.1442	969.7807	(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	530.4003	424.5898	365.8329	226.1853	123.2538	0.0000	0.0000	0.0000	0.0000	240.1397	394.7842	539.6367	(98)
Space heating												2844.8228	(98)
Space heating per m2											(98) / (4) =	80.4304	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	704.8221	554.8600	568.9972	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7441	0.7971	0.7539	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	524.4904	442.2786	428.9530	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	879.3449	833.9823	732.8648	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	255.4953	291.4275	226.1104	0.0000	0.0000	0.0000	0.0000	(104)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling												773.0332 (104)
Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000		0.0000 (106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	63.8738	72.8569	56.5276	0.0000	0.0000	0.0000		0.0000 (107)
Space cooling												193.2583 (107)
Space cooling per m2												5.4639 (108)
Energy for space heating												80.4304 (99)
Energy for space cooling												5.4639 (108)
Total												85.8943 (109)
Dwelling Fabric Energy Efficiency (DFEE)												85.9 (109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000	/ (5) =	0.1848	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.4348	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3696	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4712	0.4620	0.4527	0.4065	0.3973	0.3511	0.3511	0.3419	0.3696	0.3973	0.4158	0.4342	(22b)
Effective ac	0.6110	0.6067	0.6025	0.5826	0.5789	0.5616	0.5616	0.5584	0.5683	0.5789	0.5864	0.5943	(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 Opening Type (Uw = 1.40)			8.8400	1.3258	11.7197			(27)
GF			35.3700	0.1300	4.5981			(28b)
Main	65.2400	8.8400	56.4000	0.1800	10.1520			(29a)
Flat	35.3700		35.3700	0.1300	4.5981			(30)
Total net area of external elements Aum(A, m2)			135.9800					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		31.0679			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.1326	(36)
Total fabric heat loss					(33) + (36) =		39.2005	(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	21.8234	21.6694	21.5185	20.8096	20.6770	20.0596	20.0596	19.9453	20.2974	20.6770	20.9453	21.2258	(38)
Heat transfer coeff	61.0239	60.8699	60.7190	60.0101	59.8775	59.2601	59.2601	59.1458	59.4979	59.8775	60.1458	60.4263	(39)
Average = Sum(39)m / 12 =												60.0095	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.7253	1.7209	1.7167	1.6966	1.6929	1.6754	1.6754	1.6722	1.6822	1.6929	1.7005	1.7084	(40)
HLP (average)												1.6966	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895	(42)
Average daily hot water use (litres/day)	64.8244	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(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)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Heat gains from water heating, kWh/month

	22.4710	19.6533	20.2805	17.6810	16.9653	14.6398	13.5659	15.5671	15.7530	18.3586	20.0399	21.7620 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	9.8146	8.7172	7.0893	5.3671	4.0119	3.3871	3.6598	4.7572	6.3851	8.1073	9.4625	10.0874	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	110.0897	111.2321	108.3533	102.2247	94.4885	87.2176	82.3601	81.2177	84.0965	90.2251	97.9613	105.2323	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	30.2030	29.2460	27.2587	24.5569	22.8029	20.3330	18.2338	20.9235	21.8792	24.6756	27.8331	29.2500	(72)
Total internal gains													
	192.4491	191.5371	185.0431	174.4905	163.6451	153.2794	146.5955	149.2402	154.7025	165.3497	177.5987	186.9114	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	4.8700	10.6334	0.6300	0.7000	0.7700	15.8261	(74)
East	1.6600	19.6403	0.6300	0.7000	0.7700	9.9639	(76)
West	2.3100	19.6403	0.6300	0.7000	0.7700	13.8654	(80)

Solar gains	39.6553	76.8594	128.1609	194.5116	248.4156	259.5075	244.8698	203.0471	151.0752	91.3146	49.2357	32.7894	(83)
Total gains	232.1043	268.3965	313.2039	369.0022	412.0607	412.7870	391.4653	352.2873	305.7778	256.6643	226.8344	219.7007	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	40.2506	40.3524	40.4527	40.9306	41.0212	41.4486	41.4486	41.5287	41.2829	41.0212	40.8382	40.6487	
alpha	3.6834	3.6902	3.6968	3.7287	3.7347	3.7632	3.7632	3.7686	3.7522	3.7347	3.7225	3.7099	
util living area													
	0.9967	0.9939	0.9858	0.9589	0.8888	0.7554	0.6097	0.6785	0.8879	0.9782	0.9943	0.9973	(86)
MIT	19.1067	19.2845	19.6241	20.1010	20.5394	20.8365	20.9466	20.9199	20.6634	20.1020	19.5267	19.0814	(87)
Th 2	19.5228	19.5259	19.5289	19.5432	19.5459	19.5585	19.5585	19.5608	19.5536	19.5459	19.5405	19.5348	(88)
util rest of house													
	0.9955	0.9916	0.9801	0.9410	0.8372	0.6407	0.4356	0.5066	0.8123	0.9656	0.9918	0.9963	(89)
MIT 2	17.8454	18.0247	18.3637	18.8394	19.2443	19.4873	19.5468	19.5403	19.3695	18.8504	18.2777	17.8291	(90)
Living area fraction									fLA = Living area / (4) =			0.5900	(91)
MIT	18.5896	18.7681	19.1074	19.5838	20.0085	20.2834	20.3727	20.3543	20.1330	19.5889	19.0147	18.5680	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.5896	18.7681	19.1074	19.5838	20.0085	20.2834	20.3727	20.3543	20.1330	19.5889	19.0147	18.5680	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9944	0.9900	0.9780	0.9416	0.8560	0.7034	0.5391	0.6084	0.8478	0.9661	0.9905	0.9954	(94)
Useful gains	230.8017	265.7159	306.3006	347.4567	352.7406	290.3365	211.0562	214.3183	259.2303	247.9527	224.6835	218.6967	(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													
	872.0085	844.1492	765.5071	641.1368	497.4924	336.7993	223.5727	233.8820	358.9491	538.2331	716.6185	868.2073	(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													
	477.0579	388.7072	341.6496	211.4497	107.6953	0.0000	0.0000	0.0000	0.0000	215.9686	354.1932	483.2359	(98)
Space heating												2579.9574	(98)
Space heating per m2											(98) / (4) =	72.9420	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	557.0451	438.5249	449.5079	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7716	0.8428	0.8003	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	429.8162	369.5780	359.7420	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	532.1118	506.3355	461.1799	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	73.6528	101.7476	75.4698	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												250.8702	(104)
Cooled fraction									fC = cooled area / (4) =			1.0000	(105)

Intermittency factor (Table 10b)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	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	18.4132	25.4369	18.8675	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												62.7176 (107)
Space cooling per m2												1.7732 (108)
Energy for space heating												72.9420 (99)
Energy for space cooling												1.7732 (108)
Total												74.7152 (109)
Target Fabric Energy Efficiency (TFEE)												85.9 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		4.9500	
Infiltration rate		0.3399	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2889	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	6.6000	6.2000	5.9000	5.1000	4.9000	4.6000	4.2000	4.3000	4.9000	5.4000	5.9000	5.7000	(22)
Wind factor	1.6500	1.5500	1.4750	1.2750	1.2250	1.1500	1.0500	1.0750	1.2250	1.3500	1.4750	1.4250	(22a)
Adj infilt rate	0.4767	0.4478	0.4261	0.3684	0.3539	0.3322	0.3034	0.3106	0.3539	0.3900	0.4261	0.4117	(22b)
Effective ac	0.6136	0.6003	0.5908	0.5678	0.5626	0.5552	0.5460	0.5482	0.5626	0.5761	0.5908	0.5847	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	65.2400	16.5900	48.6500	0.2300	11.1895	9.0000	437.8500	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			135.9800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	47.3318			(33)
Party Wall 1			9.4900	0.0000	0.0000	20.0000	189.8000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		4290.8300	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							121.3127	(35)
Thermal bridges (User defined value 0.056 * total exposed area)							7.6149	(36)
Total fabric heat loss					(33) + (36) =		54.9467	(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	21.9165	21.4395	21.1013	20.2815	20.0952	19.8296	19.5017	19.5809	20.0952	20.5750	21.1013	20.8852	(38)
Heat transfer coeff	76.8632	76.3862	76.0480	75.2282	75.0419	74.7763	74.4484	74.5276	75.0419	75.5217	76.0480	75.8319	(39)
Average = Sum(39)m / 12 =												75.4803	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1731	2.1596	2.1501	2.1269	2.1216	2.1141	2.1048	2.1071	2.1216	2.1352	2.1501	2.1440	(40)
HLP (average)												2.1340	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895	(42)
Average daily hot water use (litres/day)	64.8244	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0500	(48)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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  Temperature factor from Table 2b                                                                                0.5400 (49)
Enter (49) or (54) in (55)                                                                                        0.5670 (55)
Total storage loss
               17.5770    15.8760    17.5770    17.0100    17.5770    17.0100    17.5770    17.5770    17.0100    17.5770    17.0100    17.5770 (56)
If cylinder contains dedicated solar storage
               17.5770    15.8760    17.5770    17.0100    17.5770    17.0100    17.5770    17.5770    17.0100    17.5770    17.0100    17.5770 (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
              146.5855   129.3734   136.2768   122.7267   120.6763   108.4151   104.6790   114.0963   113.6538   127.2329   133.8273   143.2488 (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
              146.5855   129.3734   136.2768   122.7267   120.6763   108.4151   104.6790   114.0963   113.6538   127.2329   133.8273   143.2488 (64)
                                                                                    Total per year (kWh/year) = Sum(64)m =   1500.7919 (64)
RHI water heating demand                                                                                          1501 (64)
Heat gains from water heating, kWh/month
               67.8321    60.2614    64.4045    59.2832    59.2173    54.5246    53.8982    57.0294    56.2664    61.3974    62.9741    66.7226 (65)
```

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

```
Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m          77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               24.5364    21.7931    17.7233    13.4177    10.0299     8.4676     9.1496    11.8930    15.9627    20.2684    23.6562    25.2184 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              164.3130   166.0181   161.7214   152.5743   141.0276   130.1755   122.9255   121.2205   125.5172   134.6643   146.2109   157.0631 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262 (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)
              -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780 (71)
Water heating gains (Table 5)
               91.1722    89.6747    86.5651    82.3377    79.5931    75.7286    72.4438    76.6525    78.1478    82.5233    87.4640    89.6810 (72)
Total internal gains
              352.8368   350.3010   338.8250   321.1448   303.4658   287.1868   277.3341   282.5811   292.4429   310.2711   330.1462   344.7776 (73)
```

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6. Solar gains

```
[Jan]                                    Area          Solar flux              g                FF            Access            Gains
                                          m2             Table 6a      Specific data    Specific data        factor                W
                                                            W/m2      or Table 6b      or Table 6c      Table 6d
-----------------------------------------------------------------------------------------------------------------------------------
North                                   9.1400           10.3621           0.7200           0.7000           0.7700           33.0794 (74)
East                                    3.1200           19.0327           0.7200           0.7000           0.7700           20.7404 (76)
West                                    4.3300           19.0327           0.7200           0.7000           0.7700           28.7840 (80)
-----------------------------------------------------------------------------------------------------------------------------------

Solar gains    82.6038   159.9685   278.9235   428.8130   549.2388   553.3461   527.6267   441.2155   324.9600   191.1362   100.1345    67.6917 (83)
Total gains   435.4406   510.2695   617.7485   749.9578   852.7046   840.5329   804.9608   723.7966   617.4029   501.4073   430.2808   412.4693 (84)
```

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7. Mean internal temperature (heating season)

```
Temperature during heating periods in the living area from Table 9, Th1 (C)                                     21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau            15.5067    15.6036    15.6730    15.8438    15.8831    15.9395    16.0097    15.9927    15.8831    15.7822    15.6730    15.7176
alpha           2.0338     2.0402     2.0449     2.0563     2.0589     2.0626     2.0673     2.0662     2.0589     2.0521     2.0449     2.0478
util living area
                0.9321     0.9076     0.8590     0.7742     0.6682     0.5676     0.4843     0.5274     0.6879     0.8395     0.9134     0.9388 (86)

MIT            17.6961    18.0408    18.6501    19.4242    20.0666    20.5041    20.7259    20.6705    20.2391    19.3578    18.3610    17.6204 (87)
Th 2           19.9134    19.9202    19.9250    19.9366    19.9392    19.9429    19.9476    19.9465    19.9392    19.9324    19.9250    19.9280 (88)
util rest of house
                0.9247     0.8978     0.8442     0.7509     0.6340     0.5192     0.4224     0.4647     0.6433     0.8172     0.9027     0.9322 (89)
MIT 2          16.8830    17.2257    17.8237    18.5762    19.1799    19.5796    19.7723    19.7314    19.3578    18.5290    17.5503    16.8179 (90)
Living area fraction                                                                                fLA = Living area / (4) =      0.5900 (91)
MIT            17.3627    17.7066    18.3113    19.0766    19.7031    20.1251    20.3350    20.2855    19.8778    19.0180    18.0287    17.2914 (92)
Temperature adjustment                                                                                            0.0000
adjusted MIT   17.3627    17.7066    18.3113    19.0766    19.7031    20.1251    20.3350    20.2855    19.8778    19.0180    18.0287    17.2914 (93)
```

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8. Space heating requirement

```
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation     0.9019     0.8723     0.8175     0.7296     0.6258     0.5280     0.4461     0.4859     0.6404     0.7946     0.8786     0.9106 (94)
Useful gains  392.7053   445.0991   504.9874   547.1613   533.6509   443.8052   359.1118   351.6647   395.4098   398.4109   378.0555   375.5843 (95)
Ext temp.       3.1000     3.6000     5.0000     7.2000     9.8000    12.7000    14.7000    14.6000    12.4000     9.1000     5.7000     2.9000 (96)
Heat loss rate W
             1096.2797  1077.5512  1012.3011   893.4527   743.1474   555.2208   419.5136   423.7300   561.1496   749.0270   937.5704  1091.3277 (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
              523.4594   425.0078   377.4414   249.3298   155.8654     0.0000     0.0000     0.0000     0.0000   260.8584   402.8507   532.5132 (98)
Space heating                                                                                                  2927.3260 (98)
RHI space heating demand                                                                                         2927 (98)
```

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SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
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1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		4.9500	
Infiltration rate		0.3399	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2889	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3684	0.3611	0.3539	0.3178	0.3106	0.2745	0.2745	0.2672	0.2889	0.3106	0.3250	0.3395	(22b)
Effective ac	0.5678	0.5652	0.5626	0.5505	0.5482	0.5377	0.5377	0.5357	0.5417	0.5482	0.5528	0.5576	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	65.2400	16.5900	48.6500	0.2300	11.1895	9.0000	437.8500	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			135.9800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	47.3318			(33)
Party Wall 1			9.4900	0.0000	0.0000	20.0000	189.8000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		4290.8300	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							121.3127	(35)
Thermal bridges (User defined value 0.056 * total exposed area)							7.6149	(36)
Total fabric heat loss					(33) + (36) =		54.9467	(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	20.2815	20.1874	20.0952	19.6620	19.5809	19.2036	19.2036	19.1337	19.3489	19.5809	19.7449	19.9163	(38)
Heat transfer coeff	75.2282	75.1341	75.0419	74.6087	74.5276	74.1503	74.1503	74.0804	74.2956	74.5276	74.6916	74.8630	(39)
Average = Sum(39)m / 12 =												74.6083	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1269	2.1242	2.1216	2.1094	2.1071	2.0964	2.0964	2.0944	2.1005	2.1071	2.1117	2.1166	(40)
HLP (average)												2.1094	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895	(42)
Average daily hot water use (litres/day)	64.8244	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0500	(48)

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  Temperature factor from Table 2b                                                                                0.5400 (49)
Enter (49) or (54) in (55)                                                                                        0.5670 (55)
Total storage loss
              17.5770    15.8760    17.5770    17.0100    17.5770    17.0100    17.5770    17.5770    17.0100    17.5770    17.0100    17.5770 (56)
If cylinder contains dedicated solar storage
              17.5770    15.8760    17.5770    17.0100    17.5770    17.0100    17.5770    17.5770    17.0100    17.5770    17.0100    17.5770 (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
             146.5855   129.3734   136.2768   122.7267   120.6763   108.4151   104.6790   114.0963   113.6538   127.2329   133.8273   143.2488 (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
             146.5855   129.3734   136.2768   122.7267   120.6763   108.4151   104.6790   114.0963   113.6538   127.2329   133.8273   143.2488 (64)
                                                                                  Total per year (kWh/year) = Sum(64)m =   1500.7919 (64)
Heat gains from water heating, kWh/month
              67.8321    60.2614    64.4045    59.2832    59.2173    54.5246    53.8982    57.0294    56.2664    61.3974    62.9741    66.7226 (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         77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              24.5364    21.7931    17.7233    13.4177    10.0299     8.4676     9.1496    11.8930    15.9627    20.2684    23.6562    25.2184 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             164.3130   166.0181   161.7214   152.5743   141.0276   130.1755   122.9255   121.2205   125.5172   134.6643   146.2109   157.0631 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262 (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)
             -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780 (71)
Water heating gains (Table 5)
              91.1722    89.6747    86.5651    82.3377    79.5931    75.7286    72.4438    76.6525    78.1478    82.5233    87.4640    89.6810 (72)
Total internal gains
             352.8368   350.3010   338.8250   321.1448   303.4658   287.1868   277.3341   282.5811   292.4429   310.2711   330.1462   344.7776 (73)


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6. Solar gains
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[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
-------------------------------------------------------------------------------------------------------------
North                                 9.1400            10.6334            0.7200           0.7000      0.7700            33.9455 (74)
East                                  3.1200            19.6403            0.7200           0.7000      0.7700            21.4026 (76)
West                                  4.3300            19.6403            0.7200           0.7000      0.7700            29.7029 (80)
-------------------------------------------------------------------------------------------------------------

Solar gains   85.0509   164.8447   274.8741   417.1816   532.7943   556.5848   525.1898   435.4886   324.0202   195.8476   105.5986    70.3253 (83)
Total gains  437.8877   515.1457   613.6991   738.3264   836.2601   843.7716   802.5239   718.0697   616.4630   506.1188   435.7449   415.1029 (84)


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7. Mean internal temperature (heating season)
-------------------------------------------------------------------------------------------------------------
Temperature during heating periods in the living area from Table 9, Th1 (C)                                     21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau           15.8438    15.8636    15.8831    15.9753    15.9927    16.0741    16.0741    16.0892    16.0426    15.9927    15.9576    15.9210
alpha          2.0563     2.0576     2.0589     2.0650     2.0662     2.0716     2.0716     2.0726     2.0695     2.0662     2.0638     2.0614
util living area
               0.9223     0.8930     0.8378     0.7386     0.6089     0.4723     0.3666     0.4154     0.6104     0.8028     0.8960     0.9295 (86)

MIT           18.0643    18.4168    19.0209    19.7640    20.3636    20.7363    20.8889    20.8525    20.5274    19.7239    18.7611    17.9900 (87)
Th 2          19.9366    19.9379    19.9392    19.9453    19.9465    19.9518    19.9518    19.9528    19.9497    19.9465    19.9441    19.9417 (88)
util rest of house
               0.9135     0.8811     0.8198     0.7100     0.5662     0.4124     0.2903     0.3361     0.5517     0.7737     0.8825     0.9214 (89)
MIT 2         17.2631    17.6086    18.1965    18.9082    19.4583    19.7823    19.8978    19.8770    19.6222    18.8911    17.9574    17.1937 (90)
Living area fraction                                                                                fLA = Living area / (4) =      0.5900 (91)
MIT           17.7359    18.0854    18.6829    19.4131    19.9925    20.3452    20.4826    20.4526    20.1563    19.3825    18.4316    17.6636 (92)
Temperature adjustment                                                                                           0.0000
adjusted MIT  17.7359    18.0854    18.6829    19.4131    19.9925    20.3452    20.4826    20.4526    20.1563    19.3825    18.4316    17.6636 (93)


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8. Space heating requirement
-------------------------------------------------------------------------------------------------------------

                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation    0.8900     0.8554     0.7946     0.6939     0.5682     0.4357     0.3300     0.3752     0.5640     0.7556     0.8582     0.8988 (94)
Useful gains 389.7109   440.6705   487.6619   512.3143   475.1547   367.6594   264.8304   269.4438   347.7144   382.4451   373.9531   373.1101 (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
            1010.7558   990.6758   914.2274   784.3711   618.0186   426.0091   287.8977   300.2187   449.9586   654.5415   846.3767  1007.9226 (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
             462.0573   369.6036   317.3647   195.8809   106.2907     0.0000     0.0000     0.0000     0.0000   202.4398   340.1450   472.3005 (98)
Space heating                                                                                                   2466.0825 (98)
Space heating per m2                                                                                  (98) / (4) =     69.7224 (99)


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8c. Space cooling requirement
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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 %)	175.1000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1408.3852	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	462.0573	369.6036	317.3647	195.8809	106.2907	0.0000	0.0000	0.0000	0.0000	202.4398	340.1450	472.3005	(98)
Space heating efficiency (main heating system 1)	175.1000	175.1000	175.1000	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175.1000	175.1000	(210)
Space heating fuel (main heating system)	263.8820	211.0814	181.2477	111.8680	60.7029	0.0000	0.0000	0.0000	0.0000	115.6138	194.2576	269.7318	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
Efficiency of water heater												175.1000	(216)
(217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(217)
Fuel for water heating, kWh/month	83.7153	73.8854	77.8280	70.0895	68.9185	61.9161	59.7824	65.1607	64.9080	72.6630	76.4290	81.8097	(219)
Water heating fuel used												857.1056	(219)
Annual totals kWh/year													
Space heating fuel - main system												1408.3852	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
Total electricity for the above, kWh/year												30.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Total delivered energy for all uses												2468.8193	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1408.3852	13.1900	185.7660	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	857.1056	13.1900	113.0522	(247)
Pumps and fans for heating	30.0000	13.1900	3.9570	(249)
Energy for lighting	173.3285	13.1900	22.8620	(250)
Additional standing charges			0.0000	(251)
Total energy cost			325.6373	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.7017	(257)
SAP value		76.2609	
SAP rating (Section 12)		76	(258)
SAP band		C	

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	1408.3852	0.5190	730.9519	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	857.1056	0.5190	444.8378	(264)
Space and water heating			1175.7897	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Total kg/year			1281.3172	(272)
CO2 emissions per m2			36.2300	(273)
EI value			78.6367	
EI rating			79	(274)
EI band			C	

Calculation of stars for heating and DHW

Main heating energy efficiency	13.19 × (1 + 0.29 × 0.00) / 1.7510 = 7.533, stars = 2
Main heating environmental impact	0.519 × (1 + 0.29 × 0.00) / 1.7510 = 0.2964, stars = 4
Water heating energy efficiency	13.19 / 1.7510 = 7.533, stars = 2
Water heating environmental impact	0.519 / 1.7510 = 0.2964, stars = 4

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		4.9500	
Infiltration rate		0.3399	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2889	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	6.6000	6.2000	5.9000	5.1000	4.9000	4.6000	4.2000	4.3000	4.9000	5.4000	5.9000	5.7000	(22)
Wind factor	1.6500	1.5500	1.4750	1.2750	1.2250	1.1500	1.0500	1.0750	1.2250	1.3500	1.4750	1.4250	(22a)
Adj infilt rate	0.4767	0.4478	0.4261	0.3684	0.3539	0.3322	0.3034	0.3106	0.3539	0.3900	0.4261	0.4117	(22b)
Effective ac	0.6136	0.6003	0.5908	0.5678	0.5626	0.5552	0.5460	0.5482	0.5626	0.5761	0.5908	0.5847	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	65.2400	16.5900	48.6500	0.2300	11.1895	9.0000	437.8500	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			135.9800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	47.3318			(33)
Party Wall 1			9.4900	0.0000	0.0000	20.0000	189.8000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		4290.8300	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							121.3127	(35)
Thermal bridges (User defined value 0.056 * total exposed area)							7.6149	(36)
Total fabric heat loss					(33) + (36) =		54.9467	(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	21.9165	21.4395	21.1013	20.2815	20.0952	19.8296	19.5017	19.5809	20.0952	20.5750	21.1013	20.8852	(38)
Heat transfer coeff	76.8632	76.3862	76.0480	75.2282	75.0419	74.7763	74.4484	74.5276	75.0419	75.5217	76.0480	75.8319	(39)
Average = Sum(39)m / 12 =												75.4803	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1731	2.1596	2.1501	2.1269	2.1216	2.1141	2.1048	2.1071	2.1216	2.1352	2.1501	2.1440	(40)
HLP (average)												2.1340	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895	(42)
Average daily hot water use (litres/day)	64.8244	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0500	(48)

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

Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.5670	(55)
Total storage loss													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(56)
If cylinder contains dedicated solar storage													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(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													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(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													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
								Total per year (kWh/year) = Sum(64)m =				1500.7919	(64)
Heat gains from water heating, kWh/month													
	67.8321	60.2614	64.4045	59.2832	59.2173	54.5246	53.8982	57.0294	56.2664	61.3974	62.9741	66.7226	(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	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.5364	21.7931	17.7233	13.4177	10.0299	8.4676	9.1496	11.8930	15.9627	20.2684	23.6562	25.2184	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	164.3130	166.0181	161.7214	152.5743	141.0276	130.1755	122.9255	121.2205	125.5172	134.6643	146.2109	157.0631	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	91.1722	89.6747	86.5651	82.3377	79.5931	75.7286	72.4438	76.6525	78.1478	82.5233	87.4640	89.6810	(72)
Total internal gains													
	352.8368	350.3010	338.8250	321.1448	303.4658	287.1868	277.3341	282.5811	292.4429	310.2711	330.1462	344.7776	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	9.1400	10.3621	0.7200	0.7000	0.7700	33.0794	(74)
East	3.1200	19.0327	0.7200	0.7000	0.7700	20.7404	(76)
West	4.3300	19.0327	0.7200	0.7000	0.7700	28.7840	(80)

Solar gains	82.6038	159.9685	278.9235	428.8130	549.2388	553.3461	527.6267	441.2155	324.9600	191.1362	100.1345	67.6917	(83)
Total gains	435.4406	510.2695	617.7485	749.9578	852.7046	840.5329	804.9608	723.7966	617.4029	501.4073	430.2808	412.4693	(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	15.5067	15.6036	15.6730	15.8438	15.8831	15.9395	16.0097	15.9927	15.8831	15.7822	15.6730	15.7176	
alpha	2.0338	2.0402	2.0449	2.0563	2.0589	2.0626	2.0673	2.0662	2.0589	2.0521	2.0449	2.0478	
util living area													
	0.9321	0.9076	0.8590	0.7742	0.6682	0.5676	0.4843	0.5274	0.6879	0.8395	0.9134	0.9388	(86)
MIT	17.6961	18.0408	18.6501	19.4242	20.0666	20.5041	20.7259	20.6705	20.2391	19.3578	18.3610	17.6204	(87)
Th 2	19.9134	19.9202	19.9250	19.9366	19.9392	19.9429	19.9476	19.9465	19.9392	19.9324	19.9250	19.9280	(88)
util rest of house													
	0.9247	0.8978	0.8442	0.7509	0.6340	0.5192	0.4224	0.4647	0.6433	0.8172	0.9027	0.9322	(89)
MIT 2	16.8830	17.2257	17.8237	18.5762	19.1799	19.5796	19.7723	19.7314	19.3578	18.5290	17.5503	16.8179	(90)
Living area fraction										fLA = Living area / (4) =		0.5900	(91)
MIT	17.3627	17.7066	18.3113	19.0766	19.7031	20.1251	20.3350	20.2855	19.8778	19.0180	18.0287	17.2914	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.3627	17.7066	18.3113	19.0766	19.7031	20.1251	20.3350	20.2855	19.8778	19.0180	18.0287	17.2914	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9019	0.8723	0.8175	0.7296	0.6258	0.5280	0.4461	0.4859	0.6404	0.7946	0.8786	0.9106	(94)
Useful gains	392.7053	445.0991	504.9874	547.1613	533.6509	443.8052	359.1118	351.6647	395.4098	398.4109	378.0555	375.5843	(95)
Ext temp.	3.1000	3.6000	5.0000	7.2000	9.8000	12.7000	14.7000	14.6000	12.4000	9.1000	5.7000	2.9000	(96)
Heat loss rate W													
	1096.2797	1077.5512	1012.3011	893.4527	743.1474	555.2208	419.5136	423.7300	561.1496	749.0270	937.5704	1091.3277	(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													
	523.4594	425.0078	377.4414	249.3298	155.8654	0.0000	0.0000	0.0000	0.0000	260.8584	402.8507	532.5132	(98)
Space heating												2927.3260	(98)
Space heating per m2											(98) / (4) =	82.7630	(99)

8c. Space cooling requirement

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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 %)												175.1000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												1671.8024	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	523.4594	425.0078	377.4414	249.3298	155.8654	0.0000	0.0000	0.0000	0.0000	260.8584	402.8507	532.5132	(98)
Space heating efficiency (main heating system 1)													
	175.1000	175.1000	175.1000	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175.1000	175.1000	(210)
Space heating fuel (main heating system)													
	298.9488	242.7229	215.5576	142.3928	89.0151	0.0000	0.0000	0.0000	0.0000	148.9768	230.0690	304.1194	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
Efficiency of water heater												175.1000	(216)
(217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(217)
Fuel for water heating, kWh/month													
	83.7153	73.8854	77.8280	70.0895	68.9185	61.9161	59.7824	65.1607	64.9080	72.6630	76.4290	81.8097	(219)
Water heating fuel used												857.1056	(219)
Annual totals kWh/year													
Space heating fuel - main system												1671.8024	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
Total electricity for the above, kWh/year												30.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Total delivered energy for all uses												2732.2365	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1671.8024	18.7000	312.6270	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	857.1056	18.7000	160.2787	(247)
Pumps and fans for heating	30.0000	18.7000	5.6100	(249)
Energy for lighting	173.3285	18.7000	32.4124	(250)
Additional standing charges			0.0000	(251)
Total energy cost			510.9282	(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	1671.8024	0.5190	867.6654	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	857.1056	0.5190	444.8378	(264)
Space and water heating			1312.5032	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Total kg/year			1418.0307	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	1671.8024	3.0700	5132.4333	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	857.1056	3.0700	2631.3142	(264)
Space and water heating			7763.7474	(265)
Pumps and fans	30.0000	3.0700	92.1000	(267)
Energy for lighting	173.3285	3.0700	532.1186	(268)
Primary energy kWh/year			8387.9660	(272)
Primary energy kWh/m2/year			237.1492	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: C 76
Current environmental impact rating: C 79

(For testing purposes):

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

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 3.6	-£ 71	-196 kg (13.8%)
U Solar photovoltaic panels	+ 16.6	-£ 326	-906 kg (74.1%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£71	5.54 kg/m²	C 80	B 82
Solar photovoltaic panels	£326	25.62 kg/m²	A 96	A 97
Total Savings	£397	31.15 kg/m²		

Potential energy efficiency rating: A 96
Potential environmental impact rating: A 97

Fuel prices for cost data on this page from database revision number 465 TEST (04 Sep 2020)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£511	£440	£71
Space heating	£318	£319	-£1
Water heating	£160	£89	£71
Lighting	£32	£32	£0
Generated (PV)	-£0	-£326	£326
Total cost of fuels	£511	£114	£397
Total cost of uses	£510	£114	£396
Delivered energy	77 kWh/m²	17 kWh/m²	60 kWh/m²
Carbon dioxide emissions	1.4 tonnes	0.3 tonnes	1.1 tonnes
CO2 emissions per m²	40 kg/m²	9 kg/m²	31 kg/m²
Primary energy	237 kWh/m²	53 kWh/m²	184 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		4.9500	
Infiltration rate		0.3399	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2889	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3684	0.3611	0.3539	0.3178	0.3106	0.2745	0.2745	0.2672	0.2889	0.3106	0.3250	0.3395	(22b)
Effective ac	0.5678	0.5652	0.5626	0.5505	0.5482	0.5377	0.5377	0.5357	0.5417	0.5482	0.5528	0.5576	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	65.2400	16.5900	48.6500	0.2300	11.1895	9.0000	437.8500	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			135.9800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	47.3318			(33)
Party Wall 1			9.4900	0.0000	0.0000	20.0000	189.8000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	4290.8300 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		121.3127 (35)
Thermal bridges (User defined value 0.056 * total exposed area)		7.6149 (36)
Total fabric heat loss	(33) + (36) =	54.9467 (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	20.2815	20.1874	20.0952	19.6620	19.5809	19.2036	19.2036	19.1337	19.3489	19.5809	19.7449	19.9163	(38)
Heat transfer coeff	75.2282	75.1341	75.0419	74.6087	74.5276	74.1503	74.1503	74.0804	74.2956	74.5276	74.6916	74.8630	(39)
Average = Sum(39)m / 12 =												74.6083	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1269	2.1242	2.1216	2.1094	2.1071	2.0964	2.0964	2.0944	2.1005	2.1071	2.1117	2.1166	(40)
HLP (average)												2.1094	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895 (42)
Average daily hot water use (litres/day)	64.8244 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0500	(48)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.5670	(55)
Total storage loss													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(56)
If cylinder contains dedicated solar storage													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(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													
	146.5855	129.3734	134.8811	115.9731	107.8819	95.8084	91.6521	101.9999	108.2509	125.8372	133.8273	143.2488	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.7781	(H8)
Utilisation factor												0.4302	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												64.8244	(H14)
Volume ratio Veff/V												1.1570	(H15)
Solar storage volume factor												1.0000	(H16)
Solar input												-685.9569	(H17)
Solar input	-19.8914	-33.1930	-56.5315	-75.7633	-93.5992	-92.0229	-90.8068	-79.3384	-62.1378	-42.4328	-23.5940	-16.6457	(63)
								Solar input (sum of months) = Sum(63)m =				-685.9569	(63)
Output from w/h													
	126.6941	96.1804	78.3496	40.2098	14.2827	3.7855	0.8453	22.6615	46.1131	83.4043	110.2332	126.6031	(64)
								Total per year (kWh/year) = Sum(64)m =				749.3626	(64)
Heat gains from water heating, kWh/month													
	67.8321	60.2614	63.2879	53.8803	48.9818	44.4392	43.4766	47.3523	51.9441	60.2808	62.9741	66.7226	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.5364	21.7931	17.7233	13.4177	10.0299	8.4676	9.1496	11.8930	15.9627	20.2684	23.6562	25.2184	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	164.3130	166.0181	161.7214	152.5743	141.0276	130.1755	122.9255	121.2205	125.5172	134.6643	146.2109	157.0631	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	91.1722	89.6747	85.0643	74.8337	65.8358	61.7211	58.4363	63.6455	72.1446	81.0225	87.4640	89.6810	(72)
Total internal gains													
	352.8368	350.3010	337.3242	313.6408	289.7085	273.1794	263.3266	269.5742	286.4397	308.7703	330.1462	344.7776	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	9.1400	10.6334	0.7200	0.7000	0.7700	33.9455	(74)
East	3.1200	19.6403	0.7200	0.7000	0.7700	21.4026	(76)
West	4.3300	19.6403	0.7200	0.7000	0.7700	29.7029	(80)

Solar gains	85.0509	164.8447	274.8741	417.1816	532.7943	556.5848	525.1898	435.4886	324.0202	195.8476	105.5986	70.3253	(83)
Total gains	437.8877	515.1457	612.1983	730.8224	822.5028	829.7641	788.5164	705.0628	610.4598	504.6180	435.7449	415.1029	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	15.8438	15.8636	15.8831	15.9753	15.9927	16.0741	16.0741	16.0892	16.0426	15.9927	15.9576	15.9210	
alpha	2.0563	2.0576	2.0589	2.0650	2.0662	2.0716	2.0716	2.0726	2.0695	2.0662	2.0638	2.0614	
util living area													
	0.9223	0.8930	0.8383	0.7417	0.6147	0.4781	0.3720	0.4213	0.6138	0.8035	0.8960	0.9295	(86)
MIT	18.0643	18.4168	19.0177	19.7527	20.3513	20.7300	20.8858	20.8484	20.5220	19.7211	18.7611	17.9900	(87)
Th 2	19.9366	19.9379	19.9392	19.9453	19.9465	19.9518	19.9518	19.9528	19.9497	19.9465	19.9441	19.9417	(88)
util rest of house													
	0.9135	0.8811	0.8204	0.7132	0.5721	0.4178	0.2949	0.3414	0.5552	0.7745	0.8825	0.9214	(89)
MIT 2	17.2631	17.6086	18.1935	18.8981	19.4481	19.7779	19.8962	19.8747	19.6181	18.8886	17.9574	17.1937	(90)
Living area fraction									fLA = Living area / (4) =			0.5900	(91)
MIT	17.7359	18.0854	18.6798	19.4023	19.9810	20.3397	20.4801	20.4492	20.1515	19.3798	18.4316	17.6636	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.7359	18.0854	18.6798	19.4023	19.9810	20.3397	20.4801	20.4492	20.1515	19.3798	18.4316	17.6636	(93)

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8. Space heating requirement

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8900	0.8554	0.7952	0.6969	0.5736	0.4410	0.3348	0.3806	0.5672	0.7564	0.8582	0.8988	(94)
Useful gains	389.7109	440.6705	486.8278	509.3119	471.7912	365.9326	264.0051	268.3619	346.2825	381.7081	373.9531	373.1101	(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	1010.7558	990.6758	913.9960	783.5644	617.1660	425.6005	287.7098	299.9683	449.5971	654.3398	846.3767	1007.9226	(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	462.0573	369.6036	317.8132	197.4618	108.1588	0.0000	0.0000	0.0000	0.0000	202.8379	340.1450	472.3005	(98)

Space heating 2470.3781 (98)
Space heating per m2 (98) / (4) = 69.8439 (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 %) 175.1000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 1410.8384 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	462.0573	369.6036	317.8132	197.4618	108.1588	0.0000	0.0000	0.0000	0.0000	202.8379	340.1450	472.3005	(98)
Space heating efficiency (main heating system 1)	175.1000	175.1000	175.1000	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175.1000	175.1000	(210)
Space heating fuel (main heating system)	263.8820	211.0814	181.5038	112.7709	61.7697	0.0000	0.0000	0.0000	0.0000	115.8412	194.2576	269.7318	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	126.6941	96.1804	78.3496	40.2098	14.2827	3.7855	0.8453	22.6615	46.1131	83.4043	110.2332	126.6031	(64)
Efficiency of water heater												175.1000	(216)
(217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(217)
Fuel for water heating, kWh/month	72.3553	54.9288	44.7456	22.9639	8.1569	2.1619	0.4827	12.9420	26.3353	47.6324	62.9544	72.3033	(219)

Water heating fuel used 427.9626 (219)
Annual totals kWh/year
Space heating fuel - main system 1410.8384 (211)
Space heating fuel - secondary 0.0000 (215)

Electricity for pumps and fans:
central heating pump 30.0000 (230c)
pump for solar water heating 50.0000 (230g)
Total electricity for the above, kWh/year 80.0000 (231)
Electricity for lighting (calculated in Appendix L) 173.3285 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) = -1727.2394 -1727.2394 (233)
Total delivered energy for all uses 364.8902 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1410.8384	13.1900	186.0896	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	427.9626	13.1900	56.4483	(247)
Pumps and fans for heating	30.0000	13.1900	3.9570	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	173.3285	13.1900	22.8620	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			48.1290	(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] = 0.2515 (257)
SAP value 96.4914
SAP rating (Section 12) 96 (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	1410.8384	0.5190	732.2251	(261)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	427.9626	0.5190	222.1126 (264)
Space and water heating			954.3378 (265)
Pumps and fans	80.0000	0.5190	41.5200 (267)
Energy for lighting	173.3285	0.5190	89.9575 (268)
Energy saving/generation technologies			
PV Unit	-1727.2394	0.5190	-896.4372 (269)
Total kg/year			189.3780 (272)
CO2 emissions per m2			5.3500 (273)
EI value			96.8425
EI rating			97 (274)
EI band			A

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		4.9500	
Infiltration rate		0.3399	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2889	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	6.6000	6.2000	5.9000	5.1000	4.9000	4.6000	4.2000	4.3000	4.9000	5.4000	5.9000	5.7000	(22)
Wind factor	1.6500	1.5500	1.4750	1.2750	1.2250	1.1500	1.0500	1.0750	1.2250	1.3500	1.4750	1.4250	(22a)
Adj infilt rate	0.4767	0.4478	0.4261	0.3684	0.3539	0.3322	0.3034	0.3106	0.3539	0.3900	0.4261	0.4117	(22b)
Effective ac	0.6136	0.6003	0.5908	0.5678	0.5626	0.5552	0.5460	0.5482	0.5626	0.5761	0.5908	0.5847	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2200	7.7814	75.0000	2652.7500	(28b)
Main	65.2400	16.5900	48.6500	0.2300	11.1895	9.0000	437.8500	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			135.9800					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	47.3318			(33)
Party Wall 1			9.4900	0.0000	0.0000	20.0000	189.8000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	4290.8300 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		121.3127 (35)
Thermal bridges (User defined value 0.056 * total exposed area)		7.6149 (36)
Total fabric heat loss	(33) + (36) =	54.9467 (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	21.9165	21.4395	21.1013	20.2815	20.0952	19.8296	19.5017	19.5809	20.0952	20.5750	21.1013	20.8852	(38)
Heat transfer coeff	76.8632	76.3862	76.0480	75.2282	75.0419	74.7763	74.4484	74.5276	75.0419	75.5217	76.0480	75.8319	(39)
Average = Sum(39)m / 12 =												75.4803	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1731	2.1596	2.1501	2.1269	2.1216	2.1141	2.1048	2.1071	2.1216	2.1352	2.1501	2.1440	(40)
HLP (average)												2.1340	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy		1.2895 (42)
Average daily hot water use (litres/day)		64.8244 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0500	(48)

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

Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.5670	(55)
Total storage loss													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(56)
If cylinder contains dedicated solar storage													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(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													
	146.5855	129.3734	134.8811	115.9731	107.8819	95.8084	91.6521	101.9999	108.2509	125.8372	133.8273	143.2488	(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												1091.0709	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1832.9992	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.7972	(H8)
Utilisation factor												0.4267	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												64.8244	(H14)
Volume ratio Veff/V												1.1570	(H15)
Solar storage volume factor												1.0000	(H16)
Solar input												-687.8113	(H17)
Solar input	-19.2686	-32.1683	-57.3554	-77.8632	-96.3853	-91.3308	-91.0993	-80.3442	-62.3188	-41.3797	-22.3236	-15.9741	(63)
								Solar input (sum of months) = Sum(63)m =				-687.8113	(63)
Output from w/h													
	127.3169	97.2050	77.5257	38.1099	11.4966	4.4776	0.5528	21.6557	45.9322	84.4575	111.5037	127.2747	(64)
								Total per year (kWh/year) = Sum(64)m =				747.5082	(64)
Heat gains from water heating, kWh/month													
	67.8321	60.2614	63.2879	53.8803	48.9818	44.4392	43.4766	47.3523	51.9441	60.2808	62.9741	66.7226	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.5364	21.7931	17.7233	13.4177	10.0299	8.4676	9.1496	11.8930	15.9627	20.2684	23.6562	25.2184	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	164.3130	166.0181	161.7214	152.5743	141.0276	130.1755	122.9255	121.2205	125.5172	134.6643	146.2109	157.0631	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	91.1722	89.6747	85.0643	74.8337	65.8358	61.7211	58.4363	63.6455	72.1446	81.0225	87.4640	89.6810	(72)
Total internal gains													
	352.8368	350.3010	337.3242	313.6408	289.7085	273.1794	263.3266	269.5742	286.4397	308.7703	330.1462	344.7776	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
North	9.1400	10.3621	0.7200	0.7000	0.7700	33.0794	(74)
East	3.1200	19.0327	0.7200	0.7000	0.7700	20.7404	(76)
West	4.3300	19.0327	0.7200	0.7000	0.7700	28.7840	(80)

Solar gains	82.6038	159.9685	278.9235	428.8130	549.2388	553.3461	527.6267	441.2155	324.9600	191.1362	100.1345	67.6917	(83)
Total gains	435.4406	510.2695	616.2477	742.4538	838.9472	826.5255	790.9533	710.7896	611.3997	499.9065	430.2808	412.4693	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	15.5067	15.6036	15.6730	15.8438	15.8831	15.9395	16.0097	15.9927	15.8831	15.7822	15.6730	15.7176	
alpha	2.0338	2.0402	2.0449	2.0563	2.0589	2.0626	2.0673	2.0662	2.0589	2.0521	2.0449	2.0478	
util living area													
	0.9321	0.9076	0.8595	0.7770	0.6737	0.5736	0.4904	0.5339	0.6911	0.8401	0.9134	0.9388	(86)
MIT	17.6961	18.0408	18.6468	19.4115	20.0508	20.4937	20.7191	20.6626	20.2317	19.3546	18.3610	17.6204	(87)
Th 2	19.9134	19.9202	19.9250	19.9366	19.9392	19.9429	19.9476	19.9465	19.9392	19.9324	19.9250	19.9280	(88)
util rest of house													
	0.9247	0.8978	0.8447	0.7539	0.6397	0.5252	0.4282	0.4709	0.6466	0.8180	0.9027	0.9322	(89)
MIT 2	16.8830	17.2257	17.8205	18.5644	19.1661	19.5715	19.7677	19.7258	19.3516	18.5261	17.5503	16.8179	(90)
Living area fraction									fLA = Living area / (4) =			0.5900	(91)
MIT	17.3627	17.7066	18.3080	19.0642	19.6881	20.1156	20.3291	20.2786	19.8709	19.0150	18.0287	17.2914	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.3627	17.7066	18.3080	19.0642	19.6881	20.1156	20.3291	20.2786	19.8709	19.0150	18.0287	17.2914	(93)

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8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9019	0.8723	0.8180	0.7324	0.6310	0.5335	0.4517	0.4917	0.6435	0.7953	0.8786	0.9106	(94)
Useful gains	392.7053	445.0991	504.0918	543.7611	529.3598	440.9561	357.2691	349.5275	393.4353	397.5759	378.0555	375.5843	(95)
Ext temp.	3.1000	3.6000	5.0000	7.2000	9.8000	12.7000	14.7000	14.6000	12.4000	9.1000	5.7000	2.9000	(96)
Heat loss rate W	1096.2797	1077.5512	1012.0502	892.5229	742.0237	554.5118	419.0743	423.2100	560.6294	748.7947	937.5704	1091.3277	(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	523.4594	425.0078	377.9211	251.1085	158.2219	0.0000	0.0000	0.0000	0.0000	261.3068	402.8507	532.5132	(98)
Space heating												2932.3893	(98)
Space heating per m2											(98) / (4) =	82.9061	(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 %)	175.1000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1674.6940	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	523.4594	425.0078	377.9211	251.1085	158.2219	0.0000	0.0000	0.0000	0.0000	261.3068	402.8507	532.5132	(98)
Space heating efficiency (main heating system 1)	175.1000	175.1000	175.1000	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175.1000	175.1000	(210)
Space heating fuel (main heating system)	298.9488	242.7229	215.8316	143.4086	90.3609	0.0000	0.0000	0.0000	0.0000	149.2329	230.0690	304.1194	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	127.3169	97.2050	77.5257	38.1099	11.4966	4.4776	0.5528	21.6557	45.9322	84.4575	111.5037	127.2747	(64)
Efficiency of water heater												175.1000	(216)
(217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(217)
Fuel for water heating, kWh/month	72.7109	55.5140	44.2751	21.7646	6.5657	2.5572	0.3157	12.3676	26.2320	48.2338	63.6800	72.6869	(219)
Water heating fuel used												426.9036	(219)

Annual totals kWh/year		
Space heating fuel - main system	1674.6940	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
pump for solar water heating	50.0000	(230g)
Total electricity for the above, kWh/year	80.0000	(231)
Electricity for lighting (calculated in Appendix L)	173.3285	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 2.50 * 1091 * 0.80) =	-1745.7135	-1745.7135 (233)
Total delivered energy for all uses	609.2127	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1674.6940	18.7000	313.1678	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	426.9036	18.7000	79.8310	(247)
Pumps and fans for heating	30.0000	18.7000	5.6100	(249)
Pump for solar water heating	50.0000	18.7000	9.3500	(249)
Energy for lighting	173.3285	18.7000	32.4124	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-1745.7135	18.7000	-326.4484	(252)
Total energy cost			113.9228	(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	1674.6940	0.5190	869.1662	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	426.9036	0.5190	221.5630	(264)
Space and water heating			1090.7292	(265)
Pumps and fans	80.0000	0.5190	41.5200	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Energy saving/generation technologies				
PV Unit	-1745.7135	0.5190	-906.0253	(269)
Total kg/year			316.1814	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	1674.6940	3.0700	5141.3107	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	426.9036	3.0700	1310.5940	(264)
Space and water heating			6451.9047	(265)
Pumps and fans	80.0000	3.0700	245.6000	(267)
Energy for lighting	173.3285	3.0700	532.1186	(268)
Energy saving/generation technologies				
PV Unit	-1745.7135	3.0700	-5359.3404	(269)
Primary energy kWh/year			1870.2829	(272)
Primary energy kWh/m2/year			52.8777	(273)

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

Overheating Calculation Input Data

Dwelling type	SemiDetached Bungalow
Number of storeys	1
Cross ventilation possible	Yes
SAP Region	North East England
Front of dwelling faces	East
Overshading	Average or unknown
Thermal mass parameter	121.3 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	6.00 (Windows fully open)

Overheating Calculation

Summer ventilation heat loss coefficient	214.30	(P1)
Transmission heat loss coefficient	54.95	(37)
Summer heat loss coefficient	269.25	(P2)

Overhangs

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

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
North	1.000	0.90	1.000	0.900	(P8)
East	1.000	0.90	1.000	0.900	(P8)
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	9.1400	74.6426	0.7200	0.7000	0.9000	278.5151
East	3.1200	111.2086	0.7200	0.7000	0.9000	141.6474
West	4.3300	111.2086	0.7200	0.7000	0.9000	196.5811
total:						616.7436

	Jun	Jul	Aug	
Solar gains	644	617	506	(P3)
Internal gains	284	274	280	
Total summer gains	928	891	786	(P5)
Summer gain/loss ratio	3.45	3.31	2.92	(P6)
Summer external temperature	13.80	15.80	15.60	
Thermal mass temperature increment (TMP = 121.3)	1.15	1.15	1.15	
Threshold temperature	18.40	20.26	19.67	(P7)
Likelihood of high internal temperature	Not significant	Not significant	Not significant	

Assessment of likelihood of high internal temperature: Not significant

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

Anderson Goddard Ltd

Property Reference	73940-WR09	**Issued on Date**	07/10/2020
Assessment Reference	001	**Prop Type Ref**	Semi
Property	Woodlands Room 9, Raithwaite Bay, WHITBY, YO21 3ST		

SAP Rating	78 C	**DER**	34.93	**TER**	40.90
Environmental	80 C	**% DER<TER**	14.60		
CO_2 Emissions (t/year)	1.30	**DFEE**	76.30	**TFEE**	76.91
General Requirements Compliance	Pass	**% DFEE<TFEE**	0.79		

Assessor Details	Mr. Paul Goddard, Anderson Goddard Limited, Tel: 0161 7757770, paul.goddard@andersongoddard.com	**Assessor ID**	B342-0001
Client			

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

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

Semi-Detached Bungalow, total floor area 35 m²

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

1a TER and DER
Fuel for main heating:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 40.90 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 34.93 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)76.9 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)76.3 kWh/m²/yrOK

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2 Fabric U-values

Element	Average	Highest	
External wall	0.23 (max. 0.30)	0.23 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.20 (max. 0.25)	0.20 (max. 0.70)	OK
Roof	0.18 (max. 0.20)	0.18 (max. 0.35)	OK
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated using user-specified y-value of 0.058

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3 Air permeability
Air permeability at 50 pascals: 4.95 (design value)
Maximum 10.0 OK

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4 Heating efficiency
Main heating system: Heat pump with radiators or underfloor - Electric
Air-to-water heat pump

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage Measured cylinder loss: 1.05 kWh/day
Permitted by DBSCG 1.70 OK
Primary pipework insulated: Yes OK

---
6 Controls
Space heating controls: Programmer and room thermostat OK

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

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

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8 Mechanical ventilation
Not applicable

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9 Summertime temperature
Overheating risk (North East England): Slight OK
Based on:
Overshading: Average
Windows facing South East: 4.33 m², No overhang
Windows facing South West: 9.14 m², No overhang
Windows facing North West: 3.12 m², No overhang
Air change rate: 8.00 ach
Blinds/curtains: None

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10 Key features
Party wall U-value 0.00 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		4.9500	
Infiltration rate		0.3399	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2889	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3684	0.3611	0.3539	0.3178	0.3106	0.2745	0.2745	0.2672	0.2889	0.3106	0.3250	0.3395	(22b)
Effective ac	0.5678	0.5652	0.5626	0.5505	0.5482	0.5377	0.5377	0.5357	0.5417	0.5482	0.5528	0.5576	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2000	7.0740	75.0000	2652.7500	(28b)
Main	61.9300	16.5900	45.3400	0.2300	10.4282	9.0000	408.0600	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			132.6700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	45.8631			(33)
Party Wall 1			12.7900	0.0000	0.0000	20.0000	255.8000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		4327.0400	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							122.3364	(35)
Thermal bridges (User defined value 0.058 * total exposed area)							7.6949	(36)
Total fabric heat loss					(33) + (36) =		53.5580	(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	20.2815	20.1874	20.0952	19.6620	19.5809	19.2036	19.2036	19.1337	19.3489	19.5809	19.7449	19.9163	(38)
Heat transfer coeff	73.8395	73.7454	73.6531	73.2199	73.1389	72.7616	72.7616	72.6917	72.9069	73.1389	73.3028	73.4743	(39)
Average = Sum(39)m / 12 =												73.2195	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.0876	2.0850	2.0824	2.0701	2.0678	2.0572	2.0572	2.0552	2.0613	2.0678	2.0725	2.0773	(40)
HLP (average)												2.0701	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895	(42)
Average daily hot water use (litres/day)	64.8244	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0500	(48)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.5670	(55)
Total storage loss													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(56)
If cylinder contains dedicated solar storage													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(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													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(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													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
								Total per year (kWh/year) = Sum(64)m =				1500.7919	(64)
Heat gains from water heating, kWh/month													
	67.8321	60.2614	64.4045	59.2832	59.2173	54.5246	53.8982	57.0294	56.2664	61.3974	62.9741	66.7226	(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	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	9.8146	8.7172	7.0893	5.3671	4.0119	3.3871	3.6598	4.7572	6.3851	8.1073	9.4625	10.0874	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	110.0897	111.2321	108.3533	102.2247	94.4885	87.2176	82.3601	81.2177	84.0965	90.2251	97.9613	105.2323	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	91.1722	89.6747	86.5651	82.3377	79.5931	75.7286	72.4438	76.6525	78.1478	82.5233	87.4640	89.6810	(72)
Total internal gains													
	256.4182	254.9658	247.3495	235.2713	223.4353	211.6749	203.8055	207.9691	213.9712	226.1975	240.2295	250.3424	(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	
Southeast	4.3300	36.7938	0.7200	0.7000	0.7700	55.6451	(77)
Southwest	9.1400	36.7938	0.7200	0.7000	0.7700	117.4586	(79)
Northwest	3.1200	11.2829	0.7200	0.7000	0.7700	12.2953	(81)

Solar gains	185.3991	319.8872	448.5315	573.9350	659.4513	661.9827	635.1840	570.2689	491.7849	356.4684	222.8091	158.1817	(83)
Total gains	441.8173	574.8530	695.8811	809.2063	882.8867	873.6576	838.9895	778.2380	705.7561	582.6659	463.0386	408.5241	(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	16.2780	16.2987	16.3191	16.4157	16.4339	16.5191	16.5191	16.5350	16.4862	16.4339	16.3971	16.3589	
alpha	2.0852	2.0866	2.0879	2.0944	2.0956	2.1013	2.1013	2.1023	2.0991	2.0956	2.0931	2.0906	
util living area													
	0.9212	0.8729	0.8058	0.7070	0.5856	0.4557	0.3488	0.3849	0.5580	0.7618	0.8853	0.9315	(86)
MIT	18.1404	18.6256	19.2421	19.9089	20.4325	20.7644	20.9040	20.8785	20.6195	19.8983	18.8844	18.0372	(87)
Th 2	19.9562	19.9575	19.9588	19.9649	19.9661	19.9714	19.9714	19.9724	19.9694	19.9661	19.9638	19.9613	(88)
util rest of house													
	0.9124	0.8595	0.7858	0.6772	0.5434	0.3976	0.2764	0.3108	0.5003	0.7299	0.8708	0.9237	(89)
MIT 2	17.3499	17.8227	18.4185	19.0537	19.5319	19.8200	19.9247	19.9103	19.7088	19.0627	18.0888	17.2523	(90)
Living area fraction										fLA = Living area / (4) =		0.5900	(91)
MIT	17.8163	18.2965	18.9044	19.5583	20.0633	20.3772	20.5025	20.4816	20.2461	19.5557	18.5583	17.7154	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.8163	18.2965	18.9044	19.5583	20.0633	20.3772	20.5025	20.4816	20.2461	19.5557	18.5583	17.7154	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8891	0.8336	0.7626	0.6645	0.5475	0.4213	0.3146	0.3485	0.5166	0.7156	0.8467	0.9018	(94)
Useful gains	392.8354	479.2215	530.6618	537.7094	483.4146	368.0655	263.9785	271.2438	364.6282	416.9779	392.0478	368.3965	(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													
	998.0392	987.9273	913.6247	780.4033	611.6794	420.3616	283.9542	296.6975	448.0965	655.0131	839.9225	993.0351	(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													
	450.2716	341.8503	284.9243	174.7396	95.4290	0.0000	0.0000	0.0000	0.0000	177.0982	322.4698	464.7311	(98)
Space heating												2311.5140	(98)
Space heating per m2											(98) / (4) =	65.3524	(99)

8c. Space cooling requirement

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	175.1000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1320.1108	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	450.2716	341.8503	284.9243	174.7396	95.4290	0.0000	0.0000	0.0000	0.0000	177.0982	322.4698	464.7311	(98)
Space heating efficiency (main heating system 1)	175.1000	175.1000	175.1000	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175.1000	175.1000	(210)
Space heating fuel (main heating system)	257.1511	195.2315	162.7209	99.7942	54.4997	0.0000	0.0000	0.0000	0.0000	101.1412	184.1632	265.4090	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
Efficiency of water heater												175.1000	(216)
(217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(217)
Fuel for water heating, kWh/month	83.7153	73.8854	77.8280	70.0895	68.9185	61.9161	59.7824	65.1607	64.9080	72.6630	76.4290	81.8097	(219)
Water heating fuel used												857.1056	(219)
Annual totals kWh/year													
Space heating fuel - main system												1320.1108	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
Total electricity for the above, kWh/year												30.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Total delivered energy for all uses												2380.5449	(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	1320.1108	0.5190	685.1375	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	857.1056	0.5190	444.8378	(264)
Space and water heating			1129.9753	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Total CO2, kg/year			1235.5028	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			34.9300	(273)

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

DER		34.9300	ZC1
Total Floor Area	TFA	35.3700	
Assumed number of occupants	N	1.2895	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		18.4441	ZC2
CO2 emissions from cooking, equation (L16)		4.2394	ZC3
Total CO2 emissions		57.6135	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		57.6135	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000	/ (5) =	0.1848	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.4348	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3696	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4712	0.4620	0.4527	0.4065	0.3973	0.3511	0.3511	0.3419	0.3696	0.3973	0.4158	0.4342	(22b)
Effective ac	0.6110	0.6067	0.6025	0.5826	0.5789	0.5616	0.5616	0.5584	0.5683	0.5789	0.5864	0.5943	(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 Opening Type (Uw = 1.40)			8.8400	1.3258	11.7197			(27)
GF			35.3700	0.1300	4.5981			(28b)
Main	61.9300	8.8400	53.0900	0.1800	9.5562			(29a)
Flat	35.3700		35.3700	0.1300	4.5981			(30)
Total net area of external elements Aum(A, m2)			132.6700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		30.4721			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.0070	(36)
Total fabric heat loss					(33) + (36) =		38.4791	(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	21.8234	21.6694	21.5185	20.8096	20.6770	20.0596	20.0596	19.9453	20.2974	20.6770	20.9453	21.2258	(38)
Heat transfer coeff	60.3025	60.1485	59.9976	59.2887	59.1561	58.5387	58.5387	58.4244	58.7765	59.1561	59.4244	59.7049	(39)
Average = Sum(39)m / 12 =												59.2881	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.7049	1.7006	1.6963	1.6762	1.6725	1.6550	1.6550	1.6518	1.6618	1.6725	1.6801	1.6880	(40)
HLP (average)												1.6762	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.2895	(42)
Average daily hot water use (litres/day)												64.8244	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.2538	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.6770	(55)
Total storage loss													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	20.9878	18.9567	20.9878	20.3108	20.9878	20.3108	20.9878	20.9878	20.3108	20.9878	20.3108	20.9878	(56)
If cylinder contains dedicated solar storage													
	20.9878	18.9567	20.9878	20.3108	20.9878	20.3108	20.9878	20.9878	20.3108	20.9878	20.3108	20.9878	(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													
	149.9962	132.4541	139.6876	126.0274	124.0870	111.7159	108.0898	117.5071	116.9546	130.6437	137.1280	146.6596	(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													
	149.9962	132.4541	139.6876	126.0274	124.0870	111.7159	108.0898	117.5071	116.9546	130.6437	137.1280	146.6596	(64)
								Total per year (kWh/year) = Sum(64)m =				1540.9510	(64)
Heat gains from water heating, kWh/month													
	70.5607	62.7260	67.1331	61.9238	61.9459	57.1652	56.6268	59.7581	58.9070	64.1260	65.6147	69.4513	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	9.8146	8.7172	7.0893	5.3671	4.0119	3.3871	3.6598	4.7572	6.3851	8.1073	9.4625	10.0874	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	110.0897	111.2321	108.3533	102.2247	94.4885	87.2176	82.3601	81.2177	84.0965	90.2251	97.9613	105.2323	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	94.8397	93.3422	90.2326	86.0052	83.2606	79.3961	76.1113	80.3200	81.8153	86.1908	91.1315	93.3485	(72)
Total internal gains													
	260.0857	258.6333	251.0170	238.9388	227.1028	215.3424	207.4730	211.6366	217.6387	229.8650	243.8970	254.0099	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	2.3100	36.7938	0.6300	0.7000	0.7700	25.9752	(77)
Southwest	4.8700	36.7938	0.6300	0.7000	0.7700	54.7616	(79)
Northwest	1.6600	11.2829	0.6300	0.7000	0.7700	5.7240	(81)

Solar gains	86.4608	149.1760	209.1593	267.6234	307.4868	308.6618	296.1686	265.9091	229.3245	166.2329	103.9063	73.7684	(83)
Total gains	346.5465	407.8093	460.1763	506.5622	534.5896	524.0042	503.6416	477.5457	446.9632	396.0979	347.8034	327.7782	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	40.7321	40.8364	40.9391	41.4286	41.5215	41.9594	41.9594	42.0415	41.7896	41.5215	41.3340	41.1398	
alpha	3.7155	3.7224	3.7293	3.7619	3.7681	3.7973	3.7973	3.8028	3.7860	3.7681	3.7556	3.7427	
util living area													
	0.9875	0.9765	0.9539	0.9019	0.8015	0.6437	0.4910	0.5333	0.7510	0.9228	0.9771	0.9897	(86)
MIT	19.3967	19.6240	19.9592	20.3688	20.7049	20.9092	20.9750	20.9657	20.8302	20.3945	19.8228	19.3589	(87)
Th 2	19.5373	19.5404	19.5435	19.5579	19.5606	19.5732	19.5732	19.5756	19.5684	19.5606	19.5551	19.5494	(88)
util rest of house													
	0.9832	0.9686	0.9381	0.8674	0.7320	0.5274	0.3416	0.3819	0.6461	0.8877	0.9680	0.9862	(89)
MIT 2	17.4954	17.8241	18.3024	18.8747	19.2989	19.5206	19.5660	19.5643	19.4522	18.9269	18.1243	17.4484	(90)
Living area fraction										fLA = Living area / (4) =		0.5900	(91)
MIT	18.6173	18.8861	19.2800	19.7563	20.1285	20.3400	20.3974	20.3912	20.2653	19.7929	19.1265	18.5757	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6173	18.8861	19.2800	19.7563	20.1285	20.3400	20.3974	20.3912	20.2653	19.7929	19.1265	18.5757	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9796	0.9640	0.9346	0.8729	0.7619	0.5929	0.4301	0.4714	0.7013	0.8944	0.9645	0.9830	(94)
Useful gains	339.4691	393.1424	430.0765	442.1538	407.2999	310.7059	216.6196	225.1128	313.4640	354.2794	335.4590	322.1995	(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													
	863.3661	841.2443	766.7677	643.6550	498.6002	336.0102	222.2944	233.1846	362.3765	543.8148	714.6673	858.2992	(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													
	389.7794	301.1245	250.4983	145.0809	67.9274	0.0000	0.0000	0.0000	0.0000	141.0144	273.0299	398.8582	(98)
Space heating												1967.3129	(98)
Space heating per m2											(98) / (4) =	55.6209	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2104.0780	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	389.7794	301.1245	250.4983	145.0809	67.9274	0.0000	0.0000	0.0000	0.0000	141.0144	273.0299	398.8582	(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)													
	416.8763	322.0583	267.9126	155.1667	72.6496	0.0000	0.0000	0.0000	0.0000	150.8175	292.0106	426.5863	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	149.9962	132.4541	139.6876	126.0274	124.0870	111.7159	108.0898	117.5071	116.9546	130.6437	137.1280	146.6596	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.2491	86.9388	86.3547	85.1900	83.2834	79.8000	79.8000	79.8000	79.8000	85.0178	86.6171	87.3512	(217)
Fuel for water heating, kWh/month													
	171.9173	152.3532	161.7603	147.9368	148.9937	139.9949	135.4509	147.2520	146.5596	153.6663	158.3152	167.8966	(219)
Water heating fuel used												1832.0967	(219)
Annual totals kWh/year													
Space heating fuel - main system												2104.0780	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Total delivered energy for all uses												4184.5032	(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	2104.0780	0.2160	454.4808	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1832.0967	0.2160	395.7329	(264)
Space and water heating			850.2137	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Total CO2, kg/m2/year			979.0962	(272)
Emissions per m2 for space and water heating			24.0377	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			2.5433	(272b)
Emissions per m2 for pumps and fans			1.1005	(272c)
Target Carbon Dioxide Emission Rate (TER) = (24.0377 * 1.55) + 2.5433 + 1.1005, rounded to 2 d.p.			40.9000	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1848	(8)
Pressure test		Yes	
Measured/design AP50		4.9500	
Infiltration rate		0.4323	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3674	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4685	0.4593	0.4501	0.4042	0.3950	0.3491	0.3491	0.3399	0.3674	0.3950	0.4134	0.4317	(22b)
Effective ac	0.6097	0.6055	0.6013	0.5817	0.5780	0.5609	0.5609	0.5578	0.5675	0.5780	0.5854	0.5932	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2000	7.0740	75.0000	2652.7500	(28b)
Main	61.9300	16.5900	45.3400	0.2300	10.4282	9.0000	408.0600	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			132.6700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	45.8631			(33)
Party Wall 1			12.7900	0.0000	0.0000	20.0000	255.8000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	4327.0400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		122.3364 (35)
Thermal bridges (User defined value 0.058 * total exposed area)		7.6949 (36)
Total fabric heat loss	(33) + (36) =	53.5580 (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	21.7779	21.6257	21.4765	20.7758	20.6447	20.0344	20.0344	19.9214	20.2695	20.6447	20.9099	21.1872	(38)
Heat transfer coeff	75.3359	75.1837	75.0345	74.3338	74.2027	73.5924	73.5924	73.4793	73.8274	74.2027	74.4679	74.7452	(39)
Average = Sum(39)m / 12 =												74.3332	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1299	2.1256	2.1214	2.1016	2.0979	2.0806	2.0806	2.0774	2.0873	2.0979	2.1054	2.1132	(40)
HLP (average)												2.1016	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895 (42)
Average daily hot water use (litres/day)	64.8244 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage

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

Heat gains from water heating, kWh/month

	22.4710	19.6533	20.2805	17.6810	16.9653	14.6398	13.5659	15.5671	15.7530	18.3586	20.0399	21.7620 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	(66)

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

	9.8146	8.7172	7.0893	5.3671	4.0119	3.3871	3.6598	4.7572	6.3851	8.1073	9.4625	10.0874 (67)

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

	110.0897	111.2321	108.3533	102.2247	94.4885	87.2176	82.3601	81.2177	84.0965	90.2251	97.9613	105.2323 (68)

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

	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473 (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)

	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780 (71)

Water heating gains (Table 5)

	30.2030	29.2460	27.2587	24.5569	22.8029	20.3330	18.2338	20.9235	21.8792	24.6756	27.8331	29.2500 (72)

Total internal gains

	192.4491	191.5371	185.0431	174.4905	163.6451	153.2794	146.5955	149.2402	154.7025	165.3497	177.5987	186.9114 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	4.3300	36.7938	0.7200	0.7000	0.7700	55.6451	(77)
Southwest	9.1400	36.7938	0.7200	0.7000	0.7700	117.4586	(79)
Northwest	3.1200	11.2829	0.7200	0.7000	0.7700	12.2953	(81)

Solar gains	185.3991	319.8872	448.5315	573.9350	659.4513	661.9827	635.1840	570.2689	491.7849	356.4684	222.8091	158.1817	(83)
Total gains	377.8481	511.4243	633.5746	748.4255	823.0964	815.2621	781.7794	719.5090	646.4875	521.8181	400.4078	345.0931	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	15.9546	15.9869	16.0187	16.1697	16.1983	16.3326	16.3326	16.3577	16.2806	16.1983	16.1406	16.0807	
alpha	2.0636	2.0658	2.0679	2.0780	2.0799	2.0888	2.0888	2.0905	2.0854	2.0799	2.0760	2.0720	
util living area	0.9400	0.8951	0.8314	0.7348	0.6142	0.4827	0.3730	0.4129	0.5927	0.7951	0.9098	0.9491	(86)
MIT	17.9057	18.4180	19.0727	19.7941	20.3629	20.7315	20.8883	20.8581	20.5631	19.7679	18.6877	17.8066	(87)
Th 2	19.2481	19.2509	19.2536	19.2665	19.2689	19.2801	19.2801	19.2822	19.2758	19.2689	19.2640	19.2589	(88)
util rest of house	0.9277	0.8748	0.7993	0.6849	0.5409	0.3791	0.2415	0.2779	0.4905	0.7428	0.8885	0.9385	(89)
MIT 2	16.5901	17.0843	17.7066	18.3764	18.8668	19.1575	19.2509	19.2410	19.0506	18.3861	17.3679	16.5006	(90)
Living area fraction									fLA = Living area / (4) =			0.5900	(91)
MIT	17.3663	17.8712	18.5126	19.2129	19.7496	20.0862	20.2171	20.1952	19.9430	19.2014	18.1467	17.2712	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.3663	17.8712	18.5126	19.2129	19.7496	20.0862	20.2171	20.1952	19.9430	19.2014	18.1467	17.2712	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9098	0.8545	0.7832	0.6832	0.5628	0.4302	0.3160	0.3530	0.5333	0.7404	0.8708	0.9219	(94)
Useful gains	343.7595	437.0328	496.1904	511.3058	463.2735	350.7392	247.0052	253.9926	344.7872	386.3578	348.6627	318.1567	(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	984.3646	975.2247	901.3623	766.6004	597.2988	403.7450	266.1882	278.8674	431.3765	638.2499	822.6236	977.0081	(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	476.6102	361.6650	301.4479	183.8121	99.7149	0.0000	0.0000	0.0000	0.0000	187.4077	341.2519	490.1854	(98)
Space heating												2442.0951	(98)
Space heating per m2											(98) / (4) =	69.0442	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	691.7681	544.5834	558.4429	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7906	0.8404	0.8159	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	546.9437	457.6577	455.6134	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1002.5373	962.5469	890.4002	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	328.0274	375.6375	323.4814	0.0000	0.0000	0.0000	0.0000	(104)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling											1027.1463	(104)
Cooled fraction									fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	82.0069	93.9094	80.8703	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling											256.7866	(107)
Space cooling per m2											7.2600	(108)
Energy for space heating											69.0442	(99)
Energy for space cooling											7.2600	(108)
Total											76.3043	(109)
Dwelling Fabric Energy Efficiency (DFEE)											76.3	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000	/ (5) =	0.1848	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.4348	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3696	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4712	0.4620	0.4527	0.4065	0.3973	0.3511	0.3511	0.3419	0.3696	0.3973	0.4158	0.4342	(22b)
Effective ac	0.6110	0.6067	0.6025	0.5826	0.5789	0.5616	0.5616	0.5584	0.5683	0.5789	0.5864	0.5943	(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 Opening Type (Uw = 1.40)			8.8400	1.3258	11.7197			(27)
GF			35.3700	0.1300	4.5981			(28b)
Main	61.9300	8.8400	53.0900	0.1800	9.5562			(29a)
Flat	35.3700		35.3700	0.1300	4.5981			(30)
Total net area of external elements Aum(A, m2)			132.6700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		30.4721			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.0070	(36)
Total fabric heat loss					(33) + (36) =		38.4791	(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	21.8234	21.6694	21.5185	20.8096	20.6770	20.0596	20.0596	19.9453	20.2974	20.6770	20.9453	21.2258	(38)
Heat transfer coeff	60.3025	60.1485	59.9976	59.2887	59.1561	58.5387	58.5387	58.4244	58.7765	59.1561	59.4244	59.7049	(39)
Average = Sum(39)m / 12 =												59.2881	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.7049	1.7006	1.6963	1.6762	1.6725	1.6550	1.6550	1.6518	1.6618	1.6725	1.6801	1.6880	(40)
HLP (average)												1.6762	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.2895	(42)
Average daily hot water use (litres/day)												64.8244	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(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)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Heat gains from water heating, kWh/month

	22.4710	19.6533	20.2805	17.6810	16.9653	14.6398	13.5659	15.5671	15.7530	18.3586	20.0399	21.7620 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	9.8146	8.7172	7.0893	5.3671	4.0119	3.3871	3.6598	4.7572	6.3851	8.1073	9.4625	10.0874	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	110.0897	111.2321	108.3533	102.2247	94.4885	87.2176	82.3601	81.2177	84.0965	90.2251	97.9613	105.2323	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	30.2030	29.2460	27.2587	24.5569	22.8029	20.3330	18.2338	20.9235	21.8792	24.6756	27.8331	29.2500	(72)
Total internal gains													
	192.4491	191.5371	185.0431	174.4905	163.6451	153.2794	146.5955	149.2402	154.7025	165.3497	177.5987	186.9114	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	2.3100	36.7938	0.6300	0.7000	0.7700	25.9752	(77)
Southwest	4.8700	36.7938	0.6300	0.7000	0.7700	54.7616	(79)
Northwest	1.6600	11.2829	0.6300	0.7000	0.7700	5.7240	(81)

Solar gains	86.4608	149.1760	209.1593	267.6234	307.4868	308.6618	296.1686	265.9091	229.3245	166.2329	103.9063	73.7684	(83)
Total gains	278.9098	340.7131	394.2024	442.1139	471.1319	461.9412	442.7640	415.1493	384.0270	331.5827	281.5050	260.6797	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	40.7321	40.8364	40.9391	41.4286	41.5215	41.9594	41.9594	42.0415	41.7896	41.5215	41.3340	41.1398	
alpha	3.7155	3.7224	3.7293	3.7619	3.7681	3.7973	3.7973	3.8028	3.7860	3.7681	3.7556	3.7427	
util living area													
	0.9939	0.9866	0.9707	0.9310	0.8468	0.7019	0.5481	0.5975	0.8121	0.9526	0.9884	0.9952	(86)
MIT	19.2399	19.4743	19.8232	20.2591	20.6334	20.8774	20.9638	20.9496	20.7724	20.2742	19.6736	19.2017	(87)
Th 2	19.5373	19.5404	19.5435	19.5579	19.5606	19.5732	19.5732	19.5756	19.5684	19.5606	19.5551	19.5494	(88)
util rest of house													
	0.9917	0.9819	0.9600	0.9041	0.7851	0.5849	0.3861	0.4351	0.7156	0.9284	0.9834	0.9935	(89)
MIT 2	17.9885	18.2227	18.5675	18.9954	19.3300	19.5223	19.5657	19.5636	19.4552	19.0218	18.4333	17.9595	(90)
Living area fraction									fLA = Living area / (4) =			0.5900	(91)
MIT	18.7269	18.9612	19.3084	19.7410	20.0990	20.3219	20.3907	20.3814	20.2324	19.7608	19.1651	18.6925	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7269	18.9612	19.3084	19.7410	20.0990	20.3219	20.3907	20.3814	20.2324	19.7608	19.1651	18.6925	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9900	0.9795	0.9578	0.9082	0.8107	0.6503	0.4823	0.5313	0.7653	0.9326	0.9816	0.9921	(94)
Useful gains	276.1300	333.7209	377.5679	401.5063	381.9678	300.3909	213.5651	220.5668	293.8893	309.2179	276.3379	258.6296	(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													
	869.9789	845.7591	768.4743	642.7509	496.8544	334.9518	221.9012	232.6137	360.4423	541.9172	716.9629	865.2740	(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													
	441.8235	344.0897	290.8343	173.6961	85.4756	0.0000	0.0000	0.0000	0.0000	173.1282	317.2500	451.3434	(98)
Space heating												2277.6409	(98)
Space heating per m2											(98) / (4) =	64.3947	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	550.2639	433.1865	444.0253	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8179	0.8825	0.8583	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	450.0804	382.3077	381.0953	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	589.5648	566.2951	534.6549	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	100.4288	136.8867	114.2484	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												351.5638	(104)
Cooled fraction									fC = cooled area / (4) =			1.0000	(105)

Intermittency factor (Table 10b)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	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	25.1072	34.2217	28.5621	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												87.8909 (107)
Space cooling per m2												2.4849 (108)
Energy for space heating												64.3947 (99)
Energy for space cooling												2.4849 (108)
Total												66.8796 (109)
Target Fabric Energy Efficiency (TFEE)												76.9 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		4.9500	
Infiltration rate		0.3399	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2889	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	6.6000	6.2000	5.9000	5.1000	4.9000	4.6000	4.2000	4.3000	4.9000	5.4000	5.9000	5.7000	(22)
Wind factor	1.6500	1.5500	1.4750	1.2750	1.2250	1.1500	1.0500	1.0750	1.2250	1.3500	1.4750	1.4250	(22a)
Adj infilt rate	0.4767	0.4478	0.4261	0.3684	0.3539	0.3322	0.3034	0.3106	0.3539	0.3900	0.4261	0.4117	(22b)
Effective ac	0.6136	0.6003	0.5908	0.5678	0.5626	0.5552	0.5460	0.5482	0.5626	0.5761	0.5908	0.5847	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2000	7.0740	75.0000	2652.7500	(28b)
Main	61.9300	16.5900	45.3400	0.2300	10.4282	9.0000	408.0600	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			132.6700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	45.8631			(33)
Party Wall 1			12.7900	0.0000	0.0000	20.0000	255.8000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		4327.0400	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							122.3364	(35)
Thermal bridges (User defined value 0.058 * total exposed area)							7.6949	(36)
Total fabric heat loss					(33) + (36) =		53.5580	(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	21.9165	21.4395	21.1013	20.2815	20.0952	19.8296	19.5017	19.5809	20.0952	20.5750	21.1013	20.8852	(38)
Heat transfer coeff	75.4745	74.9975	74.6593	73.8395	73.6531	73.3876	73.0597	73.1389	73.6531	74.1329	74.6593	74.4432	(39)
Average = Sum(39)m / 12 =												74.0916	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1339	2.1204	2.1108	2.0876	2.0824	2.0749	2.0656	2.0678	2.0824	2.0959	2.1108	2.1047	(40)
HLP (average)												2.0948	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895	(42)
Average daily hot water use (litres/day)	64.8244	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0500	(48)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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  Temperature factor from Table 2b                                                                                0.5400 (49)
Enter (49) or (54) in (55)                                                                                        0.5670 (55)
Total storage loss
              17.5770    15.8760    17.5770    17.0100    17.5770    17.0100    17.5770    17.5770    17.0100    17.5770    17.0100    17.5770 (56)
If cylinder contains dedicated solar storage
              17.5770    15.8760    17.5770    17.0100    17.5770    17.0100    17.5770    17.5770    17.0100    17.5770    17.0100    17.5770 (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
             146.5855   129.3734   136.2768   122.7267   120.6763   108.4151   104.6790   114.0963   113.6538   127.2329   133.8273   143.2488 (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
             146.5855   129.3734   136.2768   122.7267   120.6763   108.4151   104.6790   114.0963   113.6538   127.2329   133.8273   143.2488 (64)
                                                                                  Total per year (kWh/year) = Sum(64)m =   1500.7919 (64)
RHI water heating demand                                                                                          1501 (64)
Heat gains from water heating, kWh/month
              67.8321    60.2614    64.4045    59.2832    59.2173    54.5246    53.8982    57.0294    56.2664    61.3974    62.9741    66.7226 (65)
```

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

```
Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m         77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              24.5364    21.7931    17.7233    13.4177    10.0299     8.4676     9.1496    11.8930    15.9627    20.2684    23.6562    25.2184 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             164.3130   166.0181   161.7214   152.5743   141.0276   130.1755   122.9255   121.2205   125.5172   134.6643   146.2109   157.0631 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262 (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)
             -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780 (71)
Water heating gains (Table 5)
              91.1722    89.6747    86.5651    82.3377    79.5931    75.7286    72.4438    76.6525    78.1478    82.5233    87.4640    89.6810 (72)
Total internal gains
             352.8368   350.3010   338.8250   321.1448   303.4658   287.1868   277.3341   282.5811   292.4429   310.2711   330.1462   344.7776 (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
-----------------------------------------------------------------------------------------------------------------------------------
Southeast                                4.3300           36.2806            0.7200           0.7000           0.7700           54.8689 (77)
Southwest                                9.1400           36.2806            0.7200           0.7000           0.7700          115.8202 (79)
Northwest                                3.1200           10.8980            0.7200           0.7000           0.7700           11.8759 (81)
-----------------------------------------------------------------------------------------------------------------------------------

Solar gains   182.5650   315.2204   462.3597   597.9225   686.8320   663.8389   644.1345   584.8394   500.7326   353.4204   214.3262   154.2845 (83)
Total gains   535.4017   665.5214   801.1847   919.0673   990.2977   951.0257   921.4686   867.4205   793.1754   663.6915   544.4725   499.0621 (84)
```

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7. Mean internal temperature (heating season)

```
Temperature during heating periods in the living area from Table 9, Th1 (C)                                      21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau           15.9253    16.0266    16.0992    16.2780    16.3191    16.3782    16.4517    16.4339    16.3191    16.2135    16.0992    16.1459
alpha          2.0617     2.0684     2.0733     2.0852     2.0879     2.0919     2.0968     2.0956     2.0879     2.0809     2.0733     2.0764
util living area
               0.9049     0.8606     0.7965     0.7100     0.6127     0.5192     0.4335     0.4596     0.5977     0.7654     0.8745     0.9160 (86)

MIT           18.0331    18.4851    19.0846    19.7317    20.2439    20.5996    20.7883    20.7585    20.4478    19.7072    18.7068    17.9307 (87)
Th 2          19.9331    19.9398    19.9446    19.9562    19.9588    19.9626    19.9672    19.9661    19.9588    19.9520    19.9446    19.9477 (88)
util rest of house
               0.8951     0.8473     0.7778     0.6841     0.5780     0.4724     0.3758     0.4010     0.5516     0.7377     0.8604     0.9074 (89)
MIT 2         17.2241    17.6675    18.2489    18.8722    19.3492    19.6718    19.8333    19.8109    19.5456    18.8643    17.8961    17.1337 (90)
Living area fraction                                                                                fLA = Living area / (4) =      0.5900 (91)
MIT           17.7014    18.1500    18.7420    19.3793    19.8772    20.2193    20.3968    20.3700    20.0780    19.3617    18.3745    17.6040 (92)
Temperature adjustment                                                                                            0.0000
adjusted MIT  17.7014    18.1500    18.7420    19.3793    19.8772    20.2193    20.3968    20.3700    20.0780    19.3617    18.3745    17.6040 (93)
```

---

8. Space heating requirement

```
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation    0.8696     0.8203     0.7535     0.6685     0.5751     0.4844     0.4005     0.4247     0.5572     0.7202     0.8348     0.8831 (94)
Useful gains 465.6000   545.9359   603.7169   614.3981   569.4850   460.7092   369.0726   368.3692   441.9484   478.0090   454.5136   440.6980 (95)
Ext temp.      3.1000     3.6000     5.0000     7.2000     9.8000    12.7000    14.7000    14.6000    12.4000     9.1000     5.7000     2.9000 (96)
Heat loss rate W
            1102.0366  1091.2101  1025.9702   899.3161   742.2142   551.8212   416.2060   422.0136   565.5068   760.7286   946.2670  1094.6106 (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
             473.5088   366.4243   314.1565   205.1409   128.5105     0.0000     0.0000     0.0000     0.0000   210.3434   354.0625   486.5110 (98)
Space heating                                                                                                    2538.6578 (98)
RHI space heating demand                                                                                            2539 (98)
```

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
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1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		4.9500	
Infiltration rate		0.3399	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2889	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3684	0.3611	0.3539	0.3178	0.3106	0.2745	0.2745	0.2672	0.2889	0.3106	0.3250	0.3395	(22b)
Effective ac	0.5678	0.5652	0.5626	0.5505	0.5482	0.5377	0.5377	0.5357	0.5417	0.5482	0.5528	0.5576	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2000	7.0740	75.0000	2652.7500	(28b)
Main	61.9300	16.5900	45.3400	0.2300	10.4282	9.0000	408.0600	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			132.6700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	45.8631			(33)
Party Wall 1			12.7900	0.0000	0.0000	20.0000	255.8000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	4327.0400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		122.3364 (35)
Thermal bridges (User defined value 0.058 * total exposed area)		7.6949 (36)
Total fabric heat loss	(33) + (36) =	53.5580 (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	20.2815	20.1874	20.0952	19.6620	19.5809	19.2036	19.2036	19.1337	19.3489	19.5809	19.7449	19.9163	(38)
Heat transfer coeff	73.8395	73.7454	73.6531	73.2199	73.1389	72.7616	72.7616	72.6917	72.9069	73.1389	73.3028	73.4743	(39)
Average = Sum(39)m / 12 =												73.2195	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.0876	2.0850	2.0824	2.0701	2.0678	2.0572	2.0572	2.0552	2.0613	2.0678	2.0725	2.0773	(40)
HLP (average)												2.0701	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895 (42)
Average daily hot water use (litres/day)	64.8244 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)

Water storage loss:	
Store volume	125.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):	1.0500 (48)

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```
  Temperature factor from Table 2b                                                                                0.5400 (49)
Enter (49) or (54) in (55)                                                                                        0.5670 (55)
Total storage loss
              17.5770    15.8760    17.5770    17.0100    17.5770    17.0100    17.5770    17.5770    17.0100    17.5770    17.0100    17.5770 (56)
If cylinder contains dedicated solar storage
              17.5770    15.8760    17.5770    17.0100    17.5770    17.0100    17.5770    17.5770    17.0100    17.5770    17.0100    17.5770 (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
             146.5855   129.3734   136.2768   122.7267   120.6763   108.4151   104.6790   114.0963   113.6538   127.2329   133.8273   143.2488 (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
             146.5855   129.3734   136.2768   122.7267   120.6763   108.4151   104.6790   114.0963   113.6538   127.2329   133.8273   143.2488 (64)
                                                                                  Total per year (kWh/year) = Sum(64)m =   1500.7919 (64)
Heat gains from water heating, kWh/month
              67.8321    60.2614    64.4045    59.2832    59.2173    54.5246    53.8982    57.0294    56.2664    61.3974    62.9741    66.7226 (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         77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              24.5364    21.7931    17.7233    13.4177    10.0299     8.4676     9.1496    11.8930    15.9627    20.2684    23.6562    25.2184 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             164.3130   166.0181   161.7214   152.5743   141.0276   130.1755   122.9255   121.2205   125.5172   134.6643   146.2109   157.0631 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262 (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)
             -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780 (71)
Water heating gains (Table 5)
              91.1722    89.6747    86.5651    82.3377    79.5931    75.7286    72.4438    76.6525    78.1478    82.5233    87.4640    89.6810 (72)
Total internal gains
             352.8368   350.3010   338.8250   321.1448   303.4658   287.1868   277.3341   282.5811   292.4429   310.2711   330.1462   344.7776 (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
-----------------------------------------------------------------------------------------------------------------
Southeast                                4.3300           36.7938            0.7200           0.7000         0.7700           55.6451 (77)
Southwest                                9.1400           36.7938            0.7200           0.7000         0.7700          117.4586 (79)
Northwest                                3.1200           11.2829            0.7200           0.7000         0.7700           12.2953 (81)
-----------------------------------------------------------------------------------------------------------------

Solar gains   185.3991   319.8872   448.5315   573.9350   659.4513   661.9827   635.1840   570.2689   491.7849   356.4684   222.8091   158.1817 (83)
Total gains   538.2358   670.1882   787.3565   895.0798   962.9171   949.1695   912.5181   852.8500   784.2278   666.7395   552.9553   502.9593 (84)
```

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7. Mean internal temperature (heating season)

```
Temperature during heating periods in the living area from Table 9, Th1 (C)                                     21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau           16.2780    16.2987    16.3191    16.4157    16.4339    16.5191    16.5191    16.5350    16.4862    16.4339    16.3971    16.3589
alpha          2.0852     2.0866     2.0879     2.0944     2.0956     2.1013     2.1013     2.1023     2.0991     2.0956     2.0931     2.0906
util living area
               0.8916     0.8407     0.7720     0.6734     0.5545     0.4277     0.3246     0.3569     0.5203     0.7204     0.8501     0.9033 (86)

MIT           18.3927    18.8390    19.4054    20.0155    20.4913    20.7919    20.9165    20.8952    20.6690    20.0250    19.0934    18.2932 (87)
Th 2          19.9562    19.9575    19.9588    19.9649    19.9661    19.9714    19.9714    19.9724    19.9694    19.9661    19.9638    19.9613 (88)
util rest of house
               0.8801     0.8249     0.7501     0.6426     0.5124     0.3717     0.2562     0.2867     0.4636     0.6861     0.8325     0.8929 (89)
MIT 2         17.5943    18.0263    18.5701    19.1480    19.5796    19.8387    19.9312    19.9194    19.7452    19.1746    18.2873    17.5013 (90)
Living area fraction                                                                                fLA = Living area / (4) =      0.5900 (91)
MIT           18.0654    18.5058    19.0630    19.6598    20.1175    20.4012    20.5126    20.4952    20.2903    19.6763    18.7629    17.9686 (92)
Temperature adjustment                                                                                          0.0000
adjusted MIT  18.0654    18.5058    19.0630    19.6598    20.1175    20.4012    20.5126    20.4952    20.2903    19.6763    18.7629    17.9686 (93)
```

---

8. Space heating requirement

```
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation    0.8546     0.7991     0.7289     0.6328     0.5189     0.3958     0.2929     0.3232     0.4820     0.6755     0.8083     0.8681 (94)
Useful gains 459.9648   535.5745   573.9088   566.3742   499.6355   375.6347   267.2732   275.6448   378.0171   450.3696   446.9614   436.6302 (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
            1016.4282  1003.3680   925.3011   787.8337   615.6491   422.1008   284.6859   297.6843   451.3142   663.8340   854.9261  1011.6367 (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
             414.0088   314.3572   261.4359   159.4508    86.3141     0.0000     0.0000     0.0000     0.0000   158.8175   293.7346   427.8048 (98)
Space heating                                                                                                  2115.9237 (98)
Space heating per m2                                                                                  (98) / (4) =     59.8226 (99)
```

8c. Space cooling requirement

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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 %)	175.1000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1208.4087	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	414.0088	314.3572	261.4359	159.4508	86.3141	0.0000	0.0000	0.0000	0.0000	158.8175	293.7346	427.8048	(98)
Space heating efficiency (main heating system 1)													
	175.1000	175.1000	175.1000	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175.1000	175.1000	(210)
Space heating fuel (main heating system)													
	236.4413	179.5301	149.3066	91.0627	49.2942	0.0000	0.0000	0.0000	0.0000	90.7010	167.7525	244.3203	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
Efficiency of water heater												175.1000	(216)
(217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(217)
Fuel for water heating, kWh/month													
	83.7153	73.8854	77.8280	70.0895	68.9185	61.9161	59.7824	65.1607	64.9080	72.6630	76.4290	81.8097	(219)
Water heating fuel used												857.1056	(219)
Annual totals kWh/year													
Space heating fuel - main system												1208.4087	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
Total electricity for the above, kWh/year												30.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Total delivered energy for all uses												2268.8428	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1208.4087	13.1900	159.3891	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	857.1056	13.1900	113.0522	(247)
Pumps and fans for heating	30.0000	13.1900	3.9570	(249)
Energy for lighting	173.3285	13.1900	22.8620	(250)
Additional standing charges			0.0000	(251)
Total energy cost			299.2604	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.5639	(257)
SAP value		78.1838	
SAP rating (Section 12)		78	(258)
SAP band		C	

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	1208.4087	0.5190	627.1641	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	857.1056	0.5190	444.8378	(264)
Space and water heating			1072.0019	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Total kg/year			1177.5294	(272)
CO2 emissions per m2			33.2900	(273)
EI value			80.3672	
EI rating			80	(274)
EI band			C	

Calculation of stars for heating and DHW

Main heating energy efficiency	13.19 × (1 + 0.29 × 0.00) / 1.7510 = 7.533, stars = 2
Main heating environmental impact	0.519 × (1 + 0.29 × 0.00) / 1.7510 = 0.2964, stars = 4
Water heating energy efficiency	13.19 / 1.7510 = 7.533, stars = 2
Water heating environmental impact	0.519 / 1.7510 = 0.2964, stars = 4

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		4.9500	
Infiltration rate		0.3399	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2889	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	6.6000	6.2000	5.9000	5.1000	4.9000	4.6000	4.2000	4.3000	4.9000	5.4000	5.9000	5.7000	(22)
Wind factor	1.6500	1.5500	1.4750	1.2750	1.2250	1.1500	1.0500	1.0750	1.2250	1.3500	1.4750	1.4250	(22a)
Adj infilt rate	0.4767	0.4478	0.4261	0.3684	0.3539	0.3322	0.3034	0.3106	0.3539	0.3900	0.4261	0.4117	(22b)
Effective ac	0.6136	0.6003	0.5908	0.5678	0.5626	0.5552	0.5460	0.5482	0.5626	0.5761	0.5908	0.5847	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2000	7.0740	75.0000	2652.7500	(28b)
Main	61.9300	16.5900	45.3400	0.2300	10.4282	9.0000	408.0600	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			132.6700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	45.8631			(33)
Party Wall 1			12.7900	0.0000	0.0000	20.0000	255.8000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	4327.0400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		122.3364 (35)
Thermal bridges (User defined value 0.058 * total exposed area)		7.6949 (36)
Total fabric heat loss	(33) + (36) =	53.5580 (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	21.9165	21.4395	21.1013	20.2815	20.0952	19.8296	19.5017	19.5809	20.0952	20.5750	21.1013	20.8852	(38)
Heat transfer coeff	75.4745	74.9975	74.6593	73.8395	73.6531	73.3876	73.0597	73.1389	73.6531	74.1329	74.6593	74.4432	(39)
Average = Sum(39)m / 12 =												74.0916	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1339	2.1204	2.1108	2.0876	2.0824	2.0749	2.0656	2.0678	2.0824	2.0959	2.1108	2.1047	(40)
HLP (average)												2.0948	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895 (42)
Average daily hot water use (litres/day)	64.8244 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0500	(48)

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

Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 0.5670 (55)
Total storage loss

	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770 (56)

If cylinder contains dedicated solar storage

	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770 (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

	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488 (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

	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488 (64)

Total per year (kWh/year) = Sum(64)m = 1500.7919 (64)

Heat gains from water heating, kWh/month

	67.8321	60.2614	64.4045	59.2832	59.2173	54.5246	53.8982	57.0294	56.2664	61.3974	62.9741	66.7226 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	(66)

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

	24.5364	21.7931	17.7233	13.4177	10.0299	8.4676	9.1496	11.8930	15.9627	20.2684	23.6562	25.2184 (67)

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

	164.3130	166.0181	161.7214	152.5743	141.0276	130.1755	122.9255	121.2205	125.5172	134.6643	146.2109	157.0631 (68)

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

	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262 (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)

	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780 (71)

Water heating gains (Table 5)

	91.1722	89.6747	86.5651	82.3377	79.5931	75.7286	72.4438	76.6525	78.1478	82.5233	87.4640	89.6810 (72)

Total internal gains

	352.8368	350.3010	338.8250	321.1448	303.4658	287.1868	277.3341	282.5811	292.4429	310.2711	330.1462	344.7776 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	4.3300	36.2806	0.7200	0.7000	0.7700	54.8689	(77)
Southwest	9.1400	36.2806	0.7200	0.7000	0.7700	115.8202	(79)
Northwest	3.1200	10.8980	0.7200	0.7000	0.7700	11.8759	(81)

Solar gains	182.5650	315.2204	462.3597	597.9225	686.8320	663.8389	644.1345	584.8394	500.7326	353.4204	214.3262	154.2845 (83)
Total gains	535.4017	665.5214	801.1847	919.0673	990.2977	951.0257	921.4686	867.4205	793.1754	663.6915	544.4725	499.0621 (84)

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7. Mean internal temperature (heating season)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	15.9253	16.0266	16.0992	16.2780	16.3191	16.3782	16.4517	16.4339	16.3191	16.2135	16.0992	16.1459	
alpha	2.0617	2.0684	2.0733	2.0852	2.0879	2.0919	2.0968	2.0956	2.0879	2.0809	2.0733	2.0764	
util living area	0.9049	0.8606	0.7965	0.7100	0.6127	0.5192	0.4335	0.4596	0.5977	0.7654	0.8745	0.9160	(86)
MIT	18.0331	18.4851	19.0846	19.7317	20.2439	20.5996	20.7883	20.7585	20.4478	19.7072	18.7068	17.9307	(87)
Th 2	19.9331	19.9398	19.9446	19.9562	19.9588	19.9626	19.9672	19.9661	19.9588	19.9520	19.9446	19.9477	(88)
util rest of house	0.8951	0.8473	0.7778	0.6841	0.5780	0.4724	0.3758	0.4010	0.5516	0.7377	0.8604	0.9074	(89)
MIT 2	17.2241	17.6675	18.2489	18.8722	19.3492	19.6718	19.8333	19.8109	19.5456	18.8643	17.8961	17.1337	(90)
Living area fraction										fLA = Living area / (4) =		0.5900	(91)
MIT	17.7014	18.1500	18.7420	19.3793	19.8772	20.2193	20.3968	20.3700	20.0780	19.3617	18.3745	17.6040	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.7014	18.1500	18.7420	19.3793	19.8772	20.2193	20.3968	20.3700	20.0780	19.3617	18.3745	17.6040	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8696	0.8203	0.7535	0.6685	0.5751	0.4844	0.4005	0.4247	0.5572	0.7202	0.8348	0.8831	(94)
Useful gains	465.6000	545.9359	603.7169	614.3981	569.4850	460.7092	369.0726	368.3692	441.9484	478.0090	454.5136	440.6980	(95)
Ext temp.	3.1000	3.6000	5.0000	7.2000	9.8000	12.7000	14.7000	14.6000	12.4000	9.1000	5.7000	2.9000	(96)
Heat loss rate W	1102.0366	1091.2101	1025.9702	899.3161	742.2142	551.8212	416.2060	422.0136	565.5068	760.7286	946.2670	1094.6106	(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	473.5088	366.4243	314.1565	205.1409	128.5105	0.0000	0.0000	0.0000	0.0000	210.3434	354.0625	486.5110	(98)
Space heating												2538.6578	(98)
Space heating per m2											(98) / (4) =	71.7743	(99)

8c. Space cooling requirement

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

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	175.1000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1449.8331	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	473.5088	366.4243	314.1565	205.1409	128.5105	0.0000	0.0000	0.0000	0.0000	210.3434	354.0625	486.5110	(98)
Space heating efficiency (main heating system 1)													
	175.1000	175.1000	175.1000	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175.1000	175.1000	(210)
Space heating fuel (main heating system)													
	270.4219	209.2657	179.4155	117.1565	73.3926	0.0000	0.0000	0.0000	0.0000	120.1276	202.2059	277.8475	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
Efficiency of water heater												175.1000	(216)
(217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(217)
Fuel for water heating, kWh/month													
	83.7153	73.8854	77.8280	70.0895	68.9185	61.9161	59.7824	65.1607	64.9080	72.6630	76.4290	81.8097	(219)
Water heating fuel used												857.1056	(219)
Annual totals kWh/year													
Space heating fuel - main system												1449.8331	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
Total electricity for the above, kWh/year												30.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Total delivered energy for all uses												2510.2673	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1449.8331	18.7000	271.1188	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	857.1056	18.7000	160.2787	(247)
Pumps and fans for heating	30.0000	18.7000	5.6100	(249)
Energy for lighting	173.3285	18.7000	32.4124	(250)
Additional standing charges			0.0000	(251)
Total energy cost			469.4200	(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	1449.8331	0.5190	752.4634	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	857.1056	0.5190	444.8378	(264)
Space and water heating			1197.3012	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Total kg/year			1302.8287	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	1449.8331	3.0700	4450.9878	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	857.1056	3.0700	2631.3142	(264)
Space and water heating			7082.3019	(265)
Pumps and fans	30.0000	3.0700	92.1000	(267)
Energy for lighting	173.3285	3.0700	532.1186	(268)
Primary energy kWh/year			7706.5205	(272)
Primary energy kWh/m2/year			217.8830	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating:	C 78
Current environmental impact rating:	C 80

(For testing purposes):

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

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 3.6	-£ 71	-196 kg (15.1%)
U Solar photovoltaic panels	+ 16.6	-£ 326	-906 kg (81.9%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£71	5.54 kg/m²	B 82	B 84
Solar photovoltaic panels	£326	25.62 kg/m²	A 98	A 99
Total Savings	£397	31.16 kg/m²		

Potential energy efficiency rating: A 98
Potential environmental impact rating: A 99

Fuel prices for cost data on this page from database revision number 465 TEST (04 Sep 2020)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£469	£399	£71
Space heating	£277	£277	-£0
Water heating	£160	£89	£71
Lighting	£32	£32	£0
Generated (PV)	-£0	-£326	£326
Total cost of fuels	£469	£73	£397
Total cost of uses	£469	£72	£397
Delivered energy	71 kWh/m²	11 kWh/m²	60 kWh/m²
Carbon dioxide emissions	1.3 tonnes	0.2 tonnes	1.1 tonnes
CO2 emissions per m²	37 kg/m²	6 kg/m²	31 kg/m²
Primary energy	218 kWh/m²	34 kWh/m²	184 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		4.9500	
Infiltration rate		0.3399	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2889	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3684	0.3611	0.3539	0.3178	0.3106	0.2745	0.2745	0.2672	0.2889	0.3106	0.3250	0.3395	(22b)
Effective ac	0.5678	0.5652	0.5626	0.5505	0.5482	0.5377	0.5377	0.5357	0.5417	0.5482	0.5528	0.5576	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2000	7.0740	75.0000	2652.7500	(28b)
Main	61.9300	16.5900	45.3400	0.2300	10.4282	9.0000	408.0600	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			132.6700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	45.8631			(33)
Party Wall 1			12.7900	0.0000	0.0000	20.0000	255.8000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	4327.0400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		122.3364 (35)
Thermal bridges (User defined value 0.058 * total exposed area)		7.6949 (36)
Total fabric heat loss	(33) + (36) =	53.5580 (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	20.2815	20.1874	20.0952	19.6620	19.5809	19.2036	19.2036	19.1337	19.3489	19.5809	19.7449	19.9163	(38)
Heat transfer coeff	73.8395	73.7454	73.6531	73.2199	73.1389	72.7616	72.7616	72.6917	72.9069	73.1389	73.3028	73.4743	(39)
Average = Sum(39)m / 12 =												73.2195	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.0876	2.0850	2.0824	2.0701	2.0678	2.0572	2.0572	2.0552	2.0613	2.0678	2.0725	2.0773	(40)
HLP (average)												2.0701	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895 (42)
Average daily hot water use (litres/day)	64.8244 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0500	(48)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.5670	(55)
Total storage loss													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(56)
If cylinder contains dedicated solar storage													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(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													
	146.5855	129.3734	134.8811	115.9731	107.8819	95.8084	91.6521	101.9999	108.2509	125.8372	133.8273	143.2488	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.7781	(H8)
Utilisation factor												0.4302	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												64.8244	(H14)
Volume ratio Veff/V												1.1570	(H15)
Solar storage volume factor												1.0000	(H16)
Solar input												-685.9569	(H17)
Solar input	-19.8914	-33.1930	-56.5315	-75.7633	-93.5992	-92.0229	-90.8068	-79.3384	-62.1378	-42.4328	-23.5940	-16.6457	(63)
								Solar input (sum of months) = Sum(63)m =				-685.9569	(63)
Output from w/h													
	126.6941	96.1804	78.3496	40.2098	14.2827	3.7855	0.8453	22.6615	46.1131	83.4043	110.2332	126.6031	(64)
								Total per year (kWh/year) = Sum(64)m =				749.3626	(64)
Heat gains from water heating, kWh/month													
	67.8321	60.2614	63.2879	53.8803	48.9818	44.4392	43.4766	47.3523	51.9441	60.2808	62.9741	66.7226	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.5364	21.7931	17.7233	13.4177	10.0299	8.4676	9.1496	11.8930	15.9627	20.2684	23.6562	25.2184	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	164.3130	166.0181	161.7214	152.5743	141.0276	130.1755	122.9255	121.2205	125.5172	134.6643	146.2109	157.0631	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	91.1722	89.6747	85.0643	74.8337	65.8358	61.7211	58.4363	63.6455	72.1446	81.0225	87.4640	89.6810	(72)
Total internal gains													
	352.8368	350.3010	337.3242	313.6408	289.7085	273.1794	263.3266	269.5742	286.4397	308.7703	330.1462	344.7776	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	4.3300	36.7938	0.7200	0.7000	0.7700	55.6451	(77)
Southwest	9.1400	36.7938	0.7200	0.7000	0.7700	117.4586	(79)
Northwest	3.1200	11.2829	0.7200	0.7000	0.7700	12.2953	(81)

Solar gains	185.3991	319.8872	448.5315	573.9350	659.4513	661.9827	635.1840	570.2689	491.7849	356.4684	222.8091	158.1817	(83)
Total gains	538.2358	670.1882	785.8557	887.5758	949.1598	935.1621	898.5106	839.8430	778.2246	665.2387	552.9553	502.9593	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	16.2780	16.2987	16.3191	16.4157	16.4339	16.5191	16.5191	16.5350	16.4862	16.4339	16.3971	16.3589	
alpha	2.0852	2.0866	2.0879	2.0944	2.0956	2.1013	2.1013	2.1023	2.0991	2.0956	2.0931	2.0906	
util living area	0.8916	0.8407	0.7726	0.6762	0.5596	0.4327	0.3290	0.3615	0.5230	0.7211	0.8501	0.9033	(86)
MIT	18.3927	18.8390	19.4028	20.0067	20.4818	20.7872	20.9143	20.8926	20.6655	20.0229	19.0934	18.2932	(87)
Th 2	19.9562	19.9575	19.9588	19.9649	19.9661	19.9714	19.9714	19.9724	19.9694	19.9661	19.9638	19.9613	(88)
util rest of house	0.8801	0.8249	0.7507	0.6455	0.5175	0.3762	0.2598	0.2906	0.4662	0.6868	0.8325	0.8929	(89)
MIT 2	17.5943	18.0263	18.5678	19.1403	19.5719	19.8355	19.9300	19.9179	19.7427	19.1727	18.2873	17.5013	(90)
Living area fraction									fLA = Living area / (4) =			0.5900	(91)
MIT	18.0654	18.5058	19.0605	19.6515	20.1088	20.3970	20.5108	20.4930	20.2872	19.6744	18.7629	17.9686	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0654	18.5058	19.0605	19.6515	20.1088	20.3970	20.5108	20.4930	20.2872	19.6744	18.7629	17.9686	(93)

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8. Space heating requirement

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8546	0.7991	0.7294	0.6354	0.5236	0.4003	0.2968	0.3274	0.4845	0.6762	0.8083	0.8681	(94)
Useful gains	459.9648	535.5745	573.2374	564.0068	497.0045	374.3244	266.6945	274.9411	377.0758	449.8144	446.9614	436.6302	(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	1016.4282	1003.3680	925.1207	787.2241	615.0092	421.8012	284.5578	297.5272	451.0898	663.6885	854.9261	1011.6367	(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	414.0088	314.3572	261.8012	160.7165	87.7955	0.0000	0.0000	0.0000	0.0000	159.1223	293.7346	427.8048	(98)
Space heating												2119.3409	(98)
Space heating per m2											(98) / (4) =	59.9192	(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 %)	175.1000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1210.3603	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	414.0088	314.3572	261.8012	160.7165	87.7955	0.0000	0.0000	0.0000	0.0000	159.1223	293.7346	427.8048	(98)
Space heating efficiency (main heating system 1)	175.1000	175.1000	175.1000	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175.1000	175.1000	(210)
Space heating fuel (main heating system)	236.4413	179.5301	149.5153	91.7855	50.1402	0.0000	0.0000	0.0000	0.0000	90.8751	167.7525	244.3203	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	126.6941	96.1804	78.3496	40.2098	14.2827	3.7855	0.8453	22.6615	46.1131	83.4043	110.2332	126.6031	(64)
Efficiency of water heater												175.1000	(216)
(217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(217)
Fuel for water heating, kWh/month	72.3553	54.9288	44.7456	22.9639	8.1569	2.1619	0.4827	12.9420	26.3353	47.6324	62.9544	72.3033	(219)
Water heating fuel used												427.9626	(219)

Annual totals kWh/year		
Space heating fuel - main system	1210.3603	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
pump for solar water heating	50.0000	(230g)
Total electricity for the above, kWh/year	80.0000	(231)
Electricity for lighting (calculated in Appendix L)	173.3285	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =	-1727.2394	-1727.2394 (233)
Total delivered energy for all uses	164.4121	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1210.3603	13.1900	159.6465	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	427.9626	13.1900	56.4483	(247)
Pumps and fans for heating	30.0000	13.1900	3.9570	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	173.3285	13.1900	22.8620	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			21.6860	(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] =	0.1133	(257)
SAP value	98.4191	
SAP rating (Section 12)	98	(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	1210.3603	0.5190	628.1770	(261)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	427.9626	0.5190	222.1126 (264)
Space and water heating			850.2896 (265)
Pumps and fans	80.0000	0.5190	41.5200 (267)
Energy for lighting	173.3285	0.5190	89.9575 (268)
Energy saving/generation technologies			
PV Unit	-1727.2394	0.5190	-896.4372 (269)
Total kg/year			85.3299 (272)
CO2 emissions per m2			2.4100 (273)
EI value			98.5773
EI rating			99 (274)
EI band			A

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		4.9500	
Infiltration rate		0.3399	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2889	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	6.6000	6.2000	5.9000	5.1000	4.9000	4.6000	4.2000	4.3000	4.9000	5.4000	5.9000	5.7000	(22)
Wind factor	1.6500	1.5500	1.4750	1.2750	1.2250	1.1500	1.0500	1.0750	1.2250	1.3500	1.4750	1.4250	(22a)
Adj infilt rate	0.4767	0.4478	0.4261	0.3684	0.3539	0.3322	0.3034	0.3106	0.3539	0.3900	0.4261	0.4117	(22b)
Effective ac	0.6136	0.6003	0.5908	0.5678	0.5626	0.5552	0.5460	0.5482	0.5626	0.5761	0.5908	0.5847	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2000	7.0740	75.0000	2652.7500	(28b)
Main	61.9300	16.5900	45.3400	0.2300	10.4282	9.0000	408.0600	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			132.6700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	45.8631			(33)
Party Wall 1			12.7900	0.0000	0.0000	20.0000	255.8000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	4327.0400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		122.3364 (35)
Thermal bridges (User defined value 0.058 * total exposed area)		7.6949 (36)
Total fabric heat loss	(33) + (36) =	53.5580 (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	21.9165	21.4395	21.1013	20.2815	20.0952	19.8296	19.5017	19.5809	20.0952	20.5750	21.1013	20.8852	(38)
Heat transfer coeff	75.4745	74.9975	74.6593	73.8395	73.6531	73.3876	73.0597	73.1389	73.6531	74.1329	74.6593	74.4432	(39)
Average = Sum(39)m / 12 =												74.0916	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1339	2.1204	2.1108	2.0876	2.0824	2.0749	2.0656	2.0678	2.0824	2.0959	2.1108	2.1047	(40)
HLP (average)												2.0948	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895 (42)
Average daily hot water use (litres/day)	64.8244 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0500	(48)

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

```
  Temperature factor from Table 2b                                                                                0.5400 (49)
Enter (49) or (54) in (55)                                                                                        0.5670 (55)
Total storage loss
               17.5770    15.8760    17.5770    17.0100    17.5770    17.0100    17.5770    17.5770    17.0100    17.5770    17.0100    17.5770 (56)
If cylinder contains dedicated solar storage
               17.5770    15.8760    17.5770    17.0100    17.5770    17.0100    17.5770    17.5770    17.0100    17.5770    17.0100    17.5770 (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
              146.5855   129.3734   134.8811   115.9731   107.8819    95.8084    91.6521   101.9999   108.2509   125.8372   133.8273   143.2488 (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                                                                                  1091.0709 (H5)
Overshading factor                                                                                                0.8000 (H6)
Solar energy available                                                                                         1832.9992 (H7)
Adjustment factor for showers                                                                                     1.0000 (H7a)
Solar-to-load ratio                                                                                               1.7972 (H8)
Utilisation factor                                                                                                0.4267 (H9)
Collector performance factor                                                                                      0.8793 (H10)
Dedicated solar storage volume                                                                                   75.0000 (H11)
Effective solar volume                                                                                           75.0000 (H13)
Daily hot water demand                                                                                           64.8244 (H14)
Volume ratio Veff/V                                                                                               1.1570 (H15)
Solar storage volume factor                                                                                       1.0000 (H16)
Solar input                                                                                                    -687.8113 (H17)
Solar input    -19.2686   -32.1683   -57.3554   -77.8632   -96.3853   -91.3308   -91.0993   -80.3442   -62.3188   -41.3797   -22.3236   -15.9741 (63)
                                                                                  Solar input (sum of months) = Sum(63)m =   -687.8113 (63)
Output from w/h
              127.3169    97.2050    77.5257    38.1099    11.4966     4.4776     0.5528    21.6557    45.9322    84.4575   111.5037   127.2747 (64)
                                                                                   Total per year (kWh/year) = Sum(64)m =    747.5082 (64)
Heat gains from water heating, kWh/month
               67.8321    60.2614    63.2879    53.8803    48.9818    44.4392    43.4766    47.3523    51.9441    60.2808    62.9741    66.7226 (65)
```

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

```
Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m          77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               24.5364    21.7931    17.7233    13.4177    10.0299     8.4676     9.1496    11.8930    15.9627    20.2684    23.6562    25.2184 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              164.3130   166.0181   161.7214   152.5743   141.0276   130.1755   122.9255   121.2205   125.5172   134.6643   146.2109   157.0631 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262 (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)
              -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780 (71)
Water heating gains (Table 5)
               91.1722    89.6747    85.0643    74.8337    65.8358    61.7211    58.4363    63.6455    72.1446    81.0225    87.4640    89.6810 (72)
Total internal gains
              352.8368   350.3010   337.3242   313.6408   289.7085   273.1794   263.3266   269.5742   286.4397   308.7703   330.1462   344.7776 (73)
```

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6. Solar gains

```
[Jan]                                    Area          Solar flux              g                FF            Access            Gains
                                          m2           Table 6a      Specific data      Specific data      factor                W
                                                          W/m2        or Table 6b        or Table 6c      Table 6d
-------------------------------------------------------------------------------------------------------------------
Southeast                               4.3300            36.2806            0.7200             0.7000            0.7700            54.8689 (77)
Southwest                               9.1400            36.2806            0.7200             0.7000            0.7700           115.8202 (79)
Northwest                               3.1200            10.8980            0.7200             0.7000            0.7700            11.8759 (81)
-------------------------------------------------------------------------------------------------------------------

Solar gains   182.5650   315.2204   462.3597   597.9225   686.8320   663.8389   644.1345   584.8394   500.7326   353.4204   214.3262   154.2845 (83)
Total gains   535.4017   665.5214   799.6839   911.5633   976.5404   937.0182   907.4612   854.4135   787.1722   662.1907   544.4725   499.0621 (84)
```

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7. Mean internal temperature (heating season)

```
Temperature during heating periods in the living area from Table 9, Th1 (C)                                    21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau            15.9253    16.0266    16.0992    16.2780    16.3191    16.3782    16.4517    16.4339    16.3191    16.2135    16.0992    16.1459
alpha           2.0617     2.0684     2.0733     2.0852     2.0879     2.0919     2.0968     2.0956     2.0879     2.0809     2.0733     2.0764
util living area
                0.9049     0.8606     0.7970     0.7127     0.6177     0.5245     0.4386     0.4648     0.6004     0.7660     0.8745     0.9160 (86)

MIT            18.0331    18.4851    19.0819    19.7216    20.2315    20.5915    20.7834    20.7531    20.4428    19.7048    18.7068    17.9307 (87)
Th 2           19.9331    19.9398    19.9446    19.9562    19.9588    19.9626    19.9672    19.9661    19.9588    19.9520    19.9446    19.9477 (88)
util rest of house
                0.8951     0.8473     0.7784     0.6869     0.5830     0.4775     0.3806     0.4059     0.5543     0.7384     0.8604     0.9074 (89)
MIT 2          17.2241    17.6675    18.2464    18.8631    19.3386    19.6656    19.8299    19.8072    19.5416    18.8621    17.8961    17.1337 (90)
Living area fraction                                                                    fLA = Living area / (4) =      0.5900 (91)
MIT            17.7014    18.1500    18.7394    19.3696    19.8654    20.2119    20.3925    20.3653    20.0733    19.3593    18.3745    17.6040 (92)
Temperature adjustment                                                                                            0.0000
adjusted MIT   17.7014    18.1500    18.7394    19.3696    19.8654    20.2119    20.3925    20.3653    20.0733    19.3593    18.3745    17.6040 (93)
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8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8696	0.8203	0.7540	0.6710	0.5797	0.4893	0.4052	0.4294	0.5597	0.7209	0.8348	0.8831	(94)
Useful gains	465.6000	545.9359	602.9862	611.6763	566.0533	458.4620	367.7148	366.8949	440.5729	477.3560	454.5136	440.6980	(95)
Ext temp.	3.1000	3.6000	5.0000	7.2000	9.8000	12.7000	14.7000	14.6000	12.4000	9.1000	5.7000	2.9000	(96)
Heat loss rate W	1102.0366	1091.2101	1025.7709	898.6003	741.3518	551.2830	415.8941	421.6709	565.1643	760.5531	946.2670	1094.6106	(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	473.5088	366.4243	314.5518	206.5852	130.4221	0.0000	0.0000	0.0000	0.0000	210.6986	354.0625	486.5110	(98)
Space heating												2542.7643	(98)
Space heating per m2											(98) / (4) =	71.8904	(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 %)	175.1000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1452.1784	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	473.5088	366.4243	314.5518	206.5852	130.4221	0.0000	0.0000	0.0000	0.0000	210.6986	354.0625	486.5110	(98)
Space heating efficiency (main heating system 1)	175.1000	175.1000	175.1000	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175.1000	175.1000	(210)
Space heating fuel (main heating system)	270.4219	209.2657	179.6412	117.9813	74.4843	0.0000	0.0000	0.0000	0.0000	120.3305	202.2059	277.8475	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	127.3169	97.2050	77.5257	38.1099	11.4966	4.4776	0.5528	21.6557	45.9322	84.4575	111.5037	127.2747	(64)
Efficiency of water heater												175.1000	(216)
(217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(217)
Fuel for water heating, kWh/month	72.7109	55.5140	44.2751	21.7646	6.5657	2.5572	0.3157	12.3676	26.2320	48.2338	63.6800	72.6869	(219)
Water heating fuel used												426.9036	(219)
Annual totals kWh/year													
Space heating fuel - main system												1452.1784	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												80.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1091 * 0.80) =										-1745.7135		-1745.7135	(233)
Total delivered energy for all uses												386.6970	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1452.1784	18.7000	271.5574	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	426.9036	18.7000	79.8310	(247)
Pumps and fans for heating	30.0000	18.7000	5.6100	(249)
Pump for solar water heating	50.0000	18.7000	9.3500	(249)
Energy for lighting	173.3285	18.7000	32.4124	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-1745.7135	18.7000	-326.4484	(252)
Total energy cost			72.3123	(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	1452.1784	0.5190	753.6806	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	426.9036	0.5190	221.5630	(264)
Space and water heating			975.2435	(265)
Pumps and fans	80.0000	0.5190	41.5200	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Energy saving/generation technologies				
PV Unit	-1745.7135	0.5190	-906.0253	(269)
Total kg/year			200.6957	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	1452.1784	3.0700	4458.1875	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	426.9036	3.0700	1310.5940	(264)
Space and water heating			5768.7815	(265)
Pumps and fans	80.0000	3.0700	245.6000	(267)
Energy for lighting	173.3285	3.0700	532.1186	(268)
Energy saving/generation technologies				
PV Unit	-1745.7135	3.0700	-5359.3404	(269)
Primary energy kWh/year			1187.1597	(272)
Primary energy kWh/m2/year			33.5640	(273)

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

Overheating Calculation Input Data

Dwelling type	SemiDetached Bungalow
Number of storeys	1
Cross ventilation possible	Yes
SAP Region	North East England
Front of dwelling faces	North West
Overshading	Average or unknown
Thermal mass parameter	122.3 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	6.00 (Windows fully open)

Overheating Calculation

Summer ventilation heat loss coefficient		214.30 (P1)
Transmission heat loss coefficient		53.56 (37)
Summer heat loss coefficient		267.86 (P2)

Overhangs

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

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
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
South East	4.3300	115.6809	0.7200	0.7000	0.9000	204.4867
South West	9.1400	115.6809	0.7200	0.7000	0.9000	431.6418
North West	3.1200	91.1383	0.7200	0.7000	0.9000	116.0836
total:						752.2121

	Jun	Jul	Aug	
Solar gains	771	752	670	(P3)
Internal gains	284	274	280	
Total summer gains	1056	1027	949	(P5)
Summer gain/loss ratio	3.94	3.83	3.54	(P6)
Summer external temperature	13.80	15.80	15.60	
Thermal mass temperature increment (TMP = 122.3)	1.14	1.14	1.14	
Threshold temperature	18.88	20.78	20.29	(P7)
Likelihood of high internal temperature	Not significant	Slight	Not significant	

Assessment of likelihood of high internal temperature: Slight

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

Anderson Goddard Ltd

Property Reference	73940-WR10	**Issued on Date**	07/10/2020
Assessment Reference	001	**Prop Type Ref**	Semi
Property	Woodlands Room 10, Raithwaite Bay, WHITBY, YO21 3ST		

SAP Rating	78 C	**DER**	34.93	**TER**	40.90
Environmental	80 C	**% DER<TER**	14.60		
CO_2 Emissions (t/year)	1.30	**DFEE**	76.30	**TFEE**	76.91
General Requirements Compliance	Pass	**% DFEE<TFEE**	0.79		

Assessor Details	Mr. Paul Goddard, Anderson Goddard Limited, Tel: 0161 7757770, paul.goddard@andersongoddard.com	**Assessor ID**	B342-0001
Client			

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

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

Semi-Detached Bungalow, total floor area 35 m²

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

1a TER and DER
Fuel for main heating:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 40.90 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 34.93 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)76.9 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)76.3 kWh/m²/yrOK

---
2 Fabric U-values

Element	Average	Highest	
External wall	0.23 (max. 0.30)	0.23 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.20 (max. 0.25)	0.20 (max. 0.70)	OK
Roof	0.18 (max. 0.20)	0.18 (max. 0.35)	OK
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated using user-specified y-value of 0.058

---
3 Air permeability
Air permeability at 50 pascals: 4.95 (design value)
Maximum 10.0 OK

---
4 Heating efficiency
Main heating system: Heat pump with radiators or underfloor - Electric
Air-to-water heat pump

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage Measured cylinder loss: 1.05 kWh/day
Permitted by DBSCG 1.70 OK
Primary pipework insulated: Yes OK

---
6 Controls
Space heating controls: Programmer and room thermostat OK

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

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

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (North East England): Slight OK
Based on:
Overshading: Average
Windows facing South East: 4.33 m², No overhang
Windows facing South West: 9.14 m², No overhang
Windows facing North West: 3.12 m², No overhang
Air change rate: 8.00 ach
Blinds/curtains: None

---
10 Key features
Party wall U-value 0.00 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		4.9500	
Infiltration rate		0.3399	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2889	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3684	0.3611	0.3539	0.3178	0.3106	0.2745	0.2745	0.2672	0.2889	0.3106	0.3250	0.3395	(22b)
Effective ac	0.5678	0.5652	0.5626	0.5505	0.5482	0.5377	0.5377	0.5357	0.5417	0.5482	0.5528	0.5576	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2000	7.0740	75.0000	2652.7500	(28b)
Main	61.9300	16.5900	45.3400	0.2300	10.4282	9.0000	408.0600	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			132.6700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	45.8631			(33)
Party Wall 1			12.7900	0.0000	0.0000	20.0000	255.8000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		4327.0400	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							122.3364	(35)
Thermal bridges (User defined value 0.058 * total exposed area)							7.6949	(36)
Total fabric heat loss					(33) + (36) =		53.5580	(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	20.2815	20.1874	20.0952	19.6620	19.5809	19.2036	19.2036	19.1337	19.3489	19.5809	19.7449	19.9163	(38)
Heat transfer coeff	73.8395	73.7454	73.6531	73.2199	73.1389	72.7616	72.7616	72.6917	72.9069	73.1389	73.3028	73.4743	(39)
Average = Sum(39)m / 12 =												73.2195	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.0876	2.0850	2.0824	2.0701	2.0678	2.0572	2.0572	2.0552	2.0613	2.0678	2.0725	2.0773	(40)
HLP (average)												2.0701	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895	(42)
Average daily hot water use (litres/day)	64.8244	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0500	(48)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.5670	(55)
Total storage loss													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(56)
If cylinder contains dedicated solar storage													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(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													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(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													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
								Total per year (kWh/year) = Sum(64)m =				1500.7919	(64)
Heat gains from water heating, kWh/month													
	67.8321	60.2614	64.4045	59.2832	59.2173	54.5246	53.8982	57.0294	56.2664	61.3974	62.9741	66.7226	(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	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	9.8146	8.7172	7.0893	5.3671	4.0119	3.3871	3.6598	4.7572	6.3851	8.1073	9.4625	10.0874	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	110.0897	111.2321	108.3533	102.2247	94.4885	87.2176	82.3601	81.2177	84.0965	90.2251	97.9613	105.2323	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	91.1722	89.6747	86.5651	82.3377	79.5931	75.7286	72.4438	76.6525	78.1478	82.5233	87.4640	89.6810	(72)
Total internal gains													
	256.4182	254.9658	247.3495	235.2713	223.4353	211.6749	203.8055	207.9691	213.9712	226.1975	240.2295	250.3424	(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	
Southeast	4.3300	36.7938	0.7200	0.7000	0.7700	55.6451	(77)
Southwest	9.1400	36.7938	0.7200	0.7000	0.7700	117.4586	(79)
Northwest	3.1200	11.2829	0.7200	0.7000	0.7700	12.2953	(81)

Solar gains	185.3991	319.8872	448.5315	573.9350	659.4513	661.9827	635.1840	570.2689	491.7849	356.4684	222.8091	158.1817	(83)
Total gains	441.8173	574.8530	695.8811	809.2063	882.8867	873.6576	838.9895	778.2380	705.7561	582.6659	463.0386	408.5241	(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	16.2780	16.2987	16.3191	16.4157	16.4339	16.5191	16.5191	16.5350	16.4862	16.4339	16.3971	16.3589	
alpha	2.0852	2.0866	2.0879	2.0944	2.0956	2.1013	2.1013	2.1023	2.0991	2.0956	2.0931	2.0906	
util living area													
	0.9212	0.8729	0.8058	0.7070	0.5856	0.4557	0.3488	0.3849	0.5580	0.7618	0.8853	0.9315	(86)
MIT	18.1404	18.6256	19.2421	19.9089	20.4325	20.7644	20.9040	20.8785	20.6195	19.8983	18.8844	18.0372	(87)
Th 2	19.9562	19.9575	19.9588	19.9649	19.9661	19.9714	19.9714	19.9724	19.9694	19.9661	19.9638	19.9613	(88)
util rest of house													
	0.9124	0.8595	0.7858	0.6772	0.5434	0.3976	0.2764	0.3108	0.5003	0.7299	0.8708	0.9237	(89)
MIT 2	17.3499	17.8227	18.4185	19.0537	19.5319	19.8200	19.9247	19.9103	19.7088	19.0627	18.0888	17.2523	(90)
Living area fraction										fLA = Living area / (4) =		0.5900	(91)
MIT	17.8163	18.2965	18.9044	19.5583	20.0633	20.3772	20.5025	20.4816	20.2461	19.5557	18.5583	17.7154	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.8163	18.2965	18.9044	19.5583	20.0633	20.3772	20.5025	20.4816	20.2461	19.5557	18.5583	17.7154	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8891	0.8336	0.7626	0.6645	0.5475	0.4213	0.3146	0.3485	0.5166	0.7156	0.8467	0.9018	(94)
Useful gains	392.8354	479.2215	530.6618	537.7094	483.4146	368.0655	263.9785	271.2438	364.6282	416.9779	392.0478	368.3965	(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													
	998.0392	987.9273	913.6247	780.4033	611.6794	420.3616	283.9542	296.6975	448.0965	655.0131	839.9225	993.0351	(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													
	450.2716	341.8503	284.9243	174.7396	95.4290	0.0000	0.0000	0.0000	0.0000	177.0982	322.4698	464.7311	(98)
Space heating												2311.5140	(98)
Space heating per m2											(98) / (4) =	65.3524	(99)

8c. Space cooling requirement

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	175.1000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1320.1108	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	450.2716	341.8503	284.9243	174.7396	95.4290	0.0000	0.0000	0.0000	0.0000	177.0982	322.4698	464.7311	(98)
Space heating efficiency (main heating system 1)	175.1000	175.1000	175.1000	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175.1000	175.1000	(210)
Space heating fuel (main heating system)	257.1511	195.2315	162.7209	99.7942	54.4997	0.0000	0.0000	0.0000	0.0000	101.1412	184.1632	265.4090	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
Efficiency of water heater												175.1000	(216)
(217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(217)
Fuel for water heating, kWh/month	83.7153	73.8854	77.8280	70.0895	68.9185	61.9161	59.7824	65.1607	64.9080	72.6630	76.4290	81.8097	(219)
Water heating fuel used												857.1056	(219)
Annual totals kWh/year													
Space heating fuel - main system												1320.1108	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
Total electricity for the above, kWh/year												30.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Total delivered energy for all uses												2380.5449	(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	1320.1108	0.5190	685.1375	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	857.1056	0.5190	444.8378	(264)
Space and water heating			1129.9753	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Total CO2, kg/year			1235.5028	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			34.9300	(273)

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

DER		34.9300	ZC1
Total Floor Area	TFA	35.3700	
Assumed number of occupants	N	1.2895	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		18.4441	ZC2
CO2 emissions from cooking, equation (L16)		4.2394	ZC3
Total CO2 emissions		57.6135	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		57.6135	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000	/ (5) =	0.1848	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.4348	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3696	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4712	0.4620	0.4527	0.4065	0.3973	0.3511	0.3511	0.3419	0.3696	0.3973	0.4158	0.4342	(22b)
Effective ac	0.6110	0.6067	0.6025	0.5826	0.5789	0.5616	0.5616	0.5584	0.5683	0.5789	0.5864	0.5943	(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 Opening Type (Uw = 1.40)			8.8400	1.3258	11.7197			(27)
GF			35.3700	0.1300	4.5981			(28b)
Main	61.9300	8.8400	53.0900	0.1800	9.5562			(29a)
Flat	35.3700		35.3700	0.1300	4.5981			(30)
Total net area of external elements Aum(A, m2)			132.6700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		30.4721			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.0070	(36)
Total fabric heat loss					(33) + (36) =		38.4791	(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	21.8234	21.6694	21.5185	20.8096	20.6770	20.0596	20.0596	19.9453	20.2974	20.6770	20.9453	21.2258	(38)
Heat transfer coeff	60.3025	60.1485	59.9976	59.2887	59.1561	58.5387	58.5387	58.4244	58.7765	59.1561	59.4244	59.7049	(39)
Average = Sum(39)m / 12 =												59.2881	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.7049	1.7006	1.6963	1.6762	1.6725	1.6550	1.6550	1.6518	1.6618	1.6725	1.6801	1.6880	(40)
HLP (average)												1.6762	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.2895	(42)
Average daily hot water use (litres/day)												64.8244	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.2538	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.6770	(55)
Total storage loss													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	20.9878	18.9567	20.9878	20.3108	20.9878	20.3108	20.9878	20.9878	20.3108	20.9878	20.3108	20.9878	(56)
If cylinder contains dedicated solar storage													
	20.9878	18.9567	20.9878	20.3108	20.9878	20.3108	20.9878	20.9878	20.3108	20.9878	20.3108	20.9878	(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													
	149.9962	132.4541	139.6876	126.0274	124.0870	111.7159	108.0898	117.5071	116.9546	130.6437	137.1280	146.6596	(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													
	149.9962	132.4541	139.6876	126.0274	124.0870	111.7159	108.0898	117.5071	116.9546	130.6437	137.1280	146.6596	(64)
								Total per year (kWh/year) = Sum(64)m =				1540.9510	(64)
Heat gains from water heating, kWh/month													
	70.5607	62.7260	67.1331	61.9238	61.9459	57.1652	56.6268	59.7581	58.9070	64.1260	65.6147	69.4513	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	9.8146	8.7172	7.0893	5.3671	4.0119	3.3871	3.6598	4.7572	6.3851	8.1073	9.4625	10.0874	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	110.0897	111.2321	108.3533	102.2247	94.4885	87.2176	82.3601	81.2177	84.0965	90.2251	97.9613	105.2323	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	94.8397	93.3422	90.2326	86.0052	83.2606	79.3961	76.1113	80.3200	81.8153	86.1908	91.1315	93.3485	(72)
Total internal gains													
	260.0857	258.6333	251.0170	238.9388	227.1028	215.3424	207.4730	211.6366	217.6387	229.8650	243.8970	254.0099	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	2.3100	36.7938	0.6300	0.7000	0.7700	25.9752	(77)
Southwest	4.8700	36.7938	0.6300	0.7000	0.7700	54.7616	(79)
Northwest	1.6600	11.2829	0.6300	0.7000	0.7700	5.7240	(81)

Solar gains	86.4608	149.1760	209.1593	267.6234	307.4868	308.6618	296.1686	265.9091	229.3245	166.2329	103.9063	73.7684	(83)
Total gains	346.5465	407.8093	460.1763	506.5622	534.5896	524.0042	503.6416	477.5457	446.9632	396.0979	347.8034	327.7782	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	40.7321	40.8364	40.9391	41.4286	41.5215	41.9594	41.9594	42.0415	41.7896	41.5215	41.3340	41.1398	
alpha	3.7155	3.7224	3.7293	3.7619	3.7681	3.7973	3.7973	3.8028	3.7860	3.7681	3.7556	3.7427	
util living area													
	0.9875	0.9765	0.9539	0.9019	0.8015	0.6437	0.4910	0.5333	0.7510	0.9228	0.9771	0.9897	(86)
MIT	19.3967	19.6240	19.9592	20.3688	20.7049	20.9092	20.9750	20.9657	20.8302	20.3945	19.8228	19.3589	(87)
Th 2	19.5373	19.5404	19.5435	19.5579	19.5606	19.5732	19.5732	19.5756	19.5684	19.5606	19.5551	19.5494	(88)
util rest of house													
	0.9832	0.9686	0.9381	0.8674	0.7320	0.5274	0.3416	0.3819	0.6461	0.8877	0.9680	0.9862	(89)
MIT 2	17.4954	17.8241	18.3024	18.8747	19.2989	19.5206	19.5660	19.5643	19.4522	18.9269	18.1243	17.4484	(90)
Living area fraction										fLA = Living area / (4) =		0.5900	(91)
MIT	18.6173	18.8861	19.2800	19.7563	20.1285	20.3400	20.3974	20.3912	20.2653	19.7929	19.1265	18.5757	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6173	18.8861	19.2800	19.7563	20.1285	20.3400	20.3974	20.3912	20.2653	19.7929	19.1265	18.5757	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9796	0.9640	0.9346	0.8729	0.7619	0.5929	0.4301	0.4714	0.7013	0.8944	0.9645	0.9830	(94)
Useful gains	339.4691	393.1424	430.0765	442.1538	407.2999	310.7059	216.6196	225.1128	313.4640	354.2794	335.4590	322.1995	(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													
	863.3661	841.2443	766.7677	643.6550	498.6002	336.0102	222.2944	233.1846	362.3765	543.8148	714.6673	858.2992	(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													
	389.7794	301.1245	250.4983	145.0809	67.9274	0.0000	0.0000	0.0000	0.0000	141.0144	273.0299	398.8582	(98)
Space heating												1967.3129	(98)
Space heating per m2											(98) / (4) =	55.6209	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2104.0780	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	389.7794	301.1245	250.4983	145.0809	67.9274	0.0000	0.0000	0.0000	0.0000	141.0144	273.0299	398.8582	(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)													
	416.8763	322.0583	267.9126	155.1667	72.6496	0.0000	0.0000	0.0000	0.0000	150.8175	292.0106	426.5863	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	149.9962	132.4541	139.6876	126.0274	124.0870	111.7159	108.0898	117.5071	116.9546	130.6437	137.1280	146.6596	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.2491	86.9388	86.3547	85.1900	83.2834	79.8000	79.8000	79.8000	79.8000	85.0178	86.6171	87.3512	(217)
Fuel for water heating, kWh/month													
	171.9173	152.3532	161.7603	147.9368	148.9937	139.9949	135.4509	147.2520	146.5596	153.6663	158.3152	167.8966	(219)
Water heating fuel used												1832.0967	(219)
Annual totals kWh/year													
Space heating fuel - main system												2104.0780	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Total delivered energy for all uses												4184.5032	(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	2104.0780	0.2160	454.4808	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1832.0967	0.2160	395.7329	(264)
Space and water heating			850.2137	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Total CO2, kg/m2/year			979.0962	(272)
Emissions per m2 for space and water heating			24.0377	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			2.5433	(272b)
Emissions per m2 for pumps and fans			1.1005	(272c)
Target Carbon Dioxide Emission Rate (TER) = (24.0377 * 1.55) + 2.5433 + 1.1005, rounded to 2 d.p.			40.9000	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1848	(8)
Pressure test		Yes	
Measured/design AP50		4.9500	
Infiltration rate		0.4323	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3674	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4685	0.4593	0.4501	0.4042	0.3950	0.3491	0.3491	0.3399	0.3674	0.3950	0.4134	0.4317	(22b)
Effective ac	0.6097	0.6055	0.6013	0.5817	0.5780	0.5609	0.5609	0.5578	0.5675	0.5780	0.5854	0.5932	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2000	7.0740	75.0000	2652.7500	(28b)
Main	61.9300	16.5900	45.3400	0.2300	10.4282	9.0000	408.0600	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			132.6700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	45.8631			(33)
Party Wall 1			12.7900	0.0000	0.0000	20.0000	255.8000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	4327.0400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		122.3364 (35)
Thermal bridges (User defined value 0.058 * total exposed area)		7.6949 (36)
Total fabric heat loss	(33) + (36) =	53.5580 (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	21.7779	21.6257	21.4765	20.7758	20.6447	20.0344	20.0344	19.9214	20.2695	20.6447	20.9099	21.1872	(38)
Heat transfer coeff	75.3359	75.1837	75.0345	74.3338	74.2027	73.5924	73.5924	73.4793	73.8274	74.2027	74.4679	74.7452	(39)
Average = Sum(39)m / 12 =												74.3332	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1299	2.1256	2.1214	2.1016	2.0979	2.0806	2.0806	2.0774	2.0873	2.0979	2.1054	2.1132	(40)
HLP (average)												2.1016	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895 (42)
Average daily hot water use (litres/day)	64.8244 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage

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

Heat gains from water heating, kWh/month

	22.4710	19.6533	20.2805	17.6810	16.9653	14.6398	13.5659	15.5671	15.7530	18.3586	20.0399	21.7620 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	(66)

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

	9.8146	8.7172	7.0893	5.3671	4.0119	3.3871	3.6598	4.7572	6.3851	8.1073	9.4625	10.0874 (67)

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

	110.0897	111.2321	108.3533	102.2247	94.4885	87.2176	82.3601	81.2177	84.0965	90.2251	97.9613	105.2323 (68)

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

	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473 (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)

	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780 (71)

Water heating gains (Table 5)

	30.2030	29.2460	27.2587	24.5569	22.8029	20.3330	18.2338	20.9235	21.8792	24.6756	27.8331	29.2500 (72)

Total internal gains

	192.4491	191.5371	185.0431	174.4905	163.6451	153.2794	146.5955	149.2402	154.7025	165.3497	177.5987	186.9114 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	4.3300	36.7938	0.7200	0.7000	0.7700	55.6451	(77)
Southwest	9.1400	36.7938	0.7200	0.7000	0.7700	117.4586	(79)
Northwest	3.1200	11.2829	0.7200	0.7000	0.7700	12.2953	(81)

Solar gains	185.3991	319.8872	448.5315	573.9350	659.4513	661.9827	635.1840	570.2689	491.7849	356.4684	222.8091	158.1817	(83)
Total gains	377.8481	511.4243	633.5746	748.4255	823.0964	815.2621	781.7794	719.5090	646.4875	521.8181	400.4078	345.0931	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	15.9546	15.9869	16.0187	16.1697	16.1983	16.3326	16.3326	16.3577	16.2806	16.1983	16.1406	16.0807	
alpha	2.0636	2.0658	2.0679	2.0780	2.0799	2.0888	2.0888	2.0905	2.0854	2.0799	2.0760	2.0720	
util living area	0.9400	0.8951	0.8314	0.7348	0.6142	0.4827	0.3730	0.4129	0.5927	0.7951	0.9098	0.9491	(86)
MIT	17.9057	18.4180	19.0727	19.7941	20.3629	20.7315	20.8883	20.8581	20.5631	19.7679	18.6877	17.8066	(87)
Th 2	19.2481	19.2509	19.2536	19.2665	19.2689	19.2801	19.2801	19.2822	19.2758	19.2689	19.2640	19.2589	(88)
util rest of house	0.9277	0.8748	0.7993	0.6849	0.5409	0.3791	0.2415	0.2779	0.4905	0.7428	0.8885	0.9385	(89)
MIT 2	16.5901	17.0843	17.7066	18.3764	18.8668	19.1575	19.2509	19.2410	19.0506	18.3861	17.3679	16.5006	(90)
Living area fraction									fLA = Living area / (4) =			0.5900	(91)
MIT	17.3663	17.8712	18.5126	19.2129	19.7496	20.0862	20.2171	20.1952	19.9430	19.2014	18.1467	17.2712	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.3663	17.8712	18.5126	19.2129	19.7496	20.0862	20.2171	20.1952	19.9430	19.2014	18.1467	17.2712	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9098	0.8545	0.7832	0.6832	0.5628	0.4302	0.3160	0.3530	0.5333	0.7404	0.8708	0.9219	(94)
Useful gains	343.7595	437.0328	496.1904	511.3058	463.2735	350.7392	247.0052	253.9926	344.7872	386.3578	348.6627	318.1567	(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	984.3646	975.2247	901.3623	766.6004	597.2988	403.7450	266.1882	278.8674	431.3765	638.2499	822.6236	977.0081	(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	476.6102	361.6650	301.4479	183.8121	99.7149	0.0000	0.0000	0.0000	0.0000	187.4077	341.2519	490.1854	(98)
Space heating												2442.0951	(98)
Space heating per m2											(98) / (4) =	69.0442	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W	0.0000	0.0000	0.0000	0.0000	0.0000	691.7681	544.5834	558.4429	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7906	0.8404	0.8159	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	546.9437	457.6577	455.6134	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	1002.5373	962.5469	890.4002	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	328.0274	375.6375	323.4814	0.0000	0.0000	0.0000	0.0000	(104)

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Space cooling											1027.1463	(104)
Cooled fraction									fC = cooled area / (4) =		1.0000	(105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000	0.0000	(106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	82.0069	93.9094	80.8703	0.0000	0.0000	0.0000	0.0000	(107)
Space cooling											256.7866	(107)
Space cooling per m2											7.2600	(108)
Energy for space heating											69.0442	(99)
Energy for space cooling											7.2600	(108)
Total											76.3043	(109)
Dwelling Fabric Energy Efficiency (DFEE)											76.3	(109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000	/ (5) =	0.1848	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.4348	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3696	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4712	0.4620	0.4527	0.4065	0.3973	0.3511	0.3511	0.3419	0.3696	0.3973	0.4158	0.4342	(22b)
Effective ac	0.6110	0.6067	0.6025	0.5826	0.5789	0.5616	0.5616	0.5584	0.5683	0.5789	0.5864	0.5943	(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 Opening Type (Uw = 1.40)			8.8400	1.3258	11.7197			(27)
GF			35.3700	0.1300	4.5981			(28b)
Main	61.9300	8.8400	53.0900	0.1800	9.5562			(29a)
Flat	35.3700		35.3700	0.1300	4.5981			(30)
Total net area of external elements Aum(A, m2)			132.6700					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		30.4721			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							8.0070	(36)
Total fabric heat loss					(33) + (36) =		38.4791	(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	21.8234	21.6694	21.5185	20.8096	20.6770	20.0596	20.0596	19.9453	20.2974	20.6770	20.9453	21.2258	(38)
Heat transfer coeff	60.3025	60.1485	59.9976	59.2887	59.1561	58.5387	58.5387	58.4244	58.7765	59.1561	59.4244	59.7049	(39)
Average = Sum(39)m / 12 =												59.2881	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.7049	1.7006	1.6963	1.6762	1.6725	1.6550	1.6550	1.6518	1.6618	1.6725	1.6801	1.6880	(40)
HLP (average)												1.6762	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.2895	(42)
Average daily hot water use (litres/day)												64.8244	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(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)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Heat gains from water heating, kWh/month

	22.4710	19.6533	20.2805	17.6810	16.9653	14.6398	13.5659	15.5671	15.7530	18.3586	20.0399	21.7620 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	9.8146	8.7172	7.0893	5.3671	4.0119	3.3871	3.6598	4.7572	6.3851	8.1073	9.4625	10.0874	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	110.0897	111.2321	108.3533	102.2247	94.4885	87.2176	82.3601	81.2177	84.0965	90.2251	97.9613	105.2323	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	30.2030	29.2460	27.2587	24.5569	22.8029	20.3330	18.2338	20.9235	21.8792	24.6756	27.8331	29.2500	(72)
Total internal gains													
	192.4491	191.5371	185.0431	174.4905	163.6451	153.2794	146.5955	149.2402	154.7025	165.3497	177.5987	186.9114	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	2.3100	36.7938	0.6300	0.7000	0.7700	25.9752	(77)
Southwest	4.8700	36.7938	0.6300	0.7000	0.7700	54.7616	(79)
Northwest	1.6600	11.2829	0.6300	0.7000	0.7700	5.7240	(81)

Solar gains	86.4608	149.1760	209.1593	267.6234	307.4868	308.6618	296.1686	265.9091	229.3245	166.2329	103.9063	73.7684	(83)
Total gains	278.9098	340.7131	394.2024	442.1139	471.1319	461.9412	442.7640	415.1493	384.0270	331.5827	281.5050	260.6797	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	40.7321	40.8364	40.9391	41.4286	41.5215	41.9594	41.9594	42.0415	41.7896	41.5215	41.3340	41.1398	
alpha	3.7155	3.7224	3.7293	3.7619	3.7681	3.7973	3.7973	3.8028	3.7860	3.7681	3.7556	3.7427	
util living area													
	0.9939	0.9866	0.9707	0.9310	0.8468	0.7019	0.5481	0.5975	0.8121	0.9526	0.9884	0.9952	(86)
MIT	19.2399	19.4743	19.8232	20.2591	20.6334	20.8774	20.9638	20.9496	20.7724	20.2742	19.6736	19.2017	(87)
Th 2	19.5373	19.5404	19.5435	19.5579	19.5606	19.5732	19.5732	19.5756	19.5684	19.5606	19.5551	19.5494	(88)
util rest of house													
	0.9917	0.9819	0.9600	0.9041	0.7851	0.5849	0.3861	0.4351	0.7156	0.9284	0.9834	0.9935	(89)
MIT 2	17.9885	18.2227	18.5675	18.9954	19.3300	19.5223	19.5657	19.5636	19.4552	19.0218	18.4333	17.9595	(90)
Living area fraction									fLA = Living area / (4) =			0.5900	(91)
MIT	18.7269	18.9612	19.3084	19.7410	20.0990	20.3219	20.3907	20.3814	20.2324	19.7608	19.1651	18.6925	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7269	18.9612	19.3084	19.7410	20.0990	20.3219	20.3907	20.3814	20.2324	19.7608	19.1651	18.6925	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9900	0.9795	0.9578	0.9082	0.8107	0.6503	0.4823	0.5313	0.7653	0.9326	0.9816	0.9921	(94)
Useful gains	276.1300	333.7209	377.5679	401.5063	381.9678	300.3909	213.5651	220.5668	293.8893	309.2179	276.3379	258.6296	(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													
	869.9789	845.7591	768.4743	642.7509	496.8544	334.9518	221.9012	232.6137	360.4423	541.9172	716.9629	865.2740	(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													
	441.8235	344.0897	290.8343	173.6961	85.4756	0.0000	0.0000	0.0000	0.0000	173.1282	317.2500	451.3434	(98)
Space heating												2277.6409	(98)
Space heating per m2											(98) / (4) =	64.3947	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	550.2639	433.1865	444.0253	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8179	0.8825	0.8583	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	450.0804	382.3077	381.0953	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	589.5648	566.2951	534.6549	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	100.4288	136.8867	114.2484	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												351.5638	(104)
Cooled fraction									fC = cooled area / (4) =			1.0000	(105)

Intermittency factor (Table 10b)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	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	25.1072	34.2217	28.5621	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												87.8909 (107)
Space cooling per m2												2.4849 (108)
Energy for space heating												64.3947 (99)
Energy for space cooling												2.4849 (108)
Total												66.8796 (109)
Target Fabric Energy Efficiency (TFEE)												76.9 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		4.9500	
Infiltration rate		0.3399	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2889	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	6.6000	6.2000	5.9000	5.1000	4.9000	4.6000	4.2000	4.3000	4.9000	5.4000	5.9000	5.7000	(22)
Wind factor	1.6500	1.5500	1.4750	1.2750	1.2250	1.1500	1.0500	1.0750	1.2250	1.3500	1.4750	1.4250	(22a)
Adj infilt rate	0.4767	0.4478	0.4261	0.3684	0.3539	0.3322	0.3034	0.3106	0.3539	0.3900	0.4261	0.4117	(22b)
Effective ac	0.6136	0.6003	0.5908	0.5678	0.5626	0.5552	0.5460	0.5482	0.5626	0.5761	0.5908	0.5847	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2000	7.0740	75.0000	2652.7500	(28b)
Main	61.9300	16.5900	45.3400	0.2300	10.4282	9.0000	408.0600	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			132.6700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	45.8631			(33)
Party Wall 1			12.7900	0.0000	0.0000	20.0000	255.8000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		4327.0400	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							122.3364	(35)
Thermal bridges (User defined value 0.058 * total exposed area)							7.6949	(36)
Total fabric heat loss					(33) + (36) =		53.5580	(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	21.9165	21.4395	21.1013	20.2815	20.0952	19.8296	19.5017	19.5809	20.0952	20.5750	21.1013	20.8852	(38)
Heat transfer coeff	75.4745	74.9975	74.6593	73.8395	73.6531	73.3876	73.0597	73.1389	73.6531	74.1329	74.6593	74.4432	(39)
Average = Sum(39)m / 12 =												74.0916	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1339	2.1204	2.1108	2.0876	2.0824	2.0749	2.0656	2.0678	2.0824	2.0959	2.1108	2.1047	(40)
HLP (average)												2.0948	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895	(42)
Average daily hot water use (litres/day)	64.8244	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0500	(48)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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  Temperature factor from Table 2b                                                                                0.5400 (49)
Enter (49) or (54) in (55)                                                                                        0.5670 (55)
Total storage loss
              17.5770    15.8760    17.5770    17.0100    17.5770    17.0100    17.5770    17.5770    17.0100    17.5770    17.0100    17.5770 (56)
If cylinder contains dedicated solar storage
              17.5770    15.8760    17.5770    17.0100    17.5770    17.0100    17.5770    17.5770    17.0100    17.5770    17.0100    17.5770 (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
             146.5855   129.3734   136.2768   122.7267   120.6763   108.4151   104.6790   114.0963   113.6538   127.2329   133.8273   143.2488 (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
             146.5855   129.3734   136.2768   122.7267   120.6763   108.4151   104.6790   114.0963   113.6538   127.2329   133.8273   143.2488 (64)
                                                                                  Total per year (kWh/year) = Sum(64)m =   1500.7919 (64)
RHI water heating demand                                                                                          1501 (64)
Heat gains from water heating, kWh/month
              67.8321    60.2614    64.4045    59.2832    59.2173    54.5246    53.8982    57.0294    56.2664    61.3974    62.9741    66.7226 (65)
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5. Internal gains (see Table 5 and 5a)

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Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m         77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              24.5364    21.7931    17.7233    13.4177    10.0299     8.4676     9.1496    11.8930    15.9627    20.2684    23.6562    25.2184 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             164.3130   166.0181   161.7214   152.5743   141.0276   130.1755   122.9255   121.2205   125.5172   134.6643   146.2109   157.0631 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262 (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)
             -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780 (71)
Water heating gains (Table 5)
              91.1722    89.6747    86.5651    82.3377    79.5931    75.7286    72.4438    76.6525    78.1478    82.5233    87.4640    89.6810 (72)
Total internal gains
             352.8368   350.3010   338.8250   321.1448   303.4658   287.1868   277.3341   282.5811   292.4429   310.2711   330.1462   344.7776 (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
-----------------------------------------------------------------------------------------------------------------------------------
Southeast                                4.3300           36.2806            0.7200           0.7000           0.7700           54.8689 (77)
Southwest                                9.1400           36.2806            0.7200           0.7000           0.7700          115.8202 (79)
Northwest                                3.1200           10.8980            0.7200           0.7000           0.7700           11.8759 (81)
-----------------------------------------------------------------------------------------------------------------------------------

Solar gains   182.5650   315.2204   462.3597   597.9225   686.8320   663.8389   644.1345   584.8394   500.7326   353.4204   214.3262   154.2845 (83)
Total gains   535.4017   665.5214   801.1847   919.0673   990.2977   951.0257   921.4686   867.4205   793.1754   663.6915   544.4725   499.0621 (84)
```

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7. Mean internal temperature (heating season)

```
Temperature during heating periods in the living area from Table 9, Th1 (C)                                      21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau           15.9253    16.0266    16.0992    16.2780    16.3191    16.3782    16.4517    16.4339    16.3191    16.2135    16.0992    16.1459
alpha          2.0617     2.0684     2.0733     2.0852     2.0879     2.0919     2.0968     2.0956     2.0879     2.0809     2.0733     2.0764
util living area
               0.9049     0.8606     0.7965     0.7100     0.6127     0.5192     0.4335     0.4596     0.5977     0.7654     0.8745     0.9160 (86)

MIT           18.0331    18.4851    19.0846    19.7317    20.2439    20.5996    20.7883    20.7585    20.4478    19.7072    18.7068    17.9307 (87)
Th 2          19.9331    19.9398    19.9446    19.9562    19.9588    19.9626    19.9672    19.9661    19.9588    19.9520    19.9446    19.9477 (88)
util rest of house
               0.8951     0.8473     0.7778     0.6841     0.5780     0.4724     0.3758     0.4010     0.5516     0.7377     0.8604     0.9074 (89)
MIT 2         17.2241    17.6675    18.2489    18.8722    19.3492    19.6718    19.8333    19.8109    19.5456    18.8643    17.8961    17.1337 (90)
Living area fraction                                                                                fLA = Living area / (4) =      0.5900 (91)
MIT           17.7014    18.1500    18.7420    19.3793    19.8772    20.2193    20.3968    20.3700    20.0780    19.3617    18.3745    17.6040 (92)
Temperature adjustment                                                                                            0.0000
adjusted MIT  17.7014    18.1500    18.7420    19.3793    19.8772    20.2193    20.3968    20.3700    20.0780    19.3617    18.3745    17.6040 (93)
```

---

8. Space heating requirement

```
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation    0.8696     0.8203     0.7535     0.6685     0.5751     0.4844     0.4005     0.4247     0.5572     0.7202     0.8348     0.8831 (94)
Useful gains 465.6000   545.9359   603.7169   614.3981   569.4850   460.7092   369.0726   368.3692   441.9484   478.0090   454.5136   440.6980 (95)
Ext temp.      3.1000     3.6000     5.0000     7.2000     9.8000    12.7000    14.7000    14.6000    12.4000     9.1000     5.7000     2.9000 (96)
Heat loss rate W
            1102.0366  1091.2101  1025.9702   899.3161   742.2142   551.8212   416.2060   422.0136   565.5068   760.7286   946.2670  1094.6106 (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
             473.5088   366.4243   314.1565   205.1409   128.5105     0.0000     0.0000     0.0000     0.0000   210.3434   354.0625   486.5110 (98)
Space heating                                                                                                    2538.6578 (98)
RHI space heating demand                                                                                            2539 (98)
```

CALCULATION OF ENERGY RATINGS 09 Jan 2014

SAP 2012 WORKSHEET FOR New Build (As Designed) (Version 9.92, January 2014)
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1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		4.9500	
Infiltration rate		0.3399	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2889	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3684	0.3611	0.3539	0.3178	0.3106	0.2745	0.2745	0.2672	0.2889	0.3106	0.3250	0.3395	(22b)
Effective ac	0.5678	0.5652	0.5626	0.5505	0.5482	0.5377	0.5377	0.5357	0.5417	0.5482	0.5528	0.5576	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2000	7.0740	75.0000	2652.7500	(28b)
Main	61.9300	16.5900	45.3400	0.2300	10.4282	9.0000	408.0600	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			132.6700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	45.8631			(33)
Party Wall 1			12.7900	0.0000	0.0000	20.0000	255.8000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	4327.0400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		122.3364 (35)
Thermal bridges (User defined value 0.058 * total exposed area)		7.6949 (36)
Total fabric heat loss	(33) + (36) =	53.5580 (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	20.2815	20.1874	20.0952	19.6620	19.5809	19.2036	19.2036	19.1337	19.3489	19.5809	19.7449	19.9163	(38)
Heat transfer coeff	73.8395	73.7454	73.6531	73.2199	73.1389	72.7616	72.7616	72.6917	72.9069	73.1389	73.3028	73.4743	(39)
Average = Sum(39)m / 12 =												73.2195	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.0876	2.0850	2.0824	2.0701	2.0678	2.0572	2.0572	2.0552	2.0613	2.0678	2.0725	2.0773	(40)
HLP (average)												2.0701	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895 (42)
Average daily hot water use (litres/day)	64.8244 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)

Water storage loss:	
Store volume	125.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):	1.0500 (48)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

```
  Temperature factor from Table 2b                                                                                0.5400 (49)
Enter (49) or (54) in (55)                                                                                        0.5670 (55)
Total storage loss
              17.5770    15.8760    17.5770    17.0100    17.5770    17.0100    17.5770    17.5770    17.0100    17.5770    17.0100    17.5770 (56)
If cylinder contains dedicated solar storage
              17.5770    15.8760    17.5770    17.0100    17.5770    17.0100    17.5770    17.5770    17.0100    17.5770    17.0100    17.5770 (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
             146.5855   129.3734   136.2768   122.7267   120.6763   108.4151   104.6790   114.0963   113.6538   127.2329   133.8273   143.2488 (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
             146.5855   129.3734   136.2768   122.7267   120.6763   108.4151   104.6790   114.0963   113.6538   127.2329   133.8273   143.2488 (64)
                                                                                  Total per year (kWh/year) = Sum(64)m =   1500.7919 (64)
Heat gains from water heating, kWh/month
              67.8321    60.2614    64.4045    59.2832    59.2173    54.5246    53.8982    57.0294    56.2664    61.3974    62.9741    66.7226 (65)
```

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

```
Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m         77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              24.5364    21.7931    17.7233    13.4177    10.0299     8.4676     9.1496    11.8930    15.9627    20.2684    23.6562    25.2184 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             164.3130   166.0181   161.7214   152.5743   141.0276   130.1755   122.9255   121.2205   125.5172   134.6643   146.2109   157.0631 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262 (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)
             -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780 (71)
Water heating gains (Table 5)
              91.1722    89.6747    86.5651    82.3377    79.5931    75.7286    72.4438    76.6525    78.1478    82.5233    87.4640    89.6810 (72)
Total internal gains
             352.8368   350.3010   338.8250   321.1448   303.4658   287.1868   277.3341   282.5811   292.4429   310.2711   330.1462   344.7776 (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
-----------------------------------------------------------------------------------------------------------------
Southeast                                4.3300           36.7938            0.7200           0.7000         0.7700           55.6451 (77)
Southwest                                9.1400           36.7938            0.7200           0.7000         0.7700          117.4586 (79)
Northwest                                3.1200           11.2829            0.7200           0.7000         0.7700           12.2953 (81)
-----------------------------------------------------------------------------------------------------------------

Solar gains   185.3991   319.8872   448.5315   573.9350   659.4513   661.9827   635.1840   570.2689   491.7849   356.4684   222.8091   158.1817 (83)
Total gains   538.2358   670.1882   787.3565   895.0798   962.9171   949.1695   912.5181   852.8500   784.2278   666.7395   552.9553   502.9593 (84)
```

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7. Mean internal temperature (heating season)

```
Temperature during heating periods in the living area from Table 9, Th1 (C)                                     21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau           16.2780    16.2987    16.3191    16.4157    16.4339    16.5191    16.5191    16.5350    16.4862    16.4339    16.3971    16.3589
alpha          2.0852     2.0866     2.0879     2.0944     2.0956     2.1013     2.1013     2.1023     2.0991     2.0956     2.0931     2.0906
util living area
               0.8916     0.8407     0.7720     0.6734     0.5545     0.4277     0.3246     0.3569     0.5203     0.7204     0.8501     0.9033 (86)

MIT           18.3927    18.8390    19.4054    20.0155    20.4913    20.7919    20.9165    20.8952    20.6690    20.0250    19.0934    18.2932 (87)
Th 2          19.9562    19.9575    19.9588    19.9649    19.9661    19.9714    19.9714    19.9724    19.9694    19.9661    19.9638    19.9613 (88)
util rest of house
               0.8801     0.8249     0.7501     0.6426     0.5124     0.3717     0.2562     0.2867     0.4636     0.6861     0.8325     0.8929 (89)
MIT 2         17.5943    18.0263    18.5701    19.1480    19.5796    19.8387    19.9312    19.9194    19.7452    19.1746    18.2873    17.5013 (90)
Living area fraction                                                                                fLA = Living area / (4) =      0.5900 (91)
MIT           18.0654    18.5058    19.0630    19.6598    20.1175    20.4012    20.5126    20.4952    20.2903    19.6763    18.7629    17.9686 (92)
Temperature adjustment                                                                                          0.0000
adjusted MIT  18.0654    18.5058    19.0630    19.6598    20.1175    20.4012    20.5126    20.4952    20.2903    19.6763    18.7629    17.9686 (93)
```

---

8. Space heating requirement

```
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation    0.8546     0.7991     0.7289     0.6328     0.5189     0.3958     0.2929     0.3232     0.4820     0.6755     0.8083     0.8681 (94)
Useful gains 459.9648   535.5745   573.9088   566.3742   499.6355   375.6347   267.2732   275.6448   378.0171   450.3696   446.9614   436.6302 (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
            1016.4282  1003.3680   925.3011   787.8337   615.6491   422.1008   284.6859   297.6843   451.3142   663.8340   854.9261  1011.6367 (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
             414.0088   314.3572   261.4359   159.4508    86.3141     0.0000     0.0000     0.0000     0.0000   158.8175   293.7346   427.8048 (98)
Space heating                                                                                                  2115.9237 (98)
Space heating per m2                                                                                  (98) / (4) =     59.8226 (99)
```

8c. Space cooling requirement

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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 %)	175.1000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1208.4087	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	414.0088	314.3572	261.4359	159.4508	86.3141	0.0000	0.0000	0.0000	0.0000	158.8175	293.7346	427.8048	(98)
Space heating efficiency (main heating system 1)													
	175.1000	175.1000	175.1000	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175.1000	175.1000	(210)
Space heating fuel (main heating system)													
	236.4413	179.5301	149.3066	91.0627	49.2942	0.0000	0.0000	0.0000	0.0000	90.7010	167.7525	244.3203	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
Efficiency of water heater												175.1000	(216)
(217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(217)
Fuel for water heating, kWh/month													
	83.7153	73.8854	77.8280	70.0895	68.9185	61.9161	59.7824	65.1607	64.9080	72.6630	76.4290	81.8097	(219)
Water heating fuel used												857.1056	(219)
Annual totals kWh/year													
Space heating fuel - main system												1208.4087	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
Total electricity for the above, kWh/year												30.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Total delivered energy for all uses												2268.8428	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1208.4087	13.1900	159.3891	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	857.1056	13.1900	113.0522	(247)
Pumps and fans for heating	30.0000	13.1900	3.9570	(249)
Energy for lighting	173.3285	13.1900	22.8620	(250)
Additional standing charges			0.0000	(251)
Total energy cost			299.2604	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.5639	(257)
SAP value		78.1838	
SAP rating (Section 12)		78	(258)
SAP band		C	

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	1208.4087	0.5190	627.1641	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	857.1056	0.5190	444.8378	(264)
Space and water heating			1072.0019	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Total kg/year			1177.5294	(272)
CO2 emissions per m2			33.2900	(273)
EI value			80.3672	
EI rating			80	(274)
EI band			C	

Calculation of stars for heating and DHW

Main heating energy efficiency	13.19 × (1 + 0.29 × 0.00) / 1.7510 = 7.533, stars = 2
Main heating environmental impact	0.519 × (1 + 0.29 × 0.00) / 1.7510 = 0.2964, stars = 4
Water heating energy efficiency	13.19 / 1.7510 = 7.533, stars = 2
Water heating environmental impact	0.519 / 1.7510 = 0.2964, stars = 4

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		4.9500	
Infiltration rate		0.3399	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2889	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	6.6000	6.2000	5.9000	5.1000	4.9000	4.6000	4.2000	4.3000	4.9000	5.4000	5.9000	5.7000	(22)
Wind factor	1.6500	1.5500	1.4750	1.2750	1.2250	1.1500	1.0500	1.0750	1.2250	1.3500	1.4750	1.4250	(22a)
Adj infilt rate	0.4767	0.4478	0.4261	0.3684	0.3539	0.3322	0.3034	0.3106	0.3539	0.3900	0.4261	0.4117	(22b)
Effective ac	0.6136	0.6003	0.5908	0.5678	0.5626	0.5552	0.5460	0.5482	0.5626	0.5761	0.5908	0.5847	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2000	7.0740	75.0000	2652.7500	(28b)
Main	61.9300	16.5900	45.3400	0.2300	10.4282	9.0000	408.0600	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			132.6700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	45.8631			(33)
Party Wall 1			12.7900	0.0000	0.0000	20.0000	255.8000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	4327.0400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		122.3364 (35)
Thermal bridges (User defined value 0.058 * total exposed area)		7.6949 (36)
Total fabric heat loss	(33) + (36) =	53.5580 (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	21.9165	21.4395	21.1013	20.2815	20.0952	19.8296	19.5017	19.5809	20.0952	20.5750	21.1013	20.8852	(38)
Heat transfer coeff	75.4745	74.9975	74.6593	73.8395	73.6531	73.3876	73.0597	73.1389	73.6531	74.1329	74.6593	74.4432	(39)
Average = Sum(39)m / 12 =												74.0916	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1339	2.1204	2.1108	2.0876	2.0824	2.0749	2.0656	2.0678	2.0824	2.0959	2.1108	2.1047	(40)
HLP (average)												2.0948	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895 (42)
Average daily hot water use (litres/day)	64.8244 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0500	(48)

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

Temperature factor from Table 2b 0.5400 (49)
Enter (49) or (54) in (55) 0.5670 (55)
Total storage loss

	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770 (56)

If cylinder contains dedicated solar storage

	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770 (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

	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488 (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

	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488 (64)

Total per year (kWh/year) = Sum(64)m = 1500.7919 (64)

Heat gains from water heating, kWh/month

	67.8321	60.2614	64.4045	59.2832	59.2173	54.5246	53.8982	57.0294	56.2664	61.3974	62.9741	66.7226 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	(66)

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

	24.5364	21.7931	17.7233	13.4177	10.0299	8.4676	9.1496	11.8930	15.9627	20.2684	23.6562	25.2184 (67)

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

	164.3130	166.0181	161.7214	152.5743	141.0276	130.1755	122.9255	121.2205	125.5172	134.6643	146.2109	157.0631 (68)

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

	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262 (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)

	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780 (71)

Water heating gains (Table 5)

	91.1722	89.6747	86.5651	82.3377	79.5931	75.7286	72.4438	76.6525	78.1478	82.5233	87.4640	89.6810 (72)

Total internal gains

	352.8368	350.3010	338.8250	321.1448	303.4658	287.1868	277.3341	282.5811	292.4429	310.2711	330.1462	344.7776 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	4.3300	36.2806	0.7200	0.7000	0.7700	54.8689	(77)
Southwest	9.1400	36.2806	0.7200	0.7000	0.7700	115.8202	(79)
Northwest	3.1200	10.8980	0.7200	0.7000	0.7700	11.8759	(81)

Solar gains	182.5650	315.2204	462.3597	597.9225	686.8320	663.8389	644.1345	584.8394	500.7326	353.4204	214.3262	154.2845 (83)
Total gains	535.4017	665.5214	801.1847	919.0673	990.2977	951.0257	921.4686	867.4205	793.1754	663.6915	544.4725	499.0621 (84)

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7. Mean internal temperature (heating season)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	15.9253	16.0266	16.0992	16.2780	16.3191	16.3782	16.4517	16.4339	16.3191	16.2135	16.0992	16.1459	
alpha	2.0617	2.0684	2.0733	2.0852	2.0879	2.0919	2.0968	2.0956	2.0879	2.0809	2.0733	2.0764	
util living area	0.9049	0.8606	0.7965	0.7100	0.6127	0.5192	0.4335	0.4596	0.5977	0.7654	0.8745	0.9160	(86)
MIT	18.0331	18.4851	19.0846	19.7317	20.2439	20.5996	20.7883	20.7585	20.4478	19.7072	18.7068	17.9307	(87)
Th 2	19.9331	19.9398	19.9446	19.9562	19.9588	19.9626	19.9672	19.9661	19.9588	19.9520	19.9446	19.9477	(88)
util rest of house	0.8951	0.8473	0.7778	0.6841	0.5780	0.4724	0.3758	0.4010	0.5516	0.7377	0.8604	0.9074	(89)
MIT 2	17.2241	17.6675	18.2489	18.8722	19.3492	19.6718	19.8333	19.8109	19.5456	18.8643	17.8961	17.1337	(90)
Living area fraction										fLA = Living area / (4) =		0.5900	(91)
MIT	17.7014	18.1500	18.7420	19.3793	19.8772	20.2193	20.3968	20.3700	20.0780	19.3617	18.3745	17.6040	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.7014	18.1500	18.7420	19.3793	19.8772	20.2193	20.3968	20.3700	20.0780	19.3617	18.3745	17.6040	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8696	0.8203	0.7535	0.6685	0.5751	0.4844	0.4005	0.4247	0.5572	0.7202	0.8348	0.8831	(94)
Useful gains	465.6000	545.9359	603.7169	614.3981	569.4850	460.7092	369.0726	368.3692	441.9484	478.0090	454.5136	440.6980	(95)
Ext temp.	3.1000	3.6000	5.0000	7.2000	9.8000	12.7000	14.7000	14.6000	12.4000	9.1000	5.7000	2.9000	(96)
Heat loss rate W	1102.0366	1091.2101	1025.9702	899.3161	742.2142	551.8212	416.2060	422.0136	565.5068	760.7286	946.2670	1094.6106	(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	473.5088	366.4243	314.1565	205.1409	128.5105	0.0000	0.0000	0.0000	0.0000	210.3434	354.0625	486.5110	(98)
Space heating												2538.6578	(98)
Space heating per m2											(98) / (4) =	71.7743	(99)

8c. Space cooling requirement

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

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	175.1000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1449.8331	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	473.5088	366.4243	314.1565	205.1409	128.5105	0.0000	0.0000	0.0000	0.0000	210.3434	354.0625	486.5110	(98)
Space heating efficiency (main heating system 1)													
	175.1000	175.1000	175.1000	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175.1000	175.1000	(210)
Space heating fuel (main heating system)													
	270.4219	209.2657	179.4155	117.1565	73.3926	0.0000	0.0000	0.0000	0.0000	120.1276	202.2059	277.8475	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
Efficiency of water heater												175.1000	(216)
(217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(217)
Fuel for water heating, kWh/month													
	83.7153	73.8854	77.8280	70.0895	68.9185	61.9161	59.7824	65.1607	64.9080	72.6630	76.4290	81.8097	(219)
Water heating fuel used												857.1056	(219)
Annual totals kWh/year													
Space heating fuel - main system												1449.8331	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
Total electricity for the above, kWh/year												30.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Total delivered energy for all uses												2510.2673	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1449.8331	18.7000	271.1188	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	857.1056	18.7000	160.2787	(247)
Pumps and fans for heating	30.0000	18.7000	5.6100	(249)
Energy for lighting	173.3285	18.7000	32.4124	(250)
Additional standing charges			0.0000	(251)
Total energy cost			469.4200	(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	1449.8331	0.5190	752.4634	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	857.1056	0.5190	444.8378	(264)
Space and water heating			1197.3012	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Total kg/year			1302.8287	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	1449.8331	3.0700	4450.9878	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	857.1056	3.0700	2631.3142	(264)
Space and water heating			7082.3019	(265)
Pumps and fans	30.0000	3.0700	92.1000	(267)
Energy for lighting	173.3285	3.0700	532.1186	(268)
Primary energy kWh/year			7706.5205	(272)
Primary energy kWh/m2/year			217.8830	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating:	C 78
Current environmental impact rating:	C 80

(For testing purposes):

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

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 3.6	-£ 71	-196 kg (15.1%)
U Solar photovoltaic panels	+ 16.6	-£ 326	-906 kg (81.9%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£71	5.54 kg/m²	B 82	B 84
Solar photovoltaic panels	£326	25.62 kg/m²	A 98	A 99
Total Savings	£397	31.16 kg/m²		

Potential energy efficiency rating: A 98
Potential environmental impact rating: A 99

Fuel prices for cost data on this page from database revision number 465 TEST (04 Sep 2020)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£469	£399	£71
Space heating	£277	£277	-£0
Water heating	£160	£89	£71
Lighting	£32	£32	£0
Generated (PV)	-£0	-£326	£326
Total cost of fuels	£469	£73	£397
Total cost of uses	£469	£72	£397
Delivered energy	71 kWh/m²	11 kWh/m²	60 kWh/m²
Carbon dioxide emissions	1.3 tonnes	0.2 tonnes	1.1 tonnes
CO2 emissions per m²	37 kg/m²	6 kg/m²	31 kg/m²
Primary energy	218 kWh/m²	34 kWh/m²	184 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		4.9500	
Infiltration rate		0.3399	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2889	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3684	0.3611	0.3539	0.3178	0.3106	0.2745	0.2745	0.2672	0.2889	0.3106	0.3250	0.3395	(22b)
Effective ac	0.5678	0.5652	0.5626	0.5505	0.5482	0.5377	0.5377	0.5357	0.5417	0.5482	0.5528	0.5576	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2000	7.0740	75.0000	2652.7500	(28b)
Main	61.9300	16.5900	45.3400	0.2300	10.4282	9.0000	408.0600	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			132.6700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	45.8631			(33)
Party Wall 1			12.7900	0.0000	0.0000	20.0000	255.8000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	4327.0400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		122.3364 (35)
Thermal bridges (User defined value 0.058 * total exposed area)		7.6949 (36)
Total fabric heat loss	(33) + (36) =	53.5580 (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	20.2815	20.1874	20.0952	19.6620	19.5809	19.2036	19.2036	19.1337	19.3489	19.5809	19.7449	19.9163	(38)
Heat transfer coeff	73.8395	73.7454	73.6531	73.2199	73.1389	72.7616	72.7616	72.6917	72.9069	73.1389	73.3028	73.4743	(39)
Average = Sum(39)m / 12 =												73.2195	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.0876	2.0850	2.0824	2.0701	2.0678	2.0572	2.0572	2.0552	2.0613	2.0678	2.0725	2.0773	(40)
HLP (average)												2.0701	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895 (42)
Average daily hot water use (litres/day)	64.8244 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0500	(48)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.5670	(55)
Total storage loss													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(56)
If cylinder contains dedicated solar storage													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(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													
	146.5855	129.3734	134.8811	115.9731	107.8819	95.8084	91.6521	101.9999	108.2509	125.8372	133.8273	143.2488	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.7781	(H8)
Utilisation factor												0.4302	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												64.8244	(H14)
Volume ratio Veff/V												1.1570	(H15)
Solar storage volume factor												1.0000	(H16)
Solar input												-685.9569	(H17)
Solar input	-19.8914	-33.1930	-56.5315	-75.7633	-93.5992	-92.0229	-90.8068	-79.3384	-62.1378	-42.4328	-23.5940	-16.6457	(63)
								Solar input (sum of months) = Sum(63)m =				-685.9569	(63)
Output from w/h													
	126.6941	96.1804	78.3496	40.2098	14.2827	3.7855	0.8453	22.6615	46.1131	83.4043	110.2332	126.6031	(64)
								Total per year (kWh/year) = Sum(64)m =				749.3626	(64)
Heat gains from water heating, kWh/month													
	67.8321	60.2614	63.2879	53.8803	48.9818	44.4392	43.4766	47.3523	51.9441	60.2808	62.9741	66.7226	(65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.5364	21.7931	17.7233	13.4177	10.0299	8.4676	9.1496	11.8930	15.9627	20.2684	23.6562	25.2184	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	164.3130	166.0181	161.7214	152.5743	141.0276	130.1755	122.9255	121.2205	125.5172	134.6643	146.2109	157.0631	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	91.1722	89.6747	85.0643	74.8337	65.8358	61.7211	58.4363	63.6455	72.1446	81.0225	87.4640	89.6810	(72)
Total internal gains													
	352.8368	350.3010	337.3242	313.6408	289.7085	273.1794	263.3266	269.5742	286.4397	308.7703	330.1462	344.7776	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
Southeast	4.3300	36.7938	0.7200	0.7000	0.7700	55.6451	(77)
Southwest	9.1400	36.7938	0.7200	0.7000	0.7700	117.4586	(79)
Northwest	3.1200	11.2829	0.7200	0.7000	0.7700	12.2953	(81)

Solar gains	185.3991	319.8872	448.5315	573.9350	659.4513	661.9827	635.1840	570.2689	491.7849	356.4684	222.8091	158.1817	(83)
Total gains	538.2358	670.1882	785.8557	887.5758	949.1598	935.1621	898.5106	839.8430	778.2246	665.2387	552.9553	502.9593	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	16.2780	16.2987	16.3191	16.4157	16.4339	16.5191	16.5191	16.5350	16.4862	16.4339	16.3971	16.3589	
alpha	2.0852	2.0866	2.0879	2.0944	2.0956	2.1013	2.1013	2.1023	2.0991	2.0956	2.0931	2.0906	
util living area	0.8916	0.8407	0.7726	0.6762	0.5596	0.4327	0.3290	0.3615	0.5230	0.7211	0.8501	0.9033	(86)
MIT	18.3927	18.8390	19.4028	20.0067	20.4818	20.7872	20.9143	20.8926	20.6655	20.0229	19.0934	18.2932	(87)
Th 2	19.9562	19.9575	19.9588	19.9649	19.9661	19.9714	19.9714	19.9724	19.9694	19.9661	19.9638	19.9613	(88)
util rest of house	0.8801	0.8249	0.7507	0.6455	0.5175	0.3762	0.2598	0.2906	0.4662	0.6868	0.8325	0.8929	(89)
MIT 2	17.5943	18.0263	18.5678	19.1403	19.5719	19.8355	19.9300	19.9179	19.7427	19.1727	18.2873	17.5013	(90)
Living area fraction									fLA = Living area / (4) =			0.5900	(91)
MIT	18.0654	18.5058	19.0605	19.6515	20.1088	20.3970	20.5108	20.4930	20.2872	19.6744	18.7629	17.9686	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.0654	18.5058	19.0605	19.6515	20.1088	20.3970	20.5108	20.4930	20.2872	19.6744	18.7629	17.9686	(93)

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8. Space heating requirement

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8546	0.7991	0.7294	0.6354	0.5236	0.4003	0.2968	0.3274	0.4845	0.6762	0.8083	0.8681	(94)
Useful gains	459.9648	535.5745	573.2374	564.0068	497.0045	374.3244	266.6945	274.9411	377.0758	449.8144	446.9614	436.6302	(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	1016.4282	1003.3680	925.1207	787.2241	615.0092	421.8012	284.5578	297.5272	451.0898	663.6885	854.9261	1011.6367	(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	414.0088	314.3572	261.8012	160.7165	87.7955	0.0000	0.0000	0.0000	0.0000	159.1223	293.7346	427.8048	(98)
Space heating												2119.3409	(98)
Space heating per m2											(98) / (4) =	59.9192	(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 %)	175.1000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1210.3603	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	414.0088	314.3572	261.8012	160.7165	87.7955	0.0000	0.0000	0.0000	0.0000	159.1223	293.7346	427.8048	(98)
Space heating efficiency (main heating system 1)	175.1000	175.1000	175.1000	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175.1000	175.1000	(210)
Space heating fuel (main heating system)	236.4413	179.5301	149.5153	91.7855	50.1402	0.0000	0.0000	0.0000	0.0000	90.8751	167.7525	244.3203	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	126.6941	96.1804	78.3496	40.2098	14.2827	3.7855	0.8453	22.6615	46.1131	83.4043	110.2332	126.6031	(64)
Efficiency of water heater												175.1000	(216)
(217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(217)
Fuel for water heating, kWh/month	72.3553	54.9288	44.7456	22.9639	8.1569	2.1619	0.4827	12.9420	26.3353	47.6324	62.9544	72.3033	(219)
Water heating fuel used												427.9626	(219)

Annual totals kWh/year		
Space heating fuel - main system	1210.3603	(211)
Space heating fuel - secondary	0.0000	(215)
Electricity for pumps and fans:		
central heating pump	30.0000	(230c)
pump for solar water heating	50.0000	(230g)
Total electricity for the above, kWh/year	80.0000	(231)
Electricity for lighting (calculated in Appendix L)	173.3285	(232)
Energy saving/generation technologies (Appendices M ,N and Q)		
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) =	-1727.2394	-1727.2394 (233)
Total delivered energy for all uses	164.4121	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1210.3603	13.1900	159.6465	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	427.9626	13.1900	56.4483	(247)
Pumps and fans for heating	30.0000	13.1900	3.9570	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	173.3285	13.1900	22.8620	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			21.6860	(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] =	0.1133	(257)
SAP value	98.4191	
SAP rating (Section 12)	98	(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	1210.3603	0.5190	628.1770	(261)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	427.9626	0.5190	222.1126 (264)
Space and water heating			850.2896 (265)
Pumps and fans	80.0000	0.5190	41.5200 (267)
Energy for lighting	173.3285	0.5190	89.9575 (268)
Energy saving/generation technologies			
PV Unit	-1727.2394	0.5190	-896.4372 (269)
Total kg/year			85.3299 (272)
CO2 emissions per m2			2.4100 (273)
EI value			98.5773
EI rating			99 (274)
EI band			A

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		4.9500	
Infiltration rate		0.3399	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2889	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	6.6000	6.2000	5.9000	5.1000	4.9000	4.6000	4.2000	4.3000	4.9000	5.4000	5.9000	5.7000	(22)
Wind factor	1.6500	1.5500	1.4750	1.2750	1.2250	1.1500	1.0500	1.0750	1.2250	1.3500	1.4750	1.4250	(22a)
Adj infilt rate	0.4767	0.4478	0.4261	0.3684	0.3539	0.3322	0.3034	0.3106	0.3539	0.3900	0.4261	0.4117	(22b)
Effective ac	0.6136	0.6003	0.5908	0.5678	0.5626	0.5552	0.5460	0.5482	0.5626	0.5761	0.5908	0.5847	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2000	7.0740	75.0000	2652.7500	(28b)
Main	61.9300	16.5900	45.3400	0.2300	10.4282	9.0000	408.0600	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			132.6700					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	45.8631			(33)
Party Wall 1			12.7900	0.0000	0.0000	20.0000	255.8000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	4327.0400 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		122.3364 (35)
Thermal bridges (User defined value 0.058 * total exposed area)		7.6949 (36)
Total fabric heat loss	(33) + (36) =	53.5580 (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	21.9165	21.4395	21.1013	20.2815	20.0952	19.8296	19.5017	19.5809	20.0952	20.5750	21.1013	20.8852	(38)
Heat transfer coeff	75.4745	74.9975	74.6593	73.8395	73.6531	73.3876	73.0597	73.1389	73.6531	74.1329	74.6593	74.4432	(39)
Average = Sum(39)m / 12 =												74.0916	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1339	2.1204	2.1108	2.0876	2.0824	2.0749	2.0656	2.0678	2.0824	2.0959	2.1108	2.1047	(40)
HLP (average)												2.0948	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895 (42)
Average daily hot water use (litres/day)	64.8244 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0500	(48)

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

```
  Temperature factor from Table 2b                                                                                0.5400 (49)
Enter (49) or (54) in (55)                                                                                        0.5670 (55)
Total storage loss
               17.5770    15.8760    17.5770    17.0100    17.5770    17.0100    17.5770    17.5770    17.0100    17.5770    17.0100    17.5770 (56)
If cylinder contains dedicated solar storage
               17.5770    15.8760    17.5770    17.0100    17.5770    17.0100    17.5770    17.5770    17.0100    17.5770    17.0100    17.5770 (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
              146.5855   129.3734   134.8811   115.9731   107.8819    95.8084    91.6521   101.9999   108.2509   125.8372   133.8273   143.2488 (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                                                                                  1091.0709 (H5)
Overshading factor                                                                                                0.8000 (H6)
Solar energy available                                                                                         1832.9992 (H7)
Adjustment factor for showers                                                                                     1.0000 (H7a)
Solar-to-load ratio                                                                                               1.7972 (H8)
Utilisation factor                                                                                                0.4267 (H9)
Collector performance factor                                                                                      0.8793 (H10)
Dedicated solar storage volume                                                                                   75.0000 (H11)
Effective solar volume                                                                                           75.0000 (H13)
Daily hot water demand                                                                                           64.8244 (H14)
Volume ratio Veff/V                                                                                               1.1570 (H15)
Solar storage volume factor                                                                                       1.0000 (H16)
Solar input                                                                                                    -687.8113 (H17)
Solar input    -19.2686   -32.1683   -57.3554   -77.8632   -96.3853   -91.3308   -91.0993   -80.3442   -62.3188   -41.3797   -22.3236   -15.9741 (63)
                                                                                  Solar input (sum of months) = Sum(63)m =   -687.8113 (63)
Output from w/h
              127.3169    97.2050    77.5257    38.1099    11.4966     4.4776     0.5528    21.6557    45.9322    84.4575   111.5037   127.2747 (64)
                                                                                   Total per year (kWh/year) = Sum(64)m =    747.5082 (64)
Heat gains from water heating, kWh/month
               67.8321    60.2614    63.2879    53.8803    48.9818    44.4392    43.4766    47.3523    51.9441    60.2808    62.9741    66.7226 (65)
```

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

```
Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m          77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               24.5364    21.7931    17.7233    13.4177    10.0299     8.4676     9.1496    11.8930    15.9627    20.2684    23.6562    25.2184 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              164.3130   166.0181   161.7214   152.5743   141.0276   130.1755   122.9255   121.2205   125.5172   134.6643   146.2109   157.0631 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262 (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)
              -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780 (71)
Water heating gains (Table 5)
               91.1722    89.6747    85.0643    74.8337    65.8358    61.7211    58.4363    63.6455    72.1446    81.0225    87.4640    89.6810 (72)
Total internal gains
              352.8368   350.3010   337.3242   313.6408   289.7085   273.1794   263.3266   269.5742   286.4397   308.7703   330.1462   344.7776 (73)
```

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6. Solar gains

```
[Jan]                                    Area          Solar flux              g                FF            Access            Gains
                                          m2           Table 6a      Specific data      Specific data      factor                W
                                                          W/m2        or Table 6b        or Table 6c      Table 6d
-------------------------------------------------------------------------------------------------------------------
Southeast                               4.3300            36.2806            0.7200             0.7000            0.7700            54.8689 (77)
Southwest                               9.1400            36.2806            0.7200             0.7000            0.7700           115.8202 (79)
Northwest                               3.1200            10.8980            0.7200             0.7000            0.7700            11.8759 (81)
-------------------------------------------------------------------------------------------------------------------

Solar gains   182.5650   315.2204   462.3597   597.9225   686.8320   663.8389   644.1345   584.8394   500.7326   353.4204   214.3262   154.2845 (83)
Total gains   535.4017   665.5214   799.6839   911.5633   976.5404   937.0182   907.4612   854.4135   787.1722   662.1907   544.4725   499.0621 (84)
```

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7. Mean internal temperature (heating season)

```
Temperature during heating periods in the living area from Table 9, Th1 (C)                                    21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau            15.9253    16.0266    16.0992    16.2780    16.3191    16.3782    16.4517    16.4339    16.3191    16.2135    16.0992    16.1459
alpha           2.0617     2.0684     2.0733     2.0852     2.0879     2.0919     2.0968     2.0956     2.0879     2.0809     2.0733     2.0764
util living area
                0.9049     0.8606     0.7970     0.7127     0.6177     0.5245     0.4386     0.4648     0.6004     0.7660     0.8745     0.9160 (86)

MIT            18.0331    18.4851    19.0819    19.7216    20.2315    20.5915    20.7834    20.7531    20.4428    19.7048    18.7068    17.9307 (87)
Th 2           19.9331    19.9398    19.9446    19.9562    19.9588    19.9626    19.9672    19.9661    19.9588    19.9520    19.9446    19.9477 (88)
util rest of house
                0.8951     0.8473     0.7784     0.6869     0.5830     0.4775     0.3806     0.4059     0.5543     0.7384     0.8604     0.9074 (89)
MIT 2          17.2241    17.6675    18.2464    18.8631    19.3386    19.6656    19.8299    19.8072    19.5416    18.8621    17.8961    17.1337 (90)
Living area fraction                                                                    fLA = Living area / (4) =      0.5900 (91)
MIT            17.7014    18.1500    18.7394    19.3696    19.8654    20.2119    20.3925    20.3653    20.0733    19.3593    18.3745    17.6040 (92)
Temperature adjustment                                                                                            0.0000
adjusted MIT   17.7014    18.1500    18.7394    19.3696    19.8654    20.2119    20.3925    20.3653    20.0733    19.3593    18.3745    17.6040 (93)
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8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8696	0.8203	0.7540	0.6710	0.5797	0.4893	0.4052	0.4294	0.5597	0.7209	0.8348	0.8831	(94)
Useful gains	465.6000	545.9359	602.9862	611.6763	566.0533	458.4620	367.7148	366.8949	440.5729	477.3560	454.5136	440.6980	(95)
Ext temp.	3.1000	3.6000	5.0000	7.2000	9.8000	12.7000	14.7000	14.6000	12.4000	9.1000	5.7000	2.9000	(96)
Heat loss rate W	1102.0366	1091.2101	1025.7709	898.6003	741.3518	551.2830	415.8941	421.6709	565.1643	760.5531	946.2670	1094.6106	(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	473.5088	366.4243	314.5518	206.5852	130.4221	0.0000	0.0000	0.0000	0.0000	210.6986	354.0625	486.5110	(98)
Space heating												2542.7643	(98)
Space heating per m2											(98) / (4) =	71.8904	(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 %)	175.1000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1452.1784	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	473.5088	366.4243	314.5518	206.5852	130.4221	0.0000	0.0000	0.0000	0.0000	210.6986	354.0625	486.5110	(98)
Space heating efficiency (main heating system 1)	175.1000	175.1000	175.1000	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175.1000	175.1000	(210)
Space heating fuel (main heating system)	270.4219	209.2657	179.6412	117.9813	74.4843	0.0000	0.0000	0.0000	0.0000	120.3305	202.2059	277.8475	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	127.3169	97.2050	77.5257	38.1099	11.4966	4.4776	0.5528	21.6557	45.9322	84.4575	111.5037	127.2747	(64)
Efficiency of water heater												175.1000	(216)
(217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(217)
Fuel for water heating, kWh/month	72.7109	55.5140	44.2751	21.7646	6.5657	2.5572	0.3157	12.3676	26.2320	48.2338	63.6800	72.6869	(219)
Water heating fuel used												426.9036	(219)
Annual totals kWh/year													
Space heating fuel - main system												1452.1784	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												80.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1091 * 0.80) =										-1745.7135		-1745.7135	(233)
Total delivered energy for all uses												386.6970	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1452.1784	18.7000	271.5574	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	426.9036	18.7000	79.8310	(247)
Pumps and fans for heating	30.0000	18.7000	5.6100	(249)
Pump for solar water heating	50.0000	18.7000	9.3500	(249)
Energy for lighting	173.3285	18.7000	32.4124	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-1745.7135	18.7000	-326.4484	(252)
Total energy cost			72.3123	(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	1452.1784	0.5190	753.6806	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	426.9036	0.5190	221.5630	(264)
Space and water heating			975.2435	(265)
Pumps and fans	80.0000	0.5190	41.5200	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Energy saving/generation technologies				
PV Unit	-1745.7135	0.5190	-906.0253	(269)
Total kg/year			200.6957	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	1452.1784	3.0700	4458.1875	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	426.9036	3.0700	1310.5940	(264)
Space and water heating			5768.7815	(265)
Pumps and fans	80.0000	3.0700	245.6000	(267)
Energy for lighting	173.3285	3.0700	532.1186	(268)
Energy saving/generation technologies				
PV Unit	-1745.7135	3.0700	-5359.3404	(269)
Primary energy kWh/year			1187.1597	(272)
Primary energy kWh/m2/year			33.5640	(273)

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

Overheating Calculation Input Data

Dwelling type	SemiDetached Bungalow
Number of storeys	1
Cross ventilation possible	Yes
SAP Region	North East England
Front of dwelling faces	North West
Overshading	Average or unknown
Thermal mass parameter	122.3 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	6.00 (Windows fully open)

Overheating Calculation

Summer ventilation heat loss coefficient		214.30 (P1)
Transmission heat loss coefficient		53.56 (37)
Summer heat loss coefficient		267.86 (P2)

Overhangs

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

Solar shading

Orientation	Z blinds	Solar access	Z overhangs	Z summer	
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
South East	4.3300	115.6809	0.7200	0.7000	0.9000	204.4867
South West	9.1400	115.6809	0.7200	0.7000	0.9000	431.6418
North West	3.1200	91.1383	0.7200	0.7000	0.9000	116.0836
total:						752.2121

	Jun	Jul	Aug	
Solar gains	771	752	670	(P3)
Internal gains	284	274	280	
Total summer gains	1056	1027	949	(P5)
Summer gain/loss ratio	3.94	3.83	3.54	(P6)
Summer external temperature	13.80	15.80	15.60	
Thermal mass temperature increment (TMP = 122.3)	1.14	1.14	1.14	
Threshold temperature	18.88	20.78	20.29	(P7)
Likelihood of high internal temperature	Not significant	Slight	Not significant	

Assessment of likelihood of high internal temperature: Slight

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

Anderson Goddard Ltd

Property Reference	73940-WR11	**Issued on Date**	07/10/2020
Assessment Reference	001	**Prop Type Ref**	Semi
Property	Woodlands Room 11, Raithwaite Bay, WHITBY, YO21 3ST		

SAP Rating	79 C	**DER**	34.23	**TER**	40.09
Environmental	81 B	**% DER<TER**	14.62		
CO_2 Emissions (t/year)	1.28	**DFEE**	73.97	**TFEE**	74.10
General Requirements Compliance	Pass	**% DFEE<TFEE**	0.18		

Assessor Details	Mr. Paul Goddard, Anderson Goddard Limited, Tel: 0161 7757770, paul.goddard@andersongoddard.com	**Assessor ID**	B342-0001
Client			

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

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

Semi-Detached Bungalow, total floor area 35 m²

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

1a TER and DER
Fuel for main heating:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 40.09 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 34.23 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)74.1 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)74.0 kWh/m²/yrOK

---
2 Fabric U-values

Element	Average	Highest	
External wall	0.23 (max. 0.30)	0.23 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.20 (max. 0.25)	0.20 (max. 0.70)	OK
Roof	0.18 (max. 0.20)	0.18 (max. 0.35)	OK
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated using user-specified y-value of 0.061

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

---
4 Heating efficiency
Main heating system: Heat pump with radiators or underfloor - Electric
Air-to-water heat pump

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage Measured cylinder loss: 1.05 kWh/day
Permitted by DBSCG 1.70 OK
Primary pipework insulated: Yes OK

---
6 Controls
Space heating controls: Programmer and room thermostat OK

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

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

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (North East England): Slight OK
Based on:
Overshading: Average
Windows facing East: 4.33 m², No overhang
Windows facing South: 9.14 m², No overhang
Windows facing West: 3.12 m², No overhang
Air change rate: 8.00 ach
Blinds/curtains: None

---
10 Key features
Party wall U-value 0.00 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3424	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2910	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3711	0.3638	0.3565	0.3201	0.3129	0.2765	0.2765	0.2692	0.2910	0.3129	0.3274	0.3420	(22b)
Effective ac	0.5688	0.5662	0.5636	0.5512	0.5489	0.5382	0.5382	0.5362	0.5424	0.5489	0.5536	0.5585	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2000	7.0740	75.0000	2652.7500	(28b)
Main	57.3800	16.5900	40.7900	0.2300	9.3817	9.0000	367.1100	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			128.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	44.8166			(33)
Party Wall 1			17.3600	0.0000	0.0000	20.0000	347.2000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	4377.4900 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		123.7628 (35)
Thermal bridges (User defined value 0.061 * total exposed area)		7.8153 (36)
Total fabric heat loss	(33) + (36) =	52.6319 (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	20.3173	20.2218	20.1282	19.6886	19.6063	19.2235	19.2235	19.1526	19.3709	19.6063	19.7727	19.9467	(38)
Heat transfer coeff	72.9492	72.8537	72.7601	72.3205	72.2383	71.8554	71.8554	71.7845	72.0029	72.2383	72.4047	72.5786	(39)
Average = Sum(39)m / 12 =												72.3201	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.0625	2.0598	2.0571	2.0447	2.0424	2.0315	2.0315	2.0295	2.0357	2.0424	2.0471	2.0520	(40)
HLP (average)												2.0447	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895 (42)
Average daily hot water use (litres/day)	64.8244 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0500	(48)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.5670	(55)
Total storage loss													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(56)
If cylinder contains dedicated solar storage													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(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													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(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													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
								Total per year (kWh/year) = Sum(64)m =				1500.7919	(64)
Heat gains from water heating, kWh/month													
	67.8321	60.2614	64.4045	59.2832	59.2173	54.5246	53.8982	57.0294	56.2664	61.3974	62.9741	66.7226	(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	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	9.8146	8.7172	7.0893	5.3671	4.0119	3.3871	3.6598	4.7572	6.3851	8.1073	9.4625	10.0874	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	110.0897	111.2321	108.3533	102.2247	94.4885	87.2176	82.3601	81.2177	84.0965	90.2251	97.9613	105.2323	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	91.1722	89.6747	86.5651	82.3377	79.5931	75.7286	72.4438	76.6525	78.1478	82.5233	87.4640	89.6810	(72)
Total internal gains													
	256.4182	254.9658	247.3495	235.2713	223.4353	211.6749	203.8055	207.9691	213.9712	226.1975	240.2295	250.3424	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.3300	19.6403	0.7200	0.7000	0.7700	29.7029	(76)
South	9.1400	46.7521	0.7200	0.7000	0.7700	149.2488	(78)
West	3.1200	19.6403	0.7200	0.7000	0.7700	21.4026	(80)

Solar gains	200.3542	344.4042	476.0033	592.0262	660.9841	654.1505	631.6077	581.2134	516.7390	382.2683	240.6332	170.9913	(83)
Total gains	456.7724	599.3700	723.3528	827.2975	884.4194	865.8254	835.4132	789.1826	730.7102	608.4658	480.8627	421.3337	(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	16.6687	16.6906	16.7120	16.8136	16.8328	16.9225	16.9225	16.9392	16.8878	16.8328	16.7941	16.7538	
alpha	2.1112	2.1127	2.1141	2.1209	2.1222	2.1282	2.1282	2.1293	2.1259	2.1222	2.1196	2.1169	
util living area													
	0.9173	0.8649	0.7952	0.6984	0.5828	0.4560	0.3472	0.3777	0.5431	0.7480	0.8788	0.9284	(86)
MIT	18.2332	18.7326	19.3370	19.9666	20.4560	20.7730	20.9090	20.8878	20.6517	19.9699	18.9714	18.1259	(87)
Th 2	19.9688	19.9701	19.9714	19.9777	19.9788	19.9842	19.9842	19.9852	19.9821	19.9788	19.9765	19.9740	(88)
util rest of house													
	0.9081	0.8509	0.7747	0.6686	0.5409	0.3984	0.2758	0.3053	0.4862	0.7154	0.8637	0.9203	(89)
MIT 2	17.4478	17.9337	18.5163	19.1155	19.5625	19.8381	19.9398	19.9278	19.7443	19.1364	18.1802	17.3466	(90)
Living area fraction										fLA = Living area / (4) =		0.5900	(91)
MIT	17.9112	18.4051	19.0005	19.6177	20.0897	20.3897	20.5117	20.4943	20.2798	19.6282	18.6470	17.8064	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.9112	18.4051	19.0005	19.6177	20.0897	20.3897	20.5117	20.4943	20.2798	19.6282	18.6470	17.8064	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8849	0.8256	0.7527	0.6572	0.5457	0.4221	0.3137	0.3425	0.5036	0.7030	0.8400	0.8984	(94)
Useful gains	404.2015	494.8111	544.4384	543.6886	482.5905	365.4972	262.0841	270.3183	368.0202	427.7308	403.9033	378.5185	(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													
	992.9271	983.8973	909.5411	775.1080	606.0585	416.0243	281.0745	293.9064	444.9601	652.1821	836.0588	987.5347	(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													
	438.0118	328.6659	271.6364	166.6219	91.8601	0.0000	0.0000	0.0000	0.0000	166.9918	311.1520	453.1081	(98)
Space heating												2228.0481	(98)
Space heating per m2											(98) / (4) =	62.9926	(99)

8c. Space cooling requirement

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	175.1000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1272.4433	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	438.0118	328.6659	271.6364	166.6219	91.8601	0.0000	0.0000	0.0000	0.0000	166.9918	311.1520	453.1081	(98)
Space heating efficiency (main heating system 1)													
	175.1000	175.1000	175.1000	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175.1000	175.1000	(210)
Space heating fuel (main heating system)													
	250.1495	187.7018	155.1321	95.1582	52.4615	0.0000	0.0000	0.0000	0.0000	95.3694	177.6996	258.7710	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
Efficiency of water heater												175.1000	(216)
(217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(217)
Fuel for water heating, kWh/month													
	83.7153	73.8854	77.8280	70.0895	68.9185	61.9161	59.7824	65.1607	64.9080	72.6630	76.4290	81.8097	(219)
Water heating fuel used												857.1056	(219)
Annual totals kWh/year													
Space heating fuel - main system												1272.4433	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
Total electricity for the above, kWh/year												30.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Total delivered energy for all uses												2332.8774	(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	1272.4433	0.5190	660.3980	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	857.1056	0.5190	444.8378	(264)
Space and water heating			1105.2358	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Total CO2, kg/year			1210.7634	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			34.2300	(273)

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

DER		34.2300	ZC1
Total Floor Area	TFA	35.3700	
Assumed number of occupants	N	1.2895	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		18.4441	ZC2
CO2 emissions from cooking, equation (L16)		4.2394	ZC3
Total CO2 emissions		56.9135	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		56.9135	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000	/ (5) =	0.1848	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.4348	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3696	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4712	0.4620	0.4527	0.4065	0.3973	0.3511	0.3511	0.3419	0.3696	0.3973	0.4158	0.4342	(22b)
Effective ac	0.6110	0.6067	0.6025	0.5826	0.5789	0.5616	0.5616	0.5584	0.5683	0.5789	0.5864	0.5943	(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 Opening Type (Uw = 1.40)			8.8400	1.3258	11.7197			(27)
GF			35.3700	0.1300	4.5981			(28b)
Main	57.3800	8.8400	48.5400	0.1800	8.7372			(29a)
Flat	35.3700		35.3700	0.1300	4.5981			(30)
Total net area of external elements Aum(A, m2)			128.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		29.6531			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							7.8878	(36)
Total fabric heat loss					(33) + (36) =		37.5409	(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	21.8234	21.6694	21.5185	20.8096	20.6770	20.0596	20.0596	19.9453	20.2974	20.6770	20.9453	21.2258	(38)
Heat transfer coeff	59.3643	59.2103	59.0594	58.3505	58.2179	57.6005	57.6005	57.4862	57.8383	58.2179	58.4862	58.7667	(39)
Average = Sum(39)m / 12 =												58.3499	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.6784	1.6740	1.6698	1.6497	1.6460	1.6285	1.6285	1.6253	1.6352	1.6460	1.6536	1.6615	(40)
HLP (average)												1.6497	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.2895	(42)
Average daily hot water use (litres/day)												64.8244	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.2538	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.6770	(55)
Total storage loss													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	20.9878	18.9567	20.9878	20.3108	20.9878	20.3108	20.9878	20.9878	20.3108	20.9878	20.3108	20.9878	(56)
If cylinder contains dedicated solar storage													
	20.9878	18.9567	20.9878	20.3108	20.9878	20.3108	20.9878	20.9878	20.3108	20.9878	20.3108	20.9878	(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													
	149.9962	132.4541	139.6876	126.0274	124.0870	111.7159	108.0898	117.5071	116.9546	130.6437	137.1280	146.6596	(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													
	149.9962	132.4541	139.6876	126.0274	124.0870	111.7159	108.0898	117.5071	116.9546	130.6437	137.1280	146.6596	(64)
								Total per year (kWh/year) = Sum(64)m =				1540.9510	(64)
Heat gains from water heating, kWh/month													
	70.5607	62.7260	67.1331	61.9238	61.9459	57.1652	56.6268	59.7581	58.9070	64.1260	65.6147	69.4513	(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	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	9.8146	8.7172	7.0893	5.3671	4.0119	3.3871	3.6598	4.7572	6.3851	8.1073	9.4625	10.0874	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	110.0897	111.2321	108.3533	102.2247	94.4885	87.2176	82.3601	81.2177	84.0965	90.2251	97.9613	105.2323	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	94.8397	93.3422	90.2326	86.0052	83.2606	79.3961	76.1113	80.3200	81.8153	86.1908	91.1315	93.3485	(72)
Total internal gains													
	260.0857	258.6333	251.0170	238.9388	227.1028	215.3424	207.4730	211.6366	217.6387	229.8650	243.8970	254.0099	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	2.3100	19.6403	0.6300	0.7000	0.7700	13.8654	(76)
South	4.8700	46.7521	0.6300	0.7000	0.7700	69.5827	(78)
West	1.6600	19.6403	0.6300	0.7000	0.7700	9.9639	(80)

Solar gains	93.4120	160.5736	221.9313	276.0277	308.1802	304.9946	294.4839	270.9869	240.9246	178.2277	112.1915	79.7219	(83)
Total gains	353.4977	419.2069	472.9484	514.9665	535.2830	520.3371	501.9569	482.6235	458.5633	408.0927	356.0886	333.7317	(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	41.3759	41.4835	41.5895	42.0947	42.1906	42.6428	42.6428	42.7277	42.4675	42.1906	41.9971	41.7966	
alpha	3.7584	3.7656	3.7726	3.8063	3.8127	3.8429	3.8429	3.8485	3.8312	3.8127	3.7998	3.7864	
util living area													
	0.9866	0.9741	0.9493	0.8957	0.7967	0.6408	0.4861	0.5221	0.7347	0.9148	0.9751	0.9890	(86)
MIT	19.4434	19.6791	20.0119	20.4043	20.7200	20.9140	20.9770	20.9695	20.8483	20.4347	19.8673	19.4037	(87)
Th 2	19.5564	19.5595	19.5626	19.5771	19.5798	19.5925	19.5925	19.5948	19.5876	19.5798	19.5743	19.5686	(88)
util rest of house													
	0.9820	0.9656	0.9324	0.8599	0.7272	0.5258	0.3397	0.3748	0.6295	0.8775	0.9654	0.9853	(89)
MIT 2	17.5749	17.9150	18.3884	18.9348	19.3319	19.5425	19.5858	19.5849	19.4850	18.9924	18.1999	17.5254	(90)
Living area fraction									fLA = Living area / (4) =			0.5900	(91)
MIT	18.6774	18.9559	19.3463	19.8019	20.1510	20.3518	20.4067	20.4019	20.2894	19.8434	19.1837	18.6337	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6774	18.9559	19.3463	19.8019	20.1510	20.3518	20.4067	20.4019	20.2894	19.8434	19.1837	18.6337	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9783	0.9610	0.9293	0.8664	0.7576	0.5907	0.4264	0.4619	0.6856	0.8856	0.9619	0.9821	(94)
Useful gains	345.8423	402.8560	439.4932	446.1610	405.5184	307.3816	214.0502	222.9018	314.3999	361.4121	342.5221	327.7426	(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													
	853.5064	832.2551	758.6969	636.1291	491.9989	331.3043	219.2658	230.0524	357.9849	538.1312	706.7314	848.2189	(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													
	377.7021	288.5562	237.4875	136.7770	64.3414	0.0000	0.0000	0.0000	0.0000	131.4790	262.2307	387.2343	(98)
Space heating												1885.8084	(98)
Space heating per m2											(98) / (4) =	53.3166	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2016.9073	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	377.7021	288.5562	237.4875	136.7770	64.3414	0.0000	0.0000	0.0000	0.0000	131.4790	262.2307	387.2343	(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)													
	403.9595	308.6162	253.9974	146.2856	68.8144	0.0000	0.0000	0.0000	0.0000	140.6192	280.4607	414.1544	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	149.9962	132.4541	139.6876	126.0274	124.0870	111.7159	108.0898	117.5071	116.9546	130.6437	137.1280	146.6596	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.1774	86.8368	86.2185	85.0324	83.1572	79.8000	79.8000	79.8000	79.8000	84.8308	86.5167	87.2850	(217)
Fuel for water heating, kWh/month													
	172.0586	152.5321	162.0158	148.2111	149.2198	139.9949	135.4509	147.2520	146.5596	154.0049	158.4989	168.0237	(219)
Water heating fuel used												1833.8224	(219)
Annual totals kWh/year													
Space heating fuel - main system												2016.9073	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Total delivered energy for all uses												4099.0583	(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	2016.9073	0.2160	435.6520	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1833.8224	0.2160	396.1056	(264)
Space and water heating			831.7576	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Total CO2, kg/m2/year			960.6401	(272)
Emissions per m2 for space and water heating			23.5159	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			2.5433	(272b)
Emissions per m2 for pumps and fans			1.1005	(272c)
Target Carbon Dioxide Emission Rate (TER) = (23.5159 * 1.55) + 2.5433 + 1.1005, rounded to 2 d.p.			40.0900	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1848	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4348	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3696	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4712	0.4620	0.4527	0.4065	0.3973	0.3511	0.3511	0.3419	0.3696	0.3973	0.4158	0.4342	(22b)
Effective ac	0.6110	0.6067	0.6025	0.5826	0.5789	0.5616	0.5616	0.5584	0.5683	0.5789	0.5864	0.5943	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2000	7.0740	75.0000	2652.7500	(28b)
Main	57.3800	16.5900	40.7900	0.2300	9.3817	9.0000	367.1100	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			128.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	44.8166			(33)
Party Wall 1			17.3600	0.0000	0.0000	20.0000	347.2000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	4377.4900 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		123.7628 (35)
Thermal bridges (User defined value 0.061 * total exposed area)		7.8153 (36)
Total fabric heat loss	(33) + (36) =	52.6319 (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	21.8234	21.6694	21.5185	20.8096	20.6770	20.0596	20.0596	19.9453	20.2974	20.6770	20.9453	21.2258	(38)
Heat transfer coeff	74.4553	74.3014	74.1505	73.4416	73.3090	72.6916	72.6916	72.5772	72.9294	73.3090	73.5773	73.8578	(39)
Average = Sum(39)m / 12 =												73.4410	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1050	2.1007	2.0964	2.0764	2.0726	2.0552	2.0552	2.0519	2.0619	2.0726	2.0802	2.0881	(40)
HLP (average)												2.0764	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895 (42)
Average daily hot water use (litres/day)	64.8244 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage

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

Heat gains from water heating, kWh/month

	22.4710	19.6533	20.2805	17.6810	16.9653	14.6398	13.5659	15.5671	15.7530	18.3586	20.0399	21.7620 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	(66)

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

	9.8146	8.7172	7.0893	5.3671	4.0119	3.3871	3.6598	4.7572	6.3851	8.1073	9.4625	10.0874 (67)

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

	110.0897	111.2321	108.3533	102.2247	94.4885	87.2176	82.3601	81.2177	84.0965	90.2251	97.9613	105.2323 (68)

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

	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473 (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)

	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780 (71)

Water heating gains (Table 5)

	30.2030	29.2460	27.2587	24.5569	22.8029	20.3330	18.2338	20.9235	21.8792	24.6756	27.8331	29.2500 (72)

Total internal gains

	192.4491	191.5371	185.0431	174.4905	163.6451	153.2794	146.5955	149.2402	154.7025	165.3497	177.5987	186.9114 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.3300	19.6403	0.7200	0.7000	0.7700	29.7029	(76)
South	9.1400	46.7521	0.7200	0.7000	0.7700	149.2488	(78)
West	3.1200	19.6403	0.7200	0.7000	0.7700	21.4026	(80)

Solar gains	200.3542	344.4042	476.0033	592.0262	660.9841	654.1505	631.6077	581.2134	516.7390	382.2683	240.6332	170.9913	(83)
Total gains	392.8033	535.9412	661.0464	766.5167	824.6292	807.4299	778.2032	730.4536	671.4416	547.6181	418.2319	357.9027	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	16.3315	16.3654	16.3987	16.5570	16.5869	16.7278	16.7278	16.7541	16.6732	16.5869	16.5264	16.4637	
alpha	2.0888	2.0910	2.0932	2.1038	2.1058	2.1152	2.1152	2.1169	2.1115	2.1058	2.1018	2.0976	

util living area

	0.9366	0.8876	0.8211	0.7264	0.6117	0.4835	0.3716	0.4052	0.5770	0.7815	0.9037	0.9464	(86)
MIT	17.9995	18.5281	19.1718	19.8549	20.3875	20.7404	20.8937	20.8686	20.5992	19.8449	18.7774	17.8961	(87)
Th 2	19.2642	19.2671	19.2698	19.2829	19.2854	19.2968	19.2968	19.2989	19.2924	19.2854	19.2804	19.2752	(88)

util rest of house

	0.9236	0.8662	0.7879	0.6760	0.5386	0.3804	0.2416	0.2730	0.4758	0.7275	0.8814	0.9353	(89)
MIT 2	16.6891	17.1975	17.8068	18.4398	18.8989	19.1780	19.2689	19.2609	19.0873	18.4623	17.4617	16.5960	(90)
Living area fraction									fLA = Living area / (4) =			0.5900	(91)
MIT	17.4623	17.9826	18.6122	19.2748	19.7773	20.0999	20.2276	20.2095	19.9794	19.2781	18.2380	17.3631	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.4623	17.9826	18.6122	19.2748	19.7773	20.0999	20.2276	20.2095	19.9794	19.2781	18.2380	17.3631	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9056	0.8464	0.7731	0.6758	0.5612	0.4315	0.3153	0.3469	0.5196	0.7272	0.8640	0.9186	(94)
Useful gains	355.7381	453.6371	511.0567	517.9993	462.7745	348.4059	245.3966	253.3924	348.8761	398.2536	361.3638	328.7839	(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

	980.0036	972.0561	898.1258	761.9429	592.1362	399.7949	263.6975	276.4849	428.7808	636.1839	819.5035	972.1979	(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

	464.4535	348.3776	287.9794	175.6394	96.2451	0.0000	0.0000	0.0000	0.0000	177.0201	329.8606	478.7000	(98)
Space heating												2358.2758	(98)
Space heating per m2											(98) / (4) =	66.6745	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	

Heat loss rate W

	0.0000	0.0000	0.0000	0.0000	0.0000	683.3006	537.9175	551.5869	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7945	0.8450	0.8254	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	542.8641	454.5645	455.2824	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	993.3828	958.3668	903.1925	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	324.3734	374.8289	333.2451	0.0000	0.0000	0.0000	0.0000	(104)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling												1032.4474 (104)
Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000		0.0000 (106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	81.0934	93.7072	83.3113	0.0000	0.0000	0.0000		0.0000 (107)
Space cooling												258.1119 (107)
Space cooling per m2												7.2975 (108)
Energy for space heating												66.6745 (99)
Energy for space cooling												7.2975 (108)
Total												73.9719 (109)
Dwelling Fabric Energy Efficiency (DFEE)												74.0 (109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000	/ (5) =	0.1848	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.4348	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3696	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4712	0.4620	0.4527	0.4065	0.3973	0.3511	0.3511	0.3419	0.3696	0.3973	0.4158	0.4342	(22b)
Effective ac	0.6110	0.6067	0.6025	0.5826	0.5789	0.5616	0.5616	0.5584	0.5683	0.5789	0.5864	0.5943	(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 Opening Type (Uw = 1.40)			8.8400	1.3258	11.7197			(27)
GF			35.3700	0.1300	4.5981			(28b)
Main	57.3800	8.8400	48.5400	0.1800	8.7372			(29a)
Flat	35.3700		35.3700	0.1300	4.5981			(30)
Total net area of external elements Aum(A, m2)			128.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		29.6531			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							7.8878	(36)
Total fabric heat loss					(33) + (36) =		37.5409	(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	21.8234	21.6694	21.5185	20.8096	20.6770	20.0596	20.0596	19.9453	20.2974	20.6770	20.9453	21.2258	(38)
Heat transfer coeff	59.3643	59.2103	59.0594	58.3505	58.2179	57.6005	57.6005	57.4862	57.8383	58.2179	58.4862	58.7667	(39)
Average = Sum(39)m / 12 =												58.3499	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.6784	1.6740	1.6698	1.6497	1.6460	1.6285	1.6285	1.6253	1.6352	1.6460	1.6536	1.6615	(40)
HLP (average)												1.6497	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895	(42)
Average daily hot water use (litres/day)	64.8244	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(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)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Heat gains from water heating, kWh/month

	22.4710	19.6533	20.2805	17.6810	16.9653	14.6398	13.5659	15.5671	15.7530	18.3586	20.0399	21.7620 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	9.8146	8.7172	7.0893	5.3671	4.0119	3.3871	3.6598	4.7572	6.3851	8.1073	9.4625	10.0874	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	110.0897	111.2321	108.3533	102.2247	94.4885	87.2176	82.3601	81.2177	84.0965	90.2251	97.9613	105.2323	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	30.2030	29.2460	27.2587	24.5569	22.8029	20.3330	18.2338	20.9235	21.8792	24.6756	27.8331	29.2500	(72)
Total internal gains													
	192.4491	191.5371	185.0431	174.4905	163.6451	153.2794	146.5955	149.2402	154.7025	165.3497	177.5987	186.9114	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	2.3100	19.6403	0.6300	0.7000	0.7700	13.8654	(76)
South	4.8700	46.7521	0.6300	0.7000	0.7700	69.5827	(78)
West	1.6600	19.6403	0.6300	0.7000	0.7700	9.9639	(80)

Solar gains	93.4120	160.5736	221.9313	276.0277	308.1802	304.9946	294.4839	270.9869	240.9246	178.2277	112.1915	79.7219	(83)
Total gains	285.8610	352.1107	406.9744	450.5182	471.8253	458.2740	441.0794	420.2271	395.6271	343.5774	289.7902	266.6333	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	41.3759	41.4835	41.5895	42.0947	42.1906	42.6428	42.6428	42.7277	42.4675	42.1906	41.9971	41.7966	
alpha	3.7584	3.7656	3.7726	3.8063	3.8127	3.8429	3.8429	3.8485	3.8312	3.8127	3.7998	3.7864	
util living area													
	0.9933	0.9850	0.9674	0.9260	0.8429	0.6998	0.5434	0.5854	0.7964	0.9466	0.9871	0.9949	(86)
MIT	19.2865	19.5301	19.8777	20.2970	20.6500	20.8829	20.9664	20.9549	20.7951	20.3176	19.7185	19.2462	(87)
Th 2	19.5564	19.5595	19.5626	19.5771	19.5798	19.5925	19.5925	19.5948	19.5876	19.5798	19.5743	19.5686	(88)
util rest of house													
	0.9910	0.9798	0.9556	0.8979	0.7809	0.5840	0.3843	0.4267	0.6981	0.9202	0.9817	0.9930	(89)
MIT 2	18.0488	18.2919	18.6346	19.0453	19.3599	19.5437	19.5855	19.5842	19.4871	19.0766	18.4918	18.0180	(90)
Living area fraction									fLA = Living area / (4) =			0.5900	(91)
MIT	18.7791	19.0224	19.3681	19.7839	20.1211	20.3339	20.4003	20.3930	20.2589	19.8089	19.2156	18.7427	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7791	19.0224	19.3681	19.7839	20.1211	20.3339	20.4003	20.3930	20.2589	19.8089	19.2156	18.7427	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9893	0.9773	0.9536	0.9027	0.8071	0.6488	0.4788	0.5207	0.7495	0.9254	0.9800	0.9916	(94)
Useful gains	282.7995	344.1318	388.0991	406.6619	380.8197	297.3311	211.1716	218.8080	296.5249	317.9437	283.9804	264.3959	(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													
	859.5430	836.1949	759.9836	635.0796	490.2617	330.2753	218.8983	229.5424	356.2195	536.1207	708.5961	854.6270	(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													
	429.0972	330.6664	276.6820	164.4608	81.4248	0.0000	0.0000	0.0000	0.0000	162.3237	305.7233	439.1319	(98)
Space heating												2189.5101	(98)
Space heating per m2											(98) / (4) =	61.9030	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	541.4448	426.2438	436.8950	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8232	0.8880	0.8687	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	445.7182	378.5028	379.5510	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	585.2785	564.3260	540.5900	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	100.4835	138.2525	119.8130	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												358.5489	(104)
Cooled fraction									fC = cooled area / (4) =			1.0000	(105)
Intermittency factor (Table 10b)													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	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	25.1209	34.5631	29.9533	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												89.6372 (107)
Space cooling per m2												2.5343 (108)
Energy for space heating												61.9030 (99)
Energy for space cooling												2.5343 (108)
Total												64.4373 (109)
Target Fabric Energy Efficiency (TFEE)												74.1 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3424	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2910	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	6.6000	6.2000	5.9000	5.1000	4.9000	4.6000	4.2000	4.3000	4.9000	5.4000	5.9000	5.7000	(22)
Wind factor	1.6500	1.5500	1.4750	1.2750	1.2250	1.1500	1.0500	1.0750	1.2250	1.3500	1.4750	1.4250	(22a)
Adj infilt rate	0.4802	0.4511	0.4293	0.3711	0.3565	0.3347	0.3056	0.3129	0.3565	0.3929	0.4293	0.4147	(22b)
Effective ac	0.6153	0.6017	0.5921	0.5688	0.5636	0.5560	0.5467	0.5489	0.5636	0.5772	0.5921	0.5860	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2000	7.0740	75.0000	2652.7500	(28b)
Main	57.3800	16.5900	40.7900	0.2300	9.3817	9.0000	367.1100	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			128.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	44.8166			(33)
Party Wall 1			17.3600	0.0000	0.0000	20.0000	347.2000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	4377.4900 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		123.7628 (35)
Thermal bridges (User defined value 0.061 * total exposed area)		7.8153 (36)
Total fabric heat loss	(33) + (36) =	52.6319 (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	21.9764	21.4924	21.1492	20.3173	20.1282	19.8588	19.5260	19.6063	20.1282	20.6151	21.1492	20.9299	(38)
Heat transfer coeff	74.6084	74.1243	73.7811	72.9492	72.7601	72.4907	72.1579	72.2383	72.7601	73.2470	73.7811	73.5618	(39)
Average = Sum(39)m / 12 =												73.2050	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1094	2.0957	2.0860	2.0625	2.0571	2.0495	2.0401	2.0424	2.0571	2.0709	2.0860	2.0798	(40)
HLP (average)												2.0697	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895 (42)
Average daily hot water use (litres/day)	64.8244 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0500	(48)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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  Temperature factor from Table 2b                                                                                0.5400 (49)
Enter (49) or (54) in (55)                                                                                        0.5670 (55)
Total storage loss
              17.5770    15.8760    17.5770    17.0100    17.5770    17.0100    17.5770    17.5770    17.0100    17.5770    17.0100    17.5770 (56)
If cylinder contains dedicated solar storage
              17.5770    15.8760    17.5770    17.0100    17.5770    17.0100    17.5770    17.5770    17.0100    17.5770    17.0100    17.5770 (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
             146.5855   129.3734   136.2768   122.7267   120.6763   108.4151   104.6790   114.0963   113.6538   127.2329   133.8273   143.2488 (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
             146.5855   129.3734   136.2768   122.7267   120.6763   108.4151   104.6790   114.0963   113.6538   127.2329   133.8273   143.2488 (64)
                                                                                  Total per year (kWh/year) = Sum(64)m =   1500.7919 (64)
RHI water heating demand                                                                                          1501 (64)
Heat gains from water heating, kWh/month
              67.8321    60.2614    64.4045    59.2832    59.2173    54.5246    53.8982    57.0294    56.2664    61.3974    62.9741    66.7226 (65)
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5. Internal gains (see Table 5 and 5a)

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Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m         77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              24.5364    21.7931    17.7233    13.4177    10.0299     8.4676     9.1496    11.8930    15.9627    20.2684    23.6562    25.2184 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             164.3130   166.0181   161.7214   152.5743   141.0276   130.1755   122.9255   121.2205   125.5172   134.6643   146.2109   157.0631 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262 (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)
             -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780 (71)
Water heating gains (Table 5)
              91.1722    89.6747    86.5651    82.3377    79.5931    75.7286    72.4438    76.6525    78.1478    82.5233    87.4640    89.6810 (72)
Total internal gains
             352.8368   350.3010   338.8250   321.1448   303.4658   287.1868   277.3341   282.5811   292.4429   310.2711   330.1462   344.7776 (73)
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6. Solar gains

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[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
-----------------------------------------------------------------------------------------------------------------------------------
East                                    4.3300           19.0327            0.7200           0.7000           0.7700           28.7840 (76)
South                                   9.1400           46.2981            0.7200           0.7000           0.7700          147.7996 (78)
West                                    3.1200           19.0327            0.7200           0.7000           0.7700           20.7404 (80)
-----------------------------------------------------------------------------------------------------------------------------------

Solar gains  197.3240   339.6308   491.5717   618.5759   690.7157   658.1417   642.6356   597.9534   527.3562   379.4219   231.5438   166.7843 (83)
Total gains  550.1608   689.9318   830.3967   939.7207   994.1815   945.3285   919.9697   880.5344   819.7991   689.6930   561.6900   511.5619 (84)
```

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7. Mean internal temperature (heating season)

```
Temperature during heating periods in the living area from Table 9, Th1 (C)                                      21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau           16.2980    16.4045    16.4808    16.6687    16.7120    16.7741    16.8515    16.8328    16.7120    16.6009    16.4808    16.5299
alpha          2.0865     2.0936     2.0987     2.1112     2.1141     2.1183     2.1234     2.1222     2.1141     2.1067     2.0987     2.1020
util living area
               0.9012     0.8533     0.7865     0.7016     0.6094     0.5189     0.4312     0.4517     0.5838     0.7534     0.8688     0.9131 (86)

MIT           18.1252    18.5922    19.1844    19.7975    20.2753    20.6140    20.7986    20.7753    20.4901    19.7837    18.7938    18.0200 (87)
Th 2          19.9453    19.9522    19.9570    19.9688    19.9714    19.9753    19.9800    19.9788    19.9714    19.9646    19.9570    19.9601 (88)
util rest of house
               0.8912     0.8395     0.7673     0.6756     0.5748     0.4724     0.3743     0.3942     0.5380     0.7252     0.8542     0.9043 (89)
MIT 2         17.3211    17.7784    18.3516    18.9420    19.3871    19.6946    19.8523    19.8345    19.5908    18.9432    17.9876    17.2283 (90)
Living area fraction                                                                                fLA = Living area / (4) =     0.5900 (91)
MIT           17.7955    18.2586    18.8430    19.4468    19.9112    20.2371    20.4107    20.3896    20.1214    19.4391    18.4633    17.6954 (92)
Temperature adjustment                                                                                            0.0000
adjusted MIT  17.7955    18.2586    18.8430    19.4468    19.9112    20.2371    20.4107    20.3896    20.1214    19.4391    18.4633    17.6954 (93)
```

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8. Space heating requirement

```
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation    0.8659     0.8131     0.7442     0.6613     0.5727     0.4847     0.3990     0.4180     0.5451     0.7092     0.8291     0.8801 (94)
Useful gains 476.3600   560.9792   618.0063   621.4178   569.3620   458.2298   367.0730   368.0976   446.8438   489.1542   465.7044   450.2068 (95)
Ext temp.      3.1000     3.6000     5.0000     7.2000     9.8000    12.7000    14.7000    14.6000    12.4000     9.1000     5.7000     2.9000 (96)
Heat loss rate W
            1096.4094  1086.5562  1021.3495   893.3926   735.6914   546.3676   412.0699   418.2341   561.8108   757.3104   941.6914  1088.3774 (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
             461.3168   353.1877   300.0873   195.8219   123.7491     0.0000     0.0000     0.0000     0.0000   199.5082   342.7106   474.7990 (98)
Space heating                                                                                                    2451.1806 (98)
RHI space heating demand                                                                                            2451 (98)
```

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3424	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2910	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3711	0.3638	0.3565	0.3201	0.3129	0.2765	0.2765	0.2692	0.2910	0.3129	0.3274	0.3420	(22b)
Effective ac	0.5688	0.5662	0.5636	0.5512	0.5489	0.5382	0.5382	0.5362	0.5424	0.5489	0.5536	0.5585	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2000	7.0740	75.0000	2652.7500	(28b)
Main	57.3800	16.5900	40.7900	0.2300	9.3817	9.0000	367.1100	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			128.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	44.8166			(33)
Party Wall 1			17.3600	0.0000	0.0000	20.0000	347.2000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	4377.4900 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		123.7628 (35)
Thermal bridges (User defined value 0.061 * total exposed area)		7.8153 (36)
Total fabric heat loss	(33) + (36) =	52.6319 (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	20.3173	20.2218	20.1282	19.6886	19.6063	19.2235	19.2235	19.1526	19.3709	19.6063	19.7727	19.9467	(38)
Heat transfer coeff	72.9492	72.8537	72.7601	72.3205	72.2383	71.8554	71.8554	71.7845	72.0029	72.2383	72.4047	72.5786	(39)
Average = Sum(39)m / 12 =												72.3201	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.0625	2.0598	2.0571	2.0447	2.0424	2.0315	2.0315	2.0295	2.0357	2.0424	2.0471	2.0520	(40)
HLP (average)												2.0447	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895 (42)
Average daily hot water use (litres/day)	64.8244 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)

Water storage loss:	
Store volume	125.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):	1.0500 (48)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.5670	(55)
Total storage loss													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(56)
If cylinder contains dedicated solar storage													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(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													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(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													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
								Total per year (kWh/year) = Sum(64)m =				1500.7919	(64)
Heat gains from water heating, kWh/month													
	67.8321	60.2614	64.4045	59.2832	59.2173	54.5246	53.8982	57.0294	56.2664	61.3974	62.9741	66.7226	(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	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.5364	21.7931	17.7233	13.4177	10.0299	8.4676	9.1496	11.8930	15.9627	20.2684	23.6562	25.2184	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	164.3130	166.0181	161.7214	152.5743	141.0276	130.1755	122.9255	121.2205	125.5172	134.6643	146.2109	157.0631	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	91.1722	89.6747	86.5651	82.3377	79.5931	75.7286	72.4438	76.6525	78.1478	82.5233	87.4640	89.6810	(72)
Total internal gains													
	352.8368	350.3010	338.8250	321.1448	303.4658	287.1868	277.3341	282.5811	292.4429	310.2711	330.1462	344.7776	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.3300	19.6403	0.7200	0.7000	0.7700	29.7029	(76)
South	9.1400	46.7521	0.7200	0.7000	0.7700	149.2488	(78)
West	3.1200	19.6403	0.7200	0.7000	0.7700	21.4026	(80)

Solar gains	200.3542	344.4042	476.0033	592.0262	660.9841	654.1505	631.6077	581.2134	516.7390	382.2683	240.6332	170.9913	(83)
Total gains	553.1910	694.7052	814.8283	913.1710	964.4499	941.3373	908.9418	863.7945	809.1819	692.5395	570.7794	515.7689	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	16.6687	16.6906	16.7120	16.8136	16.8328	16.9225	16.9225	16.9392	16.8878	16.8328	16.7941	16.7538	
alpha	2.1112	2.1127	2.1141	2.1209	2.1222	2.1282	2.1282	2.1293	2.1259	2.1222	2.1196	2.1169	
util living area													
	0.8872	0.8323	0.7614	0.6650	0.5516	0.4277	0.3230	0.3502	0.5066	0.7069	0.8432	0.8998	(86)
MIT	18.4817	18.9399	19.4936	20.0689	20.5135	20.8001	20.9211	20.9034	20.6972	20.0897	19.1753	18.3790	(87)
Th 2	19.9688	19.9701	19.9714	19.9777	19.9788	19.9842	19.9842	19.9852	19.9821	19.9788	19.9765	19.9740	(88)
util rest of house													
	0.8755	0.8161	0.7391	0.6342	0.5099	0.3721	0.2555	0.2817	0.4508	0.6722	0.8251	0.8892	(89)
MIT 2	17.6884	18.1309	18.6614	19.2057	19.6090	19.8565	19.9461	19.9363	19.7775	19.2415	18.3734	17.5924	(90)
Living area fraction										fLA = Living area / (4) =		0.5900	(91)
MIT	18.1565	18.6082	19.1525	19.7150	20.1427	20.4133	20.5214	20.5069	20.3202	19.7420	18.8466	18.0565	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1565	18.6082	19.1525	19.7150	20.1427	20.4133	20.5214	20.5069	20.3202	19.7420	18.8466	18.0565	(93)

---

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8502	0.7911	0.7193	0.6257	0.5168	0.3962	0.2918	0.3177	0.4701	0.6634	0.8016	0.8646	(94)
Useful gains	470.3490	549.6039	586.0785	571.3378	498.4669	372.9648	265.2700	274.4217	380.3800	459.4480	457.5355	445.9355	(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													
	1010.8224	998.6959	920.5940	782.1494	609.8855	417.7179	281.7731	294.8130	447.8712	660.4007	850.5082	1005.6882	(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													
	402.1122	301.7898	248.8796	151.7844	82.8954	0.0000	0.0000	0.0000	0.0000	149.5088	282.9404	416.4560	(98)
Space heating												2036.3666	(98)
Space heating per m2											(98) / (4) =	57.5733	(99)

8c. Space cooling requirement

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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 %)	175.1000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1162.9735	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	402.1122	301.7898	248.8796	151.7844	82.8954	0.0000	0.0000	0.0000	0.0000	149.5088	282.9404	416.4560	(98)
Space heating efficiency (main heating system 1)	175.1000	175.1000	175.1000	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175.1000	175.1000	(210)
Space heating fuel (main heating system)	229.6472	172.3528	142.1357	86.6844	47.3417	0.0000	0.0000	0.0000	0.0000	85.3848	161.5879	237.8390	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
Efficiency of water heater												175.1000	(216)
(217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(217)
Fuel for water heating, kWh/month	83.7153	73.8854	77.8280	70.0895	68.9185	61.9161	59.7824	65.1607	64.9080	72.6630	76.4290	81.8097	(219)
Water heating fuel used												857.1056	(219)
Annual totals kWh/year													
Space heating fuel - main system												1162.9735	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
Total electricity for the above, kWh/year												30.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Total delivered energy for all uses												2223.4076	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1162.9735	13.1900	153.3962	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	857.1056	13.1900	113.0522	(247)
Pumps and fans for heating	30.0000	13.1900	3.9570	(249)
Energy for lighting	173.3285	13.1900	22.8620	(250)
Additional standing charges			0.0000	(251)
Total energy cost			293.2675	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.5326	(257)
SAP value		78.6207	
SAP rating (Section 12)		79	(258)
SAP band		C	

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	1162.9735	0.5190	603.5832	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	857.1056	0.5190	444.8378	(264)
Space and water heating			1048.4210	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Total kg/year			1153.9485	(272)
CO2 emissions per m2			32.6300	(273)
EI value			80.7603	
EI rating			81	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency	13.19 × (1 + 0.29 × 0.00) / 1.7510 = 7.533, stars = 2
Main heating environmental impact	0.519 × (1 + 0.29 × 0.00) / 1.7510 = 0.2964, stars = 4
Water heating energy efficiency	13.19 / 1.7510 = 7.533, stars = 2
Water heating environmental impact	0.519 / 1.7510 = 0.2964, stars = 4

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3424	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2910	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	6.6000	6.2000	5.9000	5.1000	4.9000	4.6000	4.2000	4.3000	4.9000	5.4000	5.9000	5.7000	(22)
Wind factor	1.6500	1.5500	1.4750	1.2750	1.2250	1.1500	1.0500	1.0750	1.2250	1.3500	1.4750	1.4250	(22a)
Adj infilt rate	0.4802	0.4511	0.4293	0.3711	0.3565	0.3347	0.3056	0.3129	0.3565	0.3929	0.4293	0.4147	(22b)
Effective ac	0.6153	0.6017	0.5921	0.5688	0.5636	0.5560	0.5467	0.5489	0.5636	0.5772	0.5921	0.5860	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2000	7.0740	75.0000	2652.7500	(28b)
Main	57.3800	16.5900	40.7900	0.2300	9.3817	9.0000	367.1100	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			128.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	44.8166			(33)
Party Wall 1			17.3600	0.0000	0.0000	20.0000	347.2000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		4377.4900	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							123.7628	(35)
Thermal bridges (User defined value 0.061 * total exposed area)							7.8153	(36)
Total fabric heat loss					(33) + (36) =		52.6319	(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	21.9764	21.4924	21.1492	20.3173	20.1282	19.8588	19.5260	19.6063	20.1282	20.6151	21.1492	20.9299	(38)
Heat transfer coeff	74.6084	74.1243	73.7811	72.9492	72.7601	72.4907	72.1579	72.2383	72.7601	73.2470	73.7811	73.5618	(39)
Average = Sum(39)m / 12 =												73.2050	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1094	2.0957	2.0860	2.0625	2.0571	2.0495	2.0401	2.0424	2.0571	2.0709	2.0860	2.0798	(40)
HLP (average)												2.0697	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895	(42)
Average daily hot water use (litres/day)	64.8244	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0500	(48)

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

Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.5670	(55)
Total storage loss													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(56)
If cylinder contains dedicated solar storage													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(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													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(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													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
								Total per year (kWh/year) = Sum(64)m =				1500.7919	(64)
Heat gains from water heating, kWh/month													
	67.8321	60.2614	64.4045	59.2832	59.2173	54.5246	53.8982	57.0294	56.2664	61.3974	62.9741	66.7226	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.5364	21.7931	17.7233	13.4177	10.0299	8.4676	9.1496	11.8930	15.9627	20.2684	23.6562	25.2184	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	164.3130	166.0181	161.7214	152.5743	141.0276	130.1755	122.9255	121.2205	125.5172	134.6643	146.2109	157.0631	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	91.1722	89.6747	86.5651	82.3377	79.5931	75.7286	72.4438	76.6525	78.1478	82.5233	87.4640	89.6810	(72)
Total internal gains													
	352.8368	350.3010	338.8250	321.1448	303.4658	287.1868	277.3341	282.5811	292.4429	310.2711	330.1462	344.7776	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.3300	19.0327	0.7200	0.7000	0.7700	28.7840	(76)
South	9.1400	46.2981	0.7200	0.7000	0.7700	147.7996	(78)
West	3.1200	19.0327	0.7200	0.7000	0.7700	20.7404	(80)

Solar gains	197.3240	339.6308	491.5717	618.5759	690.7157	658.1417	642.6356	597.9534	527.3562	379.4219	231.5438	166.7843	(83)
Total gains	550.1608	689.9318	830.3967	939.7207	994.1815	945.3285	919.9697	880.5344	819.7991	689.6930	561.6900	511.5619	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	16.2980	16.4045	16.4808	16.6687	16.7120	16.7741	16.8515	16.8328	16.7120	16.6009	16.4808	16.5299	
alpha	2.0865	2.0936	2.0987	2.1112	2.1141	2.1183	2.1234	2.1222	2.1141	2.1067	2.0987	2.1020	
util living area													
	0.9012	0.8533	0.7865	0.7016	0.6094	0.5189	0.4312	0.4517	0.5838	0.7534	0.8688	0.9131	(86)
MIT	18.1252	18.5922	19.1844	19.7975	20.2753	20.6140	20.7986	20.7753	20.4901	19.7837	18.7938	18.0200	(87)
Th 2	19.9453	19.9522	19.9570	19.9688	19.9714	19.9753	19.9800	19.9788	19.9714	19.9646	19.9570	19.9601	(88)
util rest of house													
	0.8912	0.8395	0.7673	0.6756	0.5748	0.4724	0.3743	0.3942	0.5380	0.7252	0.8542	0.9043	(89)
MIT 2	17.3211	17.7784	18.3516	18.9420	19.3871	19.6946	19.8523	19.8345	19.5908	18.9432	17.9876	17.2283	(90)
Living area fraction										fLA = Living area / (4) =		0.5900	(91)
MIT	17.7955	18.2586	18.8430	19.4468	19.9112	20.2371	20.4107	20.3896	20.1214	19.4391	18.4633	17.6954	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.7955	18.2586	18.8430	19.4468	19.9112	20.2371	20.4107	20.3896	20.1214	19.4391	18.4633	17.6954	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8659	0.8131	0.7442	0.6613	0.5727	0.4847	0.3990	0.4180	0.5451	0.7092	0.8291	0.8801	(94)
Useful gains	476.3600	560.9792	618.0063	621.4178	569.3620	458.2298	367.0730	368.0976	446.8438	489.1542	465.7044	450.2068	(95)
Ext temp.	3.1000	3.6000	5.0000	7.2000	9.8000	12.7000	14.7000	14.6000	12.4000	9.1000	5.7000	2.9000	(96)
Heat loss rate W													
	1096.4094	1086.5562	1021.3495	893.3926	735.6914	546.3676	412.0699	418.2341	561.8108	757.3104	941.6914	1088.3774	(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													
	461.3168	353.1877	300.0873	195.8219	123.7491	0.0000	0.0000	0.0000	0.0000	199.5082	342.7106	474.7990	(98)
Space heating												2451.1806	(98)
Space heating per m2											(98) / (4) =	69.3011	(99)

8c. Space cooling requirement

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

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												175.1000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												1399.8747	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	461.3168	353.1877	300.0873	195.8219	123.7491	0.0000	0.0000	0.0000	0.0000	199.5082	342.7106	474.7990	(98)
Space heating efficiency (main heating system 1)													
	175.1000	175.1000	175.1000	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175.1000	175.1000	(210)
Space heating fuel (main heating system)													
	263.4590	201.7063	171.3805	111.8343	70.6734	0.0000	0.0000	0.0000	0.0000	113.9396	195.7228	271.1588	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
Efficiency of water heater												175.1000	(216)
(217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(217)
Fuel for water heating, kWh/month													
	83.7153	73.8854	77.8280	70.0895	68.9185	61.9161	59.7824	65.1607	64.9080	72.6630	76.4290	81.8097	(219)
Water heating fuel used												857.1056	(219)
Annual totals kWh/year													
Space heating fuel - main system												1399.8747	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
Total electricity for the above, kWh/year												30.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Total delivered energy for all uses												2460.3088	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1399.8747	18.7000	261.7766	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	857.1056	18.7000	160.2787	(247)
Pumps and fans for heating	30.0000	18.7000	5.6100	(249)
Energy for lighting	173.3285	18.7000	32.4124	(250)
Additional standing charges			0.0000	(251)
Total energy cost			460.0777	(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	1399.8747	0.5190	726.5350	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	857.1056	0.5190	444.8378	(264)
Space and water heating			1171.3728	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Total kg/year			1276.9003	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	1399.8747	3.0700	4297.6153	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	857.1056	3.0700	2631.3142	(264)
Space and water heating			6928.9294	(265)
Pumps and fans	30.0000	3.0700	92.1000	(267)
Energy for lighting	173.3285	3.0700	532.1186	(268)
Primary energy kWh/year			7553.1480	(272)
Primary energy kWh/m2/year			213.5467	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: C 79
Current environmental impact rating: B 81

(For testing purposes):

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

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 3.6	-£ 71	-196 kg (15.4%)
U Solar photovoltaic panels	+ 16.6	-£ 326	-906 kg (83.8%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£71	5.55 kg/m²	B 82	B 84
Solar photovoltaic panels	£326	25.62 kg/m²	A 99	A 99
Total Savings	£397	31.16 kg/m²		

Potential energy efficiency rating: A 99
Potential environmental impact rating: A 99

Fuel prices for cost data on this page from database revision number 465 TEST (04 Sep 2020)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£460	£389	£71
Space heating	£267	£268	-£0
Water heating	£160	£89	£71
Lighting	£32	£32	£0
Generated (PV)	-£0	-£326	£326
Total cost of fuels	£460	£63	£397
Total cost of uses	£459	£63	£397
Delivered energy	70 kWh/m²	10 kWh/m²	60 kWh/m²
Carbon dioxide emissions	1.3 tonnes	0.2 tonnes	1.1 tonnes
CO2 emissions per m²	36 kg/m²	5 kg/m²	31 kg/m²
Primary energy	214 kWh/m²	29 kWh/m²	184 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3424	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2910	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3711	0.3638	0.3565	0.3201	0.3129	0.2765	0.2765	0.2692	0.2910	0.3129	0.3274	0.3420	(22b)
Effective ac	0.5688	0.5662	0.5636	0.5512	0.5489	0.5382	0.5382	0.5362	0.5424	0.5489	0.5536	0.5585	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2000	7.0740	75.0000	2652.7500	(28b)
Main	57.3800	16.5900	40.7900	0.2300	9.3817	9.0000	367.1100	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			128.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	44.8166			(33)
Party Wall 1			17.3600	0.0000	0.0000	20.0000	347.2000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	4377.4900 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		123.7628 (35)
Thermal bridges (User defined value 0.061 * total exposed area)		7.8153 (36)
Total fabric heat loss	(33) + (36) =	52.6319 (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	20.3173	20.2218	20.1282	19.6886	19.6063	19.2235	19.2235	19.1526	19.3709	19.6063	19.7727	19.9467	(38)
Heat transfer coeff	72.9492	72.8537	72.7601	72.3205	72.2383	71.8554	71.8554	71.7845	72.0029	72.2383	72.4047	72.5786	(39)
Average = Sum(39)m / 12 =												72.3201	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.0625	2.0598	2.0571	2.0447	2.0424	2.0315	2.0315	2.0295	2.0357	2.0424	2.0471	2.0520	(40)
HLP (average)												2.0447	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895 (42)
Average daily hot water use (litres/day)	64.8244 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)

Water storage loss:	
Store volume	125.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):	1.0500 (48)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.5670	(55)
Total storage loss													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(56)
If cylinder contains dedicated solar storage													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(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													
	146.5855	129.3734	134.8811	115.9731	107.8819	95.8084	91.6521	101.9999	108.2509	125.8372	133.8273	143.2488	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.7781	(H8)
Utilisation factor												0.4302	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												64.8244	(H14)
Volume ratio Veff/V												1.1570	(H15)
Solar storage volume factor												1.0000	(H16)
Solar input												-685.9569	(H17)
Solar input	-19.8914	-33.1930	-56.5315	-75.7633	-93.5992	-92.0229	-90.8068	-79.3384	-62.1378	-42.4328	-23.5940	-16.6457	(63)
								Solar input (sum of months) = Sum(63)m =				-685.9569	(63)
Output from w/h													
	126.6941	96.1804	78.3496	40.2098	14.2827	3.7855	0.8453	22.6615	46.1131	83.4043	110.2332	126.6031	(64)
								Total per year (kWh/year) = Sum(64)m =				749.3626	(64)
Heat gains from water heating, kWh/month													
	67.8321	60.2614	63.2879	53.8803	48.9818	44.4392	43.4766	47.3523	51.9441	60.2808	62.9741	66.7226	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.5364	21.7931	17.7233	13.4177	10.0299	8.4676	9.1496	11.8930	15.9627	20.2684	23.6562	25.2184	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	164.3130	166.0181	161.7214	152.5743	141.0276	130.1755	122.9255	121.2205	125.5172	134.6643	146.2109	157.0631	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	91.1722	89.6747	85.0643	74.8337	65.8358	61.7211	58.4363	63.6455	72.1446	81.0225	87.4640	89.6810	(72)
Total internal gains													
	352.8368	350.3010	337.3242	313.6408	289.7085	273.1794	263.3266	269.5742	286.4397	308.7703	330.1462	344.7776	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.3300	19.6403	0.7200	0.7000	0.7700	29.7029	(76)
South	9.1400	46.7521	0.7200	0.7000	0.7700	149.2488	(78)
West	3.1200	19.6403	0.7200	0.7000	0.7700	21.4026	(80)

Solar gains	200.3542	344.4042	476.0033	592.0262	660.9841	654.1505	631.6077	581.2134	516.7390	382.2683	240.6332	170.9913	(83)
Total gains	553.1910	694.7052	813.3275	905.6670	950.6926	927.3299	894.9343	850.7876	803.1787	691.0387	570.7794	515.7689	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	16.6687	16.6906	16.7120	16.8136	16.8328	16.9225	16.9225	16.9392	16.8878	16.8328	16.7941	16.7538	
alpha	2.1112	2.1127	2.1141	2.1209	2.1222	2.1282	2.1282	2.1293	2.1259	2.1222	2.1196	2.1169	
util living area													
	0.8872	0.8323	0.7620	0.6678	0.5567	0.4327	0.3273	0.3547	0.5092	0.7076	0.8432	0.8998	(86)
MIT	18.4817	18.9399	19.4912	20.0605	20.5042	20.7955	20.9190	20.9009	20.6940	20.0877	19.1753	18.3790	(87)
Th 2	19.9688	19.9701	19.9714	19.9777	19.9788	19.9842	19.9842	19.9852	19.9821	19.9788	19.9765	19.9740	(88)
util rest of house													
	0.8755	0.8161	0.7397	0.6371	0.5150	0.3767	0.2591	0.2856	0.4534	0.6730	0.8251	0.8892	(89)
MIT 2	17.6884	18.1309	18.6592	19.1983	19.6015	19.8534	19.9450	19.9349	19.7752	19.2398	18.3734	17.5924	(90)
Living area fraction									fLA = Living area / (4) =			0.5900	(91)
MIT	18.1565	18.6082	19.1501	19.7071	20.1342	20.4093	20.5197	20.5049	20.3174	19.7401	18.8466	18.0565	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1565	18.6082	19.1501	19.7071	20.1342	20.4093	20.5197	20.5049	20.3174	19.7401	18.8466	18.0565	(93)

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8. Space heating requirement

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8502	0.7911	0.7198	0.6283	0.5216	0.4008	0.2958	0.3218	0.4725	0.6641	0.8016	0.8646	(94)
Useful gains	470.3490	549.6039	585.4325	569.0561	495.8945	371.6741	264.7112	273.7661	379.5115	458.9212	457.5355	445.9355	(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	1010.8224	998.6959	920.4235	781.5723	609.2692	417.4266	281.6509	294.6687	447.6682	660.2653	850.5082	1005.6882	(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	402.1122	301.7898	249.2333	153.0116	84.3508	0.0000	0.0000	0.0000	0.0000	149.8001	282.9404	416.4560	(98)

Space heating 2039.6942 (98)
Space heating per m2 (98) / (4) = 57.6674 (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 %) 175.1000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 1164.8739 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	402.1122	301.7898	249.2333	153.0116	84.3508	0.0000	0.0000	0.0000	0.0000	149.8001	282.9404	416.4560	(98)
Space heating efficiency (main heating system 1)	175.1000	175.1000	175.1000	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175.1000	175.1000	(210)
Space heating fuel (main heating system)	229.6472	172.3528	142.3377	87.3853	48.1729	0.0000	0.0000	0.0000	0.0000	85.5512	161.5879	237.8390	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	126.6941	96.1804	78.3496	40.2098	14.2827	3.7855	0.8453	22.6615	46.1131	83.4043	110.2332	126.6031	(64)
Efficiency of water heater												175.1000	(216)
(217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(217)
Fuel for water heating, kWh/month	72.3553	54.9288	44.7456	22.9639	8.1569	2.1619	0.4827	12.9420	26.3353	47.6324	62.9544	72.3033	(219)

Water heating fuel used 427.9626 (219)
Annual totals kWh/year
Space heating fuel - main system 1164.8739 (211)
Space heating fuel - secondary 0.0000 (215)

Electricity for pumps and fans:
central heating pump 30.0000 (230c)
pump for solar water heating 50.0000 (230g)
Total electricity for the above, kWh/year 80.0000 (231)
Electricity for lighting (calculated in Appendix L) 173.3285 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) = -1727.2394 -1727.2394 (233)
Total delivered energy for all uses 118.9257 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1164.8739	13.1900	153.6469	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	427.9626	13.1900	56.4483	(247)
Pumps and fans for heating	30.0000	13.1900	3.9570	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	173.3285	13.1900	22.8620	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			15.6863	(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] = 0.0820 (257)
SAP value 98.8565
SAP rating (Section 12) 99 (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	1164.8739	0.5190	604.5696	(261)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	427.9626	0.5190	222.1126 (264)
Space and water heating			826.6822 (265)
Pumps and fans	80.0000	0.5190	41.5200 (267)
Energy for lighting	173.3285	0.5190	89.9575 (268)
Energy saving/generation technologies			
PV Unit	-1727.2394	0.5190	-896.4372 (269)
Total kg/year			61.7224 (272)
CO2 emissions per m2			1.7500 (273)
EI value			98.9709
EI rating			99 (274)
EI band			A

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3424	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2910	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	6.6000	6.2000	5.9000	5.1000	4.9000	4.6000	4.2000	4.3000	4.9000	5.4000	5.9000	5.7000	(22)
Wind factor	1.6500	1.5500	1.4750	1.2750	1.2250	1.1500	1.0500	1.0750	1.2250	1.3500	1.4750	1.4250	(22a)
Adj infilt rate	0.4802	0.4511	0.4293	0.3711	0.3565	0.3347	0.3056	0.3129	0.3565	0.3929	0.4293	0.4147	(22b)
Effective ac	0.6153	0.6017	0.5921	0.5688	0.5636	0.5560	0.5467	0.5489	0.5636	0.5772	0.5921	0.5860	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2000	7.0740	75.0000	2652.7500	(28b)
Main	57.3800	16.5900	40.7900	0.2300	9.3817	9.0000	367.1100	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			128.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	44.8166			(33)
Party Wall 1			17.3600	0.0000	0.0000	20.0000	347.2000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		4377.4900	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							123.7628	(35)
Thermal bridges (User defined value 0.061 * total exposed area)							7.8153	(36)
Total fabric heat loss					(33) + (36) =		52.6319	(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	21.9764	21.4924	21.1492	20.3173	20.1282	19.8588	19.5260	19.6063	20.1282	20.6151	21.1492	20.9299	(38)
Heat transfer coeff	74.6084	74.1243	73.7811	72.9492	72.7601	72.4907	72.1579	72.2383	72.7601	73.2470	73.7811	73.5618	(39)
Average = Sum(39)m / 12 =												73.2050	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1094	2.0957	2.0860	2.0625	2.0571	2.0495	2.0401	2.0424	2.0571	2.0709	2.0860	2.0798	(40)
HLP (average)												2.0697	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895	(42)
Average daily hot water use (litres/day)	64.8244	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0500	(48)

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

```
  Temperature factor from Table 2b                                                                                0.5400 (49)
Enter (49) or (54) in (55)                                                                                        0.5670 (55)
Total storage loss
               17.5770    15.8760    17.5770    17.0100    17.5770    17.0100    17.5770    17.5770    17.0100    17.5770    17.0100    17.5770 (56)
If cylinder contains dedicated solar storage
               17.5770    15.8760    17.5770    17.0100    17.5770    17.0100    17.5770    17.5770    17.0100    17.5770    17.0100    17.5770 (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
              146.5855   129.3734   134.8811   115.9731   107.8819    95.8084    91.6521   101.9999   108.2509   125.8372   133.8273   143.2488 (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                                                                                  1091.0709 (H5)
Overshading factor                                                                                                0.8000 (H6)
Solar energy available                                                                                         1832.9992 (H7)
Adjustment factor for showers                                                                                     1.0000 (H7a)
Solar-to-load ratio                                                                                               1.7972 (H8)
Utilisation factor                                                                                                0.4267 (H9)
Collector performance factor                                                                                      0.8793 (H10)
Dedicated solar storage volume                                                                                   75.0000 (H11)
Effective solar volume                                                                                           75.0000 (H13)
Daily hot water demand                                                                                           64.8244 (H14)
Volume ratio Veff/V                                                                                               1.1570 (H15)
Solar storage volume factor                                                                                       1.0000 (H16)
Solar input                                                                                                    -687.8113 (H17)
Solar input    -19.2686   -32.1683   -57.3554   -77.8632   -96.3853   -91.3308   -91.0993   -80.3442   -62.3188   -41.3797   -22.3236   -15.9741 (63)
                                                                    Solar input (sum of months) = Sum(63)m =   -687.8113 (63)
Output from w/h
              127.3169    97.2050    77.5257    38.1099    11.4966     4.4776     0.5528    21.6557    45.9322    84.4575   111.5037   127.2747 (64)
                                                                     Total per year (kWh/year) = Sum(64)m =    747.5082 (64)
Heat gains from water heating, kWh/month
               67.8321    60.2614    63.2879    53.8803    48.9818    44.4392    43.4766    47.3523    51.9441    60.2808    62.9741    66.7226 (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          77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               24.5364    21.7931    17.7233    13.4177    10.0299     8.4676     9.1496    11.8930    15.9627    20.2684    23.6562    25.2184 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              164.3130   166.0181   161.7214   152.5743   141.0276   130.1755   122.9255   121.2205   125.5172   134.6643   146.2109   157.0631 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262 (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)
              -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780 (71)
Water heating gains (Table 5)
               91.1722    89.6747    85.0643    74.8337    65.8358    61.7211    58.4363    63.6455    72.1446    81.0225    87.4640    89.6810 (72)
Total internal gains
              352.8368   350.3010   337.3242   313.6408   289.7085   273.1794   263.3266   269.5742   286.4397   308.7703   330.1462   344.7776 (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
-------------------------------------------------------------------------------------------------------------------
East                                    4.3300           19.0327            0.7200             0.7000            0.7700           28.7840 (76)
South                                   9.1400           46.2981            0.7200             0.7000            0.7700          147.7996 (78)
West                                    3.1200           19.0327            0.7200             0.7000            0.7700           20.7404 (80)
-------------------------------------------------------------------------------------------------------------------

Solar gains   197.3240   339.6308   491.5717   618.5759   690.7157   658.1417   642.6356   597.9534   527.3562   379.4219   231.5438   166.7843 (83)
Total gains   550.1608   689.9318   828.8959   932.2167   980.4241   931.3210   905.9623   867.5275   813.7959   688.1922   561.6900   511.5619 (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            16.2980    16.4045    16.4808    16.6687    16.7120    16.7741    16.8515    16.8328    16.7120    16.6009    16.4808    16.5299
alpha           2.0865     2.0936     2.0987     2.1112     2.1141     2.1183     2.1234     2.1222     2.1141     2.1067     2.0987     2.1020
util living area
                0.9012     0.8533     0.7870     0.7043     0.6144     0.5242     0.4364     0.4568     0.5865     0.7540     0.8688     0.9131 (86)

MIT            18.1252    18.5922    19.1817    19.7878    20.2632    20.6060    20.7938    20.7703    20.4854    19.7814    18.7938    18.0200 (87)
Th 2           19.9453    19.9522    19.9570    19.9688    19.9714    19.9753    19.9800    19.9788    19.9714    19.9646    19.9570    19.9601 (88)
util rest of house
                0.8912     0.8395     0.7679     0.6783     0.5798     0.4776     0.3790     0.3989     0.5407     0.7259     0.8542     0.9043 (89)
MIT 2          17.3211    17.7784    18.3491    18.9332    19.3767    19.6884    19.8491    19.8311    19.5870    18.9410    17.9876    17.2283 (90)
Living area fraction                                                                    fLA = Living area / (4) =      0.5900 (91)
MIT            17.7955    18.2586    18.8404    19.4375    19.8998    20.2298    20.4065    20.3852    20.1171    19.4369    18.4633    17.6954 (92)
Temperature adjustment                                                                                            0.0000
adjusted MIT   17.7955    18.2586    18.8404    19.4375    19.8998    20.2298    20.4065    20.3852    20.1171    19.4369    18.4633    17.6954 (93)
```

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8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8659	0.8131	0.7447	0.6638	0.5773	0.4896	0.4037	0.4227	0.5475	0.7099	0.8291	0.8801	(94)
Useful gains	476.3600	560.9792	617.3011	618.7878	566.0002	456.0092	365.7528	366.7076	445.5581	488.5293	465.7044	450.2068	(95)
Ext temp.	3.1000	3.6000	5.0000	7.2000	9.8000	12.7000	14.7000	14.6000	12.4000	9.1000	5.7000	2.9000	(96)
Heat loss rate W	1096.4094	1086.5562	1021.1602	892.7128	734.8594	545.8429	411.7708	417.9163	561.4971	757.1454	941.6914	1088.3774	(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	461.3168	353.1877	300.4712	197.2260	125.6313	0.0000	0.0000	0.0000	0.0000	199.8504	342.7106	474.7990	(98)
Space heating												2455.1930	(98)
Space heating per m2											(98) / (4) =	69.4146	(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 %)	175.1000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1402.1662	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	461.3168	353.1877	300.4712	197.2260	125.6313	0.0000	0.0000	0.0000	0.0000	199.8504	342.7106	474.7990	(98)
Space heating efficiency (main heating system 1)	175.1000	175.1000	175.1000	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175.1000	175.1000	(210)
Space heating fuel (main heating system)	263.4590	201.7063	171.5998	112.6362	71.7483	0.0000	0.0000	0.0000	0.0000	114.1350	195.7228	271.1588	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	127.3169	97.2050	77.5257	38.1099	11.4966	4.4776	0.5528	21.6557	45.9322	84.4575	111.5037	127.2747	(64)
Efficiency of water heater												175.1000	(216)
(217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(217)
Fuel for water heating, kWh/month	72.7109	55.5140	44.2751	21.7646	6.5657	2.5572	0.3157	12.3676	26.2320	48.2338	63.6800	72.6869	(219)
Water heating fuel used												426.9036	(219)
Annual totals kWh/year													
Space heating fuel - main system												1402.1662	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												80.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1091 * 0.80) =										-1745.7135		-1745.7135	(233)
Total delivered energy for all uses												336.6848	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1402.1662	18.7000	262.2051	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	426.9036	18.7000	79.8310	(247)
Pumps and fans for heating	30.0000	18.7000	5.6100	(249)
Pump for solar water heating	50.0000	18.7000	9.3500	(249)
Energy for lighting	173.3285	18.7000	32.4124	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-1745.7135	18.7000	-326.4484	(252)
Total energy cost			62.9601	(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	1402.1662	0.5190	727.7243	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	426.9036	0.5190	221.5630	(264)
Space and water heating			949.2872	(265)
Pumps and fans	80.0000	0.5190	41.5200	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Energy saving/generation technologies				
PV Unit	-1745.7135	0.5190	-906.0253	(269)
Total kg/year			174.7394	(272)

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

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	1402.1662	3.0700	4304.6502	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	426.9036	3.0700	1310.5940	(264)
Space and water heating			5615.2442	(265)
Pumps and fans	80.0000	3.0700	245.6000	(267)
Energy for lighting	173.3285	3.0700	532.1186	(268)
Energy saving/generation technologies				
PV Unit	-1745.7135	3.0700	-5359.3404	(269)
Primary energy kWh/year			1033.6224	(272)
Primary energy kWh/m2/year			29.2231	(273)

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

Overheating Calculation Input Data

Dwelling type	SemiDetached Bungalow
Number of storeys	1
Cross ventilation possible	Yes
SAP Region	North East England
Front of dwelling faces	West
Overshading	Average or unknown
Thermal mass parameter	123.8 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	6.00 (Windows fully open)

Overheating Calculation

Summer ventilation heat loss coefficient		214.30 (P1)
Transmission heat loss coefficient		52.63 (37)
Summer heat loss coefficient		266.93 (P2)

Overhangs

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

Solar shading

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

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
East	4.3300	111.2086	0.7200	0.7000	0.9000	196.5811
South	9.1400	110.4126	0.7200	0.7000	0.9000	411.9841
West	3.1200	111.2086	0.7200	0.7000	0.9000	141.6474
total:						750.2126

	Jun	Jul	Aug	
Solar gains	765	750	685	(P3)
Internal gains	284	274	280	
Total summer gains	1049	1025	964	(P5)
Summer gain/loss ratio	3.93	3.84	3.61	(P6)
Summer external temperature	13.80	15.80	15.60	
Thermal mass temperature increment (TMP = 123.8)	1.13	1.13	1.13	
Threshold temperature	18.86	20.77	20.35	(P7)
Likelihood of high internal temperature	Not significant	Slight	Not significant	

Assessment of likelihood of high internal temperature: Slight

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

Anderson Goddard Ltd

Property Reference	73940-WR12	**Issued on Date**	07/10/2020
Assessment Reference	001	**Prop Type Ref**	Semi
Property	Woodlands Room 12, Raithwaite Bay, WHITBY, YO21 3ST		

SAP Rating	79 C	**DER**	34.23	**TER**	40.09
Environmental	81 B	**% DER<TER**	14.62		
CO_2 Emissions (t/year)	1.28	**DFEE**	73.97	**TFEE**	74.10
General Requirements Compliance	Pass	**% DFEE<TFEE**	0.18		

Assessor Details	Mr. Paul Goddard, Anderson Goddard Limited, Tel: 0161 7757770, paul.goddard@andersongoddard.com	**Assessor ID**	B342-0001
Client			

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

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

Semi-Detached Bungalow, total floor area 35 m²

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

1a TER and DER
Fuel for main heating:Electricity
Fuel factor:1.55 (electricity)
Target Carbon Dioxide Emission Rate (TER) 40.09 kgCO□/m²
Dwelling Carbon Dioxide Emission Rate (DER) 34.23 kgCO□/m²OK

1b TFEE and DFEE
Target Fabric Energy Efficiency (TFEE)74.1 kWh/m²/yr
Dwelling Fabric Energy Efficiency (DFEE)74.0 kWh/m²/yrOK

---
2 Fabric U-values

Element	Average	Highest	
External wall	0.23 (max. 0.30)	0.23 (max. 0.70)	OK
Party wall	0.00 (max. 0.20)	-	OK
Floor	0.20 (max. 0.25)	0.20 (max. 0.70)	OK
Roof	0.18 (max. 0.20)	0.18 (max. 0.35)	OK
Openings	1.40 (max. 2.00)	1.40 (max. 3.30)	OK

2a Thermal bridging
Thermal bridging calculated using user-specified y-value of 0.061

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

---
4 Heating efficiency
Main heating system: Heat pump with radiators or underfloor - Electric
Air-to-water heat pump

Secondary heating system: None

---
5 Cylinder insulation
Hot water storage Measured cylinder loss: 1.05 kWh/day
Permitted by DBSCG 1.70 OK
Primary pipework insulated: Yes OK

---
6 Controls
Space heating controls: Programmer and room thermostat OK

Hot water controls: Cylinderstat OK
Independent timer for DHW OK

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

---
8 Mechanical ventilation
Not applicable

---
9 Summertime temperature
Overheating risk (North East England): Slight OK
Based on:
Overshading: Average
Windows facing East: 4.33 m², No overhang
Windows facing South: 9.14 m², No overhang
Windows facing West: 3.12 m², No overhang
Air change rate: 8.00 ach
Blinds/curtains: None

---
10 Key features
Party wall U-value 0.00 W/m²K

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3424	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2910	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3711	0.3638	0.3565	0.3201	0.3129	0.2765	0.2765	0.2692	0.2910	0.3129	0.3274	0.3420	(22b)
Effective ac	0.5688	0.5662	0.5636	0.5512	0.5489	0.5382	0.5382	0.5362	0.5424	0.5489	0.5536	0.5585	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2000	7.0740	75.0000	2652.7500	(28b)
Main	57.3800	16.5900	40.7900	0.2300	9.3817	9.0000	367.1100	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			128.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	44.8166			(33)
Party Wall 1			17.3600	0.0000	0.0000	20.0000	347.2000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	4377.4900 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		123.7628 (35)
Thermal bridges (User defined value 0.061 * total exposed area)		7.8153 (36)
Total fabric heat loss	(33) + (36) =	52.6319 (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	20.3173	20.2218	20.1282	19.6886	19.6063	19.2235	19.2235	19.1526	19.3709	19.6063	19.7727	19.9467	(38)
Heat transfer coeff	72.9492	72.8537	72.7601	72.3205	72.2383	71.8554	71.8554	71.7845	72.0029	72.2383	72.4047	72.5786	(39)
Average = Sum(39)m / 12 =												72.3201	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.0625	2.0598	2.0571	2.0447	2.0424	2.0315	2.0315	2.0295	2.0357	2.0424	2.0471	2.0520	(40)
HLP (average)												2.0447	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895 (42)
Average daily hot water use (litres/day)	64.8244 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0500	(48)

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.5670	(55)
Total storage loss													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(56)
If cylinder contains dedicated solar storage													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(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													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(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													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
								Total per year (kWh/year) = Sum(64)m =				1500.7919	(64)
Heat gains from water heating, kWh/month													
	67.8321	60.2614	64.4045	59.2832	59.2173	54.5246	53.8982	57.0294	56.2664	61.3974	62.9741	66.7226	(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	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	9.8146	8.7172	7.0893	5.3671	4.0119	3.3871	3.6598	4.7572	6.3851	8.1073	9.4625	10.0874	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	110.0897	111.2321	108.3533	102.2247	94.4885	87.2176	82.3601	81.2177	84.0965	90.2251	97.9613	105.2323	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	91.1722	89.6747	86.5651	82.3377	79.5931	75.7286	72.4438	76.6525	78.1478	82.5233	87.4640	89.6810	(72)
Total internal gains													
	256.4182	254.9658	247.3495	235.2713	223.4353	211.6749	203.8055	207.9691	213.9712	226.1975	240.2295	250.3424	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.3300	19.6403	0.7200	0.7000	0.7700	29.7029	(76)
South	9.1400	46.7521	0.7200	0.7000	0.7700	149.2488	(78)
West	3.1200	19.6403	0.7200	0.7000	0.7700	21.4026	(80)

Solar gains	200.3542	344.4042	476.0033	592.0262	660.9841	654.1505	631.6077	581.2134	516.7390	382.2683	240.6332	170.9913	(83)
Total gains	456.7724	599.3700	723.3528	827.2975	884.4194	865.8254	835.4132	789.1826	730.7102	608.4658	480.8627	421.3337	(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	16.6687	16.6906	16.7120	16.8136	16.8328	16.9225	16.9225	16.9392	16.8878	16.8328	16.7941	16.7538	
alpha	2.1112	2.1127	2.1141	2.1209	2.1222	2.1282	2.1282	2.1293	2.1259	2.1222	2.1196	2.1169	
util living area													
	0.9173	0.8649	0.7952	0.6984	0.5828	0.4560	0.3472	0.3777	0.5431	0.7480	0.8788	0.9284	(86)
MIT	18.2332	18.7326	19.3370	19.9666	20.4560	20.7730	20.9090	20.8878	20.6517	19.9699	18.9714	18.1259	(87)
Th 2	19.9688	19.9701	19.9714	19.9777	19.9788	19.9842	19.9842	19.9852	19.9821	19.9788	19.9765	19.9740	(88)
util rest of house													
	0.9081	0.8509	0.7747	0.6686	0.5409	0.3984	0.2758	0.3053	0.4862	0.7154	0.8637	0.9203	(89)
MIT 2	17.4478	17.9337	18.5163	19.1155	19.5625	19.8381	19.9398	19.9278	19.7443	19.1364	18.1802	17.3466	(90)
Living area fraction										fLA = Living area / (4) =		0.5900	(91)
MIT	17.9112	18.4051	19.0005	19.6177	20.0897	20.3897	20.5117	20.4943	20.2798	19.6282	18.6470	17.8064	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.9112	18.4051	19.0005	19.6177	20.0897	20.3897	20.5117	20.4943	20.2798	19.6282	18.6470	17.8064	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8849	0.8256	0.7527	0.6572	0.5457	0.4221	0.3137	0.3425	0.5036	0.7030	0.8400	0.8984	(94)
Useful gains	404.2015	494.8111	544.4384	543.6886	482.5905	365.4972	262.0841	270.3183	368.0202	427.7308	403.9033	378.5185	(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													
	992.9271	983.8973	909.5411	775.1080	606.0585	416.0243	281.0745	293.9064	444.9601	652.1821	836.0588	987.5347	(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													
	438.0118	328.6659	271.6364	166.6219	91.8601	0.0000	0.0000	0.0000	0.0000	166.9918	311.1520	453.1081	(98)
Space heating												2228.0481	(98)
Space heating per m2											(98) / (4) =	62.9926	(99)

8c. Space cooling requirement

CALCULATION OF DWELLING EMISSIONS FOR REGULATIONS COMPLIANCE 09 Jan 2014

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	175.1000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1272.4433	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	438.0118	328.6659	271.6364	166.6219	91.8601	0.0000	0.0000	0.0000	0.0000	166.9918	311.1520	453.1081	(98)
Space heating efficiency (main heating system 1)													
	175.1000	175.1000	175.1000	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175.1000	175.1000	(210)
Space heating fuel (main heating system)													
	250.1495	187.7018	155.1321	95.1582	52.4615	0.0000	0.0000	0.0000	0.0000	95.3694	177.6996	258.7710	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
Efficiency of water heater												175.1000	(216)
(217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(217)
Fuel for water heating, kWh/month													
	83.7153	73.8854	77.8280	70.0895	68.9185	61.9161	59.7824	65.1607	64.9080	72.6630	76.4290	81.8097	(219)
Water heating fuel used												857.1056	(219)
Annual totals kWh/year													
Space heating fuel - main system												1272.4433	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
Total electricity for the above, kWh/year												30.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Total delivered energy for all uses												2332.8774	(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	1272.4433	0.5190	660.3980	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	857.1056	0.5190	444.8378	(264)
Space and water heating			1105.2358	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Total CO2, kg/year			1210.7634	(272)
Dwelling Carbon Dioxide Emission Rate (DER)			34.2300	(273)

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

DER		34.2300	ZC1
Total Floor Area	TFA	35.3700	
Assumed number of occupants	N	1.2895	
CO2 emission factor in Table 12 for electricity displaced from grid	EF	0.5190	
CO2 emissions from appliances, equation (L14)		18.4441	ZC2
CO2 emissions from cooking, equation (L16)		4.2394	ZC3
Total CO2 emissions		56.9135	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		56.9135	ZC8

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000	/ (5) =	0.1848	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.4348	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3696	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4712	0.4620	0.4527	0.4065	0.3973	0.3511	0.3511	0.3419	0.3696	0.3973	0.4158	0.4342	(22b)
Effective ac	0.6110	0.6067	0.6025	0.5826	0.5789	0.5616	0.5616	0.5584	0.5683	0.5789	0.5864	0.5943	(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 Opening Type (Uw = 1.40)			8.8400	1.3258	11.7197			(27)
GF			35.3700	0.1300	4.5981			(28b)
Main	57.3800	8.8400	48.5400	0.1800	8.7372			(29a)
Flat	35.3700		35.3700	0.1300	4.5981			(30)
Total net area of external elements Aum(A, m2)			128.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		29.6531			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							7.8878	(36)
Total fabric heat loss					(33) + (36) =		37.5409	(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	21.8234	21.6694	21.5185	20.8096	20.6770	20.0596	20.0596	19.9453	20.2974	20.6770	20.9453	21.2258	(38)
Heat transfer coeff	59.3643	59.2103	59.0594	58.3505	58.2179	57.6005	57.6005	57.4862	57.8383	58.2179	58.4862	58.7667	(39)
Average = Sum(39)m / 12 =												58.3499	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.6784	1.6740	1.6698	1.6497	1.6460	1.6285	1.6285	1.6253	1.6352	1.6460	1.6536	1.6615	(40)
HLP (average)												1.6497	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy												1.2895	(42)
Average daily hot water use (litres/day)												64.8244	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.2538	(48)
Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.6770	(55)
Total storage loss													

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

	20.9878	18.9567	20.9878	20.3108	20.9878	20.3108	20.9878	20.9878	20.3108	20.9878	20.3108	20.9878	(56)
If cylinder contains dedicated solar storage													
	20.9878	18.9567	20.9878	20.3108	20.9878	20.3108	20.9878	20.9878	20.3108	20.9878	20.3108	20.9878	(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													
	149.9962	132.4541	139.6876	126.0274	124.0870	111.7159	108.0898	117.5071	116.9546	130.6437	137.1280	146.6596	(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													
	149.9962	132.4541	139.6876	126.0274	124.0870	111.7159	108.0898	117.5071	116.9546	130.6437	137.1280	146.6596	(64)
								Total per year (kWh/year) = Sum(64)m =				1540.9510	(64)
Heat gains from water heating, kWh/month													
	70.5607	62.7260	67.1331	61.9238	61.9459	57.1652	56.6268	59.7581	58.9070	64.1260	65.6147	69.4513	(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	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	9.8146	8.7172	7.0893	5.3671	4.0119	3.3871	3.6598	4.7572	6.3851	8.1073	9.4625	10.0874	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	110.0897	111.2321	108.3533	102.2247	94.4885	87.2176	82.3601	81.2177	84.0965	90.2251	97.9613	105.2323	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	94.8397	93.3422	90.2326	86.0052	83.2606	79.3961	76.1113	80.3200	81.8153	86.1908	91.1315	93.3485	(72)
Total internal gains													
	260.0857	258.6333	251.0170	238.9388	227.1028	215.3424	207.4730	211.6366	217.6387	229.8650	243.8970	254.0099	(73)

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	2.3100	19.6403	0.6300	0.7000	0.7700	13.8654	(76)
South	4.8700	46.7521	0.6300	0.7000	0.7700	69.5827	(78)
West	1.6600	19.6403	0.6300	0.7000	0.7700	9.9639	(80)

Solar gains	93.4120	160.5736	221.9313	276.0277	308.1802	304.9946	294.4839	270.9869	240.9246	178.2277	112.1915	79.7219	(83)
Total gains	353.4977	419.2069	472.9484	514.9665	535.2830	520.3371	501.9569	482.6235	458.5633	408.0927	356.0886	333.7317	(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	41.3759	41.4835	41.5895	42.0947	42.1906	42.6428	42.6428	42.7277	42.4675	42.1906	41.9971	41.7966	
alpha	3.7584	3.7656	3.7726	3.8063	3.8127	3.8429	3.8429	3.8485	3.8312	3.8127	3.7998	3.7864	
util living area													
	0.9866	0.9741	0.9493	0.8957	0.7967	0.6408	0.4861	0.5221	0.7347	0.9148	0.9751	0.9890	(86)
MIT	19.4434	19.6791	20.0119	20.4043	20.7200	20.9140	20.9770	20.9695	20.8483	20.4347	19.8673	19.4037	(87)
Th 2	19.5564	19.5595	19.5626	19.5771	19.5798	19.5925	19.5925	19.5948	19.5876	19.5798	19.5743	19.5686	(88)
util rest of house													
	0.9820	0.9656	0.9324	0.8599	0.7272	0.5258	0.3397	0.3748	0.6295	0.8775	0.9654	0.9853	(89)
MIT 2	17.5749	17.9150	18.3884	18.9348	19.3319	19.5425	19.5858	19.5849	19.4850	18.9924	18.1999	17.5254	(90)
Living area fraction									fLA = Living area / (4) =			0.5900	(91)
MIT	18.6774	18.9559	19.3463	19.8019	20.1510	20.3518	20.4067	20.4019	20.2894	19.8434	19.1837	18.6337	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.6774	18.9559	19.3463	19.8019	20.1510	20.3518	20.4067	20.4019	20.2894	19.8434	19.1837	18.6337	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9783	0.9610	0.9293	0.8664	0.7576	0.5907	0.4264	0.4619	0.6856	0.8856	0.9619	0.9821	(94)
Useful gains	345.8423	402.8560	439.4932	446.1610	405.5184	307.3816	214.0502	222.9018	314.3999	361.4121	342.5221	327.7426	(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													
	853.5064	832.2551	758.6969	636.1291	491.9989	331.3043	219.2658	230.0524	357.9849	538.1312	706.7314	848.2189	(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													
	377.7021	288.5562	237.4875	136.7770	64.3414	0.0000	0.0000	0.0000	0.0000	131.4790	262.2307	387.2343	(98)
Space heating												1885.8084	(98)
Space heating per m2											(98) / (4) =	53.3166	(99)

8c. Space cooling requirement

Not applicable

CALCULATION OF TARGET EMISSIONS 09 Jan 2014

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												93.5000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												2016.9073	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	377.7021	288.5562	237.4875	136.7770	64.3414	0.0000	0.0000	0.0000	0.0000	131.4790	262.2307	387.2343	(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)													
	403.9595	308.6162	253.9974	146.2856	68.8144	0.0000	0.0000	0.0000	0.0000	140.6192	280.4607	414.1544	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	149.9962	132.4541	139.6876	126.0274	124.0870	111.7159	108.0898	117.5071	116.9546	130.6437	137.1280	146.6596	(64)
Efficiency of water heater												79.8000	(216)
(217)m	87.1774	86.8368	86.2185	85.0324	83.1572	79.8000	79.8000	79.8000	79.8000	84.8308	86.5167	87.2850	(217)
Fuel for water heating, kWh/month													
	172.0586	152.5321	162.0158	148.2111	149.2198	139.9949	135.4509	147.2520	146.5596	154.0049	158.4989	168.0237	(219)
Water heating fuel used												1833.8224	(219)
Annual totals kWh/year													
Space heating fuel - main system												2016.9073	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
main heating flue fan												45.0000	(230e)
Total electricity for the above, kWh/year												75.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Total delivered energy for all uses												4099.0583	(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	2016.9073	0.2160	435.6520	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	1833.8224	0.2160	396.1056	(264)
Space and water heating			831.7576	(265)
Pumps and fans	75.0000	0.5190	38.9250	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Total CO2, kg/m2/year			960.6401	(272)
Emissions per m2 for space and water heating			23.5159	(272a)
Fuel factor (electricity)			1.5500	
Emissions per m2 for lighting			2.5433	(272b)
Emissions per m2 for pumps and fans			1.1005	(272c)
Target Carbon Dioxide Emission Rate (TER) = (23.5159 * 1.55) + 2.5433 + 1.1005, rounded to 2 d.p.			40.0900	(273)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000 / (5) =	0.1848	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.4348	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.3696	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4712	0.4620	0.4527	0.4065	0.3973	0.3511	0.3511	0.3419	0.3696	0.3973	0.4158	0.4342	(22b)
Effective ac	0.6110	0.6067	0.6025	0.5826	0.5789	0.5616	0.5616	0.5584	0.5683	0.5789	0.5864	0.5943	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2000	7.0740	75.0000	2652.7500	(28b)
Main	57.3800	16.5900	40.7900	0.2300	9.3817	9.0000	367.1100	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			128.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	44.8166			(33)
Party Wall 1			17.3600	0.0000	0.0000	20.0000	347.2000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	4377.4900 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		123.7628 (35)
Thermal bridges (User defined value 0.061 * total exposed area)		7.8153 (36)
Total fabric heat loss	(33) + (36) =	52.6319 (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	21.8234	21.6694	21.5185	20.8096	20.6770	20.0596	20.0596	19.9453	20.2974	20.6770	20.9453	21.2258	(38)
Heat transfer coeff	74.4553	74.3014	74.1505	73.4416	73.3090	72.6916	72.6916	72.5772	72.9294	73.3090	73.5773	73.8578	(39)
Average = Sum(39)m / 12 =												73.4410	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1050	2.1007	2.0964	2.0764	2.0726	2.0552	2.0552	2.0519	2.0619	2.0726	2.0802	2.0881	(40)
HLP (average)												2.0764	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895 (42)
Average daily hot water use (litres/day)	64.8244 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(46)
Water storage loss:													
Total storage loss	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(56)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

If cylinder contains dedicated solar storage

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

Heat gains from water heating, kWh/month

	22.4710	19.6533	20.2805	17.6810	16.9653	14.6398	13.5659	15.5671	15.7530	18.3586	20.0399	21.7620 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	(66)

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

	9.8146	8.7172	7.0893	5.3671	4.0119	3.3871	3.6598	4.7572	6.3851	8.1073	9.4625	10.0874 (67)

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

	110.0897	111.2321	108.3533	102.2247	94.4885	87.2176	82.3601	81.2177	84.0965	90.2251	97.9613	105.2323 (68)

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

	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473 (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)

	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780 (71)

Water heating gains (Table 5)

	30.2030	29.2460	27.2587	24.5569	22.8029	20.3330	18.2338	20.9235	21.8792	24.6756	27.8331	29.2500 (72)

Total internal gains

	192.4491	191.5371	185.0431	174.4905	163.6451	153.2794	146.5955	149.2402	154.7025	165.3497	177.5987	186.9114 (73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.3300	19.6403	0.7200	0.7000	0.7700	29.7029	(76)
South	9.1400	46.7521	0.7200	0.7000	0.7700	149.2488	(78)
West	3.1200	19.6403	0.7200	0.7000	0.7700	21.4026	(80)

Solar gains	200.3542	344.4042	476.0033	592.0262	660.9841	654.1505	631.6077	581.2134	516.7390	382.2683	240.6332	170.9913	(83)
Total gains	392.8033	535.9412	661.0464	766.5167	824.6292	807.4299	778.2032	730.4536	671.4416	547.6181	418.2319	357.9027	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	16.3315	16.3654	16.3987	16.5570	16.5869	16.7278	16.7278	16.7541	16.6732	16.5869	16.5264	16.4637	
alpha	2.0888	2.0910	2.0932	2.1038	2.1058	2.1152	2.1152	2.1169	2.1115	2.1058	2.1018	2.0976	

util living area

	0.9366	0.8876	0.8211	0.7264	0.6117	0.4835	0.3716	0.4052	0.5770	0.7815	0.9037	0.9464	(86)
MIT	17.9995	18.5281	19.1718	19.8549	20.3875	20.7404	20.8937	20.8686	20.5992	19.8449	18.7774	17.8961	(87)
Th 2	19.2642	19.2671	19.2698	19.2829	19.2854	19.2968	19.2968	19.2989	19.2924	19.2854	19.2804	19.2752	(88)

util rest of house

	0.9236	0.8662	0.7879	0.6760	0.5386	0.3804	0.2416	0.2730	0.4758	0.7275	0.8814	0.9353	(89)
MIT 2	16.6891	17.1975	17.8068	18.4398	18.8989	19.1780	19.2689	19.2609	19.0873	18.4623	17.4617	16.5960	(90)
Living area fraction									fLA = Living area / (4) =			0.5900	(91)
MIT	17.4623	17.9826	18.6122	19.2748	19.7773	20.0999	20.2276	20.2095	19.9794	19.2781	18.2380	17.3631	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.4623	17.9826	18.6122	19.2748	19.7773	20.0999	20.2276	20.2095	19.9794	19.2781	18.2380	17.3631	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9056	0.8464	0.7731	0.6758	0.5612	0.4315	0.3153	0.3469	0.5196	0.7272	0.8640	0.9186	(94)
Useful gains	355.7381	453.6371	511.0567	517.9993	462.7745	348.4059	245.3966	253.3924	348.8761	398.2536	361.3638	328.7839	(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

	980.0036	972.0561	898.1258	761.9429	592.1362	399.7949	263.6975	276.4849	428.7808	636.1839	819.5035	972.1979	(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

	464.4535	348.3776	287.9794	175.6394	96.2451	0.0000	0.0000	0.0000	0.0000	177.0201	329.8606	478.7000	(98)
Space heating												2358.2758	(98)
Space heating per m2											(98) / (4) =	66.6745	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	

Heat loss rate W

	0.0000	0.0000	0.0000	0.0000	0.0000	683.3006	537.9175	551.5869	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.7945	0.8450	0.8254	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	542.8641	454.5645	455.2824	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	993.3828	958.3668	903.1925	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	324.3734	374.8289	333.2451	0.0000	0.0000	0.0000	0.0000	(104)

CALCULATION OF FABRIC ENERGY EFFICIENCY 09 Jan 2014

Space cooling												1032.4474 (104)
Cooled fraction											fC = cooled area / (4) =	1.0000 (105)
Intermittency factor (Table 10b)												
0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.2500	0.2500	0.0000	0.0000	0.0000		0.0000 (106)
Space cooling kWh												
0.0000	0.0000	0.0000	0.0000	0.0000	81.0934	93.7072	83.3113	0.0000	0.0000	0.0000		0.0000 (107)
Space cooling												258.1119 (107)
Space cooling per m2												7.2975 (108)
Energy for space heating												66.6745 (99)
Energy for space cooling												7.2975 (108)
Total												73.9719 (109)
Dwelling Fabric Energy Efficiency (DFEE)												74.0 (109)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(5)

2. Ventilation rate

	main heating		secondary heating		other		total	m3 per hour	
Number of chimneys	0	+	0	+	0	=	0 * 40 =	0.0000	(6a)
Number of open flues	0	+	0	+	0	=	0 * 20 =	0.0000	(6b)
Number of intermittent fans							2 * 10 =	20.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

			Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	20.0000	/ (5) =	0.1848	(8)
Pressure test			Yes	
Measured/design AP50			5.0000	
Infiltration rate			0.4348	(18)
Number of sides sheltered			2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =		0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =		0.3696	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.4712	0.4620	0.4527	0.4065	0.3973	0.3511	0.3511	0.3419	0.3696	0.3973	0.4158	0.4342	(22b)
Effective ac	0.6110	0.6067	0.6025	0.5826	0.5789	0.5616	0.5616	0.5584	0.5683	0.5789	0.5864	0.5943	(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 Opening Type (Uw = 1.40)			8.8400	1.3258	11.7197			(27)
GF			35.3700	0.1300	4.5981			(28b)
Main	57.3800	8.8400	48.5400	0.1800	8.7372			(29a)
Flat	35.3700		35.3700	0.1300	4.5981			(30)
Total net area of external elements Aum(A, m2)			128.1200					(31)
Fabric heat loss, W/K = Sum (A x U)			(26)...(30) + (32) =		29.6531			(33)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							250.0000	(35)
Thermal bridges (Sum(L x Psi) calculated using Appendix K)							7.8878	(36)
Total fabric heat loss					(33) + (36) =		37.5409	(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	21.8234	21.6694	21.5185	20.8096	20.6770	20.0596	20.0596	19.9453	20.2974	20.6770	20.9453	21.2258	(38)
Heat transfer coeff	59.3643	59.2103	59.0594	58.3505	58.2179	57.6005	57.6005	57.4862	57.8383	58.2179	58.4862	58.7667	(39)
Average = Sum(39)m / 12 =												58.3499	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	1.6784	1.6740	1.6698	1.6497	1.6460	1.6285	1.6285	1.6253	1.6352	1.6460	1.6536	1.6615	(40)
HLP (average)												1.6497	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895	(42)
Average daily hot water use (litres/day)	64.8244	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(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)

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

Heat gains from water heating, kWh/month

	22.4710	19.6533	20.2805	17.6810	16.9653	14.6398	13.5659	15.5671	15.7530	18.3586	20.0399	21.7620 (65)

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

Metabolic gains (Table 5), Watts

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	64.4725	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	9.8146	8.7172	7.0893	5.3671	4.0119	3.3871	3.6598	4.7572	6.3851	8.1073	9.4625	10.0874	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	110.0897	111.2321	108.3533	102.2247	94.4885	87.2176	82.3601	81.2177	84.0965	90.2251	97.9613	105.2323	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	29.4473	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	30.2030	29.2460	27.2587	24.5569	22.8029	20.3330	18.2338	20.9235	21.8792	24.6756	27.8331	29.2500	(72)
Total internal gains													
	192.4491	191.5371	185.0431	174.4905	163.6451	153.2794	146.5955	149.2402	154.7025	165.3497	177.5987	186.9114	(73)

---

6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	2.3100	19.6403	0.6300	0.7000	0.7700	13.8654	(76)
South	4.8700	46.7521	0.6300	0.7000	0.7700	69.5827	(78)
West	1.6600	19.6403	0.6300	0.7000	0.7700	9.9639	(80)

Solar gains	93.4120	160.5736	221.9313	276.0277	308.1802	304.9946	294.4839	270.9869	240.9246	178.2277	112.1915	79.7219	(83)
Total gains	285.8610	352.1107	406.9744	450.5182	471.8253	458.2740	441.0794	420.2271	395.6271	343.5774	289.7902	266.6333	(84)

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7. Mean internal temperature (heating season)

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	41.3759	41.4835	41.5895	42.0947	42.1906	42.6428	42.6428	42.7277	42.4675	42.1906	41.9971	41.7966	
alpha	3.7584	3.7656	3.7726	3.8063	3.8127	3.8429	3.8429	3.8485	3.8312	3.8127	3.7998	3.7864	
util living area													
	0.9933	0.9850	0.9674	0.9260	0.8429	0.6998	0.5434	0.5854	0.7964	0.9466	0.9871	0.9949	(86)
MIT	19.2865	19.5301	19.8777	20.2970	20.6500	20.8829	20.9664	20.9549	20.7951	20.3176	19.7185	19.2462	(87)
Th 2	19.5564	19.5595	19.5626	19.5771	19.5798	19.5925	19.5925	19.5948	19.5876	19.5798	19.5743	19.5686	(88)
util rest of house													
	0.9910	0.9798	0.9556	0.8979	0.7809	0.5840	0.3843	0.4267	0.6981	0.9202	0.9817	0.9930	(89)
MIT 2	18.0488	18.2919	18.6346	19.0453	19.3599	19.5437	19.5855	19.5842	19.4871	19.0766	18.4918	18.0180	(90)
Living area fraction									fLA = Living area / (4) =			0.5900	(91)
MIT	18.7791	19.0224	19.3681	19.7839	20.1211	20.3339	20.4003	20.3930	20.2589	19.8089	19.2156	18.7427	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.7791	19.0224	19.3681	19.7839	20.1211	20.3339	20.4003	20.3930	20.2589	19.8089	19.2156	18.7427	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.9893	0.9773	0.9536	0.9027	0.8071	0.6488	0.4788	0.5207	0.7495	0.9254	0.9800	0.9916	(94)
Useful gains	282.7995	344.1318	388.0991	406.6619	380.8197	297.3311	211.1716	218.8080	296.5249	317.9437	283.9804	264.3959	(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													
	859.5430	836.1949	759.9836	635.0796	490.2617	330.2753	218.8983	229.5424	356.2195	536.1207	708.5961	854.6270	(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													
	429.0972	330.6664	276.6820	164.4608	81.4248	0.0000	0.0000	0.0000	0.0000	162.3237	305.7233	439.1319	(98)
Space heating												2189.5101	(98)
Space heating per m2											(98) / (4) =	61.9030	(99)

8c. Space cooling requirement

Calculated for June, July and August. See Table 10b

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ext. temp.	4.3000	4.9000	6.5000	8.9000	11.7000	14.6000	16.6000	16.4000	14.1000	10.6000	7.1000	4.2000	
Heat loss rate W													
	0.0000	0.0000	0.0000	0.0000	0.0000	541.4448	426.2438	436.8950	0.0000	0.0000	0.0000	0.0000	(100)
Utilisation	0.0000	0.0000	0.0000	0.0000	0.0000	0.8232	0.8880	0.8687	0.0000	0.0000	0.0000	0.0000	(101)
Useful loss	0.0000	0.0000	0.0000	0.0000	0.0000	445.7182	378.5028	379.5510	0.0000	0.0000	0.0000	0.0000	(102)
Total gains	0.0000	0.0000	0.0000	0.0000	0.0000	585.2785	564.3260	540.5900	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	100.4835	138.2525	119.8130	0.0000	0.0000	0.0000	0.0000	(104)
Space cooling												358.5489	(104)
Cooled fraction									fC = cooled area / (4) =			1.0000	(105)
Intermittency factor (Table 10b)													

CALCULATION OF TARGET FABRIC ENERGY EFFICIENCY 09 Jan 2014

	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	25.1209	34.5631	29.9533	0.0000	0.0000	0.0000	0.0000 (107)
Space cooling												89.6372 (107)
Space cooling per m2												2.5343 (108)
Energy for space heating												61.9030 (99)
Energy for space cooling												2.5343 (108)
Total												64.4373 (109)
Target Fabric Energy Efficiency (TFEE)												74.1 (109)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3424	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2910	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	6.6000	6.2000	5.9000	5.1000	4.9000	4.6000	4.2000	4.3000	4.9000	5.4000	5.9000	5.7000	(22)
Wind factor	1.6500	1.5500	1.4750	1.2750	1.2250	1.1500	1.0500	1.0750	1.2250	1.3500	1.4750	1.4250	(22a)
Adj infilt rate	0.4802	0.4511	0.4293	0.3711	0.3565	0.3347	0.3056	0.3129	0.3565	0.3929	0.4293	0.4147	(22b)
Effective ac	0.6153	0.6017	0.5921	0.5688	0.5636	0.5560	0.5467	0.5489	0.5636	0.5772	0.5921	0.5860	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2000	7.0740	75.0000	2652.7500	(28b)
Main	57.3800	16.5900	40.7900	0.2300	9.3817	9.0000	367.1100	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			128.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	44.8166			(33)
Party Wall 1			17.3600	0.0000	0.0000	20.0000	347.2000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	4377.4900 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		123.7628 (35)
Thermal bridges (User defined value 0.061 * total exposed area)		7.8153 (36)
Total fabric heat loss	(33) + (36) =	52.6319 (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	21.9764	21.4924	21.1492	20.3173	20.1282	19.8588	19.5260	19.6063	20.1282	20.6151	21.1492	20.9299	(38)
Heat transfer coeff	74.6084	74.1243	73.7811	72.9492	72.7601	72.4907	72.1579	72.2383	72.7601	73.2470	73.7811	73.5618	(39)
Average = Sum(39)m / 12 =												73.2050	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1094	2.0957	2.0860	2.0625	2.0571	2.0495	2.0401	2.0424	2.0571	2.0709	2.0860	2.0798	(40)
HLP (average)												2.0697	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895 (42)
Average daily hot water use (litres/day)	64.8244 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0500	(48)

CALCULATION OF HEAT DEMAND 09 Jan 2014

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  Temperature factor from Table 2b                                                                                0.5400 (49)
Enter (49) or (54) in (55)                                                                                        0.5670 (55)
Total storage loss
              17.5770    15.8760    17.5770    17.0100    17.5770    17.0100    17.5770    17.5770    17.0100    17.5770    17.0100    17.5770 (56)
If cylinder contains dedicated solar storage
              17.5770    15.8760    17.5770    17.0100    17.5770    17.0100    17.5770    17.5770    17.0100    17.5770    17.0100    17.5770 (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
             146.5855   129.3734   136.2768   122.7267   120.6763   108.4151   104.6790   114.0963   113.6538   127.2329   133.8273   143.2488 (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
             146.5855   129.3734   136.2768   122.7267   120.6763   108.4151   104.6790   114.0963   113.6538   127.2329   133.8273   143.2488 (64)
                                                                                  Total per year (kWh/year) = Sum(64)m =   1500.7919 (64)
RHI water heating demand                                                                                          1501 (64)
Heat gains from water heating, kWh/month
              67.8321    60.2614    64.4045    59.2832    59.2173    54.5246    53.8982    57.0294    56.2664    61.3974    62.9741    66.7226 (65)
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5. Internal gains (see Table 5 and 5a)

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Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m         77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
              24.5364    21.7931    17.7233    13.4177    10.0299     8.4676     9.1496    11.8930    15.9627    20.2684    23.6562    25.2184 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
             164.3130   166.0181   161.7214   152.5743   141.0276   130.1755   122.9255   121.2205   125.5172   134.6643   146.2109   157.0631 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
              44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262 (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)
             -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780 (71)
Water heating gains (Table 5)
              91.1722    89.6747    86.5651    82.3377    79.5931    75.7286    72.4438    76.6525    78.1478    82.5233    87.4640    89.6810 (72)
Total internal gains
             352.8368   350.3010   338.8250   321.1448   303.4658   287.1868   277.3341   282.5811   292.4429   310.2711   330.1462   344.7776 (73)
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6. Solar gains

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[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
-----------------------------------------------------------------------------------------------------------------------------------
East                                    4.3300           19.0327            0.7200           0.7000           0.7700           28.7840 (76)
South                                   9.1400           46.2981            0.7200           0.7000           0.7700          147.7996 (78)
West                                    3.1200           19.0327            0.7200           0.7000           0.7700           20.7404 (80)
-----------------------------------------------------------------------------------------------------------------------------------

Solar gains  197.3240   339.6308   491.5717   618.5759   690.7157   658.1417   642.6356   597.9534   527.3562   379.4219   231.5438   166.7843 (83)
Total gains  550.1608   689.9318   830.3967   939.7207   994.1815   945.3285   919.9697   880.5344   819.7991   689.6930   561.6900   511.5619 (84)
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7. Mean internal temperature (heating season)

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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           16.2980    16.4045    16.4808    16.6687    16.7120    16.7741    16.8515    16.8328    16.7120    16.6009    16.4808    16.5299
alpha          2.0865     2.0936     2.0987     2.1112     2.1141     2.1183     2.1234     2.1222     2.1141     2.1067     2.0987     2.1020
util living area
               0.9012     0.8533     0.7865     0.7016     0.6094     0.5189     0.4312     0.4517     0.5838     0.7534     0.8688     0.9131 (86)

MIT           18.1252    18.5922    19.1844    19.7975    20.2753    20.6140    20.7986    20.7753    20.4901    19.7837    18.7938    18.0200 (87)
Th 2          19.9453    19.9522    19.9570    19.9688    19.9714    19.9753    19.9800    19.9788    19.9714    19.9646    19.9570    19.9601 (88)
util rest of house
               0.8912     0.8395     0.7673     0.6756     0.5748     0.4724     0.3743     0.3942     0.5380     0.7252     0.8542     0.9043 (89)
MIT 2         17.3211    17.7784    18.3516    18.9420    19.3871    19.6946    19.8523    19.8345    19.5908    18.9432    17.9876    17.2283 (90)
Living area fraction                                                                                fLA = Living area / (4) =     0.5900 (91)
MIT           17.7955    18.2586    18.8430    19.4468    19.9112    20.2371    20.4107    20.3896    20.1214    19.4391    18.4633    17.6954 (92)
Temperature adjustment                                                                                            0.0000
adjusted MIT  17.7955    18.2586    18.8430    19.4468    19.9112    20.2371    20.4107    20.3896    20.1214    19.4391    18.4633    17.6954 (93)
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8. Space heating requirement

```
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
Utilisation    0.8659     0.8131     0.7442     0.6613     0.5727     0.4847     0.3990     0.4180     0.5451     0.7092     0.8291     0.8801 (94)
Useful gains 476.3600   560.9792   618.0063   621.4178   569.3620   458.2298   367.0730   368.0976   446.8438   489.1542   465.7044   450.2068 (95)
Ext temp.      3.1000     3.6000     5.0000     7.2000     9.8000    12.7000    14.7000    14.6000    12.4000     9.1000     5.7000     2.9000 (96)
Heat loss rate W
            1096.4094  1086.5562  1021.3495   893.3926   735.6914   546.3676   412.0699   418.2341   561.8108   757.3104   941.6914  1088.3774 (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
             461.3168   353.1877   300.0873   195.8219   123.7491     0.0000     0.0000     0.0000     0.0000   199.5082   342.7106   474.7990 (98)
Space heating                                                                                                    2451.1806 (98)
RHI space heating demand                                                                                            2451 (98)
```

CALCULATION OF ENERGY RATINGS 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3424	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2910	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3711	0.3638	0.3565	0.3201	0.3129	0.2765	0.2765	0.2692	0.2910	0.3129	0.3274	0.3420	(22b)
Effective ac	0.5688	0.5662	0.5636	0.5512	0.5489	0.5382	0.5382	0.5362	0.5424	0.5489	0.5536	0.5585	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2000	7.0740	75.0000	2652.7500	(28b)
Main	57.3800	16.5900	40.7900	0.2300	9.3817	9.0000	367.1100	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			128.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	44.8166			(33)
Party Wall 1			17.3600	0.0000	0.0000	20.0000	347.2000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	4377.4900 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		123.7628 (35)
Thermal bridges (User defined value 0.061 * total exposed area)		7.8153 (36)
Total fabric heat loss	(33) + (36) =	52.6319 (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	20.3173	20.2218	20.1282	19.6886	19.6063	19.2235	19.2235	19.1526	19.3709	19.6063	19.7727	19.9467	(38)
Heat transfer coeff	72.9492	72.8537	72.7601	72.3205	72.2383	71.8554	71.8554	71.7845	72.0029	72.2383	72.4047	72.5786	(39)
Average = Sum(39)m / 12 =												72.3201	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.0625	2.0598	2.0571	2.0447	2.0424	2.0315	2.0315	2.0295	2.0357	2.0424	2.0471	2.0520	(40)
HLP (average)												2.0447	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895 (42)
Average daily hot water use (litres/day)	64.8244 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)

Water storage loss:	
Store volume	125.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):	1.0500 (48)

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.5670	(55)
Total storage loss													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(56)
If cylinder contains dedicated solar storage													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(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													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(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													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
								Total per year (kWh/year) = Sum(64)m =				1500.7919	(64)
Heat gains from water heating, kWh/month													
	67.8321	60.2614	64.4045	59.2832	59.2173	54.5246	53.8982	57.0294	56.2664	61.3974	62.9741	66.7226	(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	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.5364	21.7931	17.7233	13.4177	10.0299	8.4676	9.1496	11.8930	15.9627	20.2684	23.6562	25.2184	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	164.3130	166.0181	161.7214	152.5743	141.0276	130.1755	122.9255	121.2205	125.5172	134.6643	146.2109	157.0631	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	91.1722	89.6747	86.5651	82.3377	79.5931	75.7286	72.4438	76.6525	78.1478	82.5233	87.4640	89.6810	(72)
Total internal gains													
	352.8368	350.3010	338.8250	321.1448	303.4658	287.1868	277.3341	282.5811	292.4429	310.2711	330.1462	344.7776	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.3300	19.6403	0.7200	0.7000	0.7700	29.7029	(76)
South	9.1400	46.7521	0.7200	0.7000	0.7700	149.2488	(78)
West	3.1200	19.6403	0.7200	0.7000	0.7700	21.4026	(80)

Solar gains	200.3542	344.4042	476.0033	592.0262	660.9841	654.1505	631.6077	581.2134	516.7390	382.2683	240.6332	170.9913	(83)
Total gains	553.1910	694.7052	814.8283	913.1710	964.4499	941.3373	908.9418	863.7945	809.1819	692.5395	570.7794	515.7689	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	16.6687	16.6906	16.7120	16.8136	16.8328	16.9225	16.9225	16.9392	16.8878	16.8328	16.7941	16.7538	
alpha	2.1112	2.1127	2.1141	2.1209	2.1222	2.1282	2.1282	2.1293	2.1259	2.1222	2.1196	2.1169	
util living area													
	0.8872	0.8323	0.7614	0.6650	0.5516	0.4277	0.3230	0.3502	0.5066	0.7069	0.8432	0.8998	(86)
MIT	18.4817	18.9399	19.4936	20.0689	20.5135	20.8001	20.9211	20.9034	20.6972	20.0897	19.1753	18.3790	(87)
Th 2	19.9688	19.9701	19.9714	19.9777	19.9788	19.9842	19.9842	19.9852	19.9821	19.9788	19.9765	19.9740	(88)
util rest of house													
	0.8755	0.8161	0.7391	0.6342	0.5099	0.3721	0.2555	0.2817	0.4508	0.6722	0.8251	0.8892	(89)
MIT 2	17.6884	18.1309	18.6614	19.2057	19.6090	19.8565	19.9461	19.9363	19.7775	19.2415	18.3734	17.5924	(90)
Living area fraction										fLA = Living area / (4) =		0.5900	(91)
MIT	18.1565	18.6082	19.1525	19.7150	20.1427	20.4133	20.5214	20.5069	20.3202	19.7420	18.8466	18.0565	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1565	18.6082	19.1525	19.7150	20.1427	20.4133	20.5214	20.5069	20.3202	19.7420	18.8466	18.0565	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8502	0.7911	0.7193	0.6257	0.5168	0.3962	0.2918	0.3177	0.4701	0.6634	0.8016	0.8646	(94)
Useful gains	470.3490	549.6039	586.0785	571.3378	498.4669	372.9648	265.2700	274.4217	380.3800	459.4480	457.5355	445.9355	(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													
	1010.8224	998.6959	920.5940	782.1494	609.8855	417.7179	281.7731	294.8130	447.8712	660.4007	850.5082	1005.6882	(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													
	402.1122	301.7898	248.8796	151.7844	82.8954	0.0000	0.0000	0.0000	0.0000	149.5088	282.9404	416.4560	(98)
Space heating												2036.3666	(98)
Space heating per m2											(98) / (4) =	57.5733	(99)

8c. Space cooling requirement

CALCULATION OF ENERGY RATINGS 09 Jan 2014

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)	0.0000	(201)
Fraction of space heat from main system(s)	1.0000	(202)
Efficiency of main space heating system 1 (in %)	175.1000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1162.9735	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	402.1122	301.7898	248.8796	151.7844	82.8954	0.0000	0.0000	0.0000	0.0000	149.5088	282.9404	416.4560	(98)
Space heating efficiency (main heating system 1)	175.1000	175.1000	175.1000	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175.1000	175.1000	(210)
Space heating fuel (main heating system)	229.6472	172.3528	142.1357	86.6844	47.3417	0.0000	0.0000	0.0000	0.0000	85.3848	161.5879	237.8390	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
Efficiency of water heater												175.1000	(216)
(217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(217)
Fuel for water heating, kWh/month	83.7153	73.8854	77.8280	70.0895	68.9185	61.9161	59.7824	65.1607	64.9080	72.6630	76.4290	81.8097	(219)
Water heating fuel used												857.1056	(219)
Annual totals kWh/year													
Space heating fuel - main system												1162.9735	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
Total electricity for the above, kWh/year												30.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Total delivered energy for all uses												2223.4076	(238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1162.9735	13.1900	153.3962	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	857.1056	13.1900	113.0522	(247)
Pumps and fans for heating	30.0000	13.1900	3.9570	(249)
Energy for lighting	173.3285	13.1900	22.8620	(250)
Additional standing charges			0.0000	(251)
Total energy cost			293.2675	(255)

11a. SAP rating - Individual heating systems

Energy cost deflator (Table 12):		0.4200	(256)
Energy cost factor (ECF)	[(255) x (256)] / [(4) + 45.0] =	1.5326	(257)
SAP value		78.6207	
SAP rating (Section 12)		79	(258)
SAP band		C	

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	1162.9735	0.5190	603.5832	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	857.1056	0.5190	444.8378	(264)
Space and water heating			1048.4210	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Total kg/year			1153.9485	(272)
CO2 emissions per m2			32.6300	(273)
EI value			80.7603	
EI rating			81	(274)
EI band			B	

Calculation of stars for heating and DHW

Main heating energy efficiency	13.19 × (1 + 0.29 × 0.00) / 1.7510 = 7.533, stars = 2
Main heating environmental impact	0.519 × (1 + 0.29 × 0.00) / 1.7510 = 0.2964, stars = 4
Water heating energy efficiency	13.19 / 1.7510 = 7.533, stars = 2
Water heating environmental impact	0.519 / 1.7510 = 0.2964, stars = 4

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3424	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2910	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	6.6000	6.2000	5.9000	5.1000	4.9000	4.6000	4.2000	4.3000	4.9000	5.4000	5.9000	5.7000	(22)
Wind factor	1.6500	1.5500	1.4750	1.2750	1.2250	1.1500	1.0500	1.0750	1.2250	1.3500	1.4750	1.4250	(22a)
Adj infilt rate	0.4802	0.4511	0.4293	0.3711	0.3565	0.3347	0.3056	0.3129	0.3565	0.3929	0.4293	0.4147	(22b)
Effective ac	0.6153	0.6017	0.5921	0.5688	0.5636	0.5560	0.5467	0.5489	0.5636	0.5772	0.5921	0.5860	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2000	7.0740	75.0000	2652.7500	(28b)
Main	57.3800	16.5900	40.7900	0.2300	9.3817	9.0000	367.1100	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			128.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	44.8166			(33)
Party Wall 1			17.3600	0.0000	0.0000	20.0000	347.2000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		4377.4900	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							123.7628	(35)
Thermal bridges (User defined value 0.061 * total exposed area)							7.8153	(36)
Total fabric heat loss					(33) + (36) =		52.6319	(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	21.9764	21.4924	21.1492	20.3173	20.1282	19.8588	19.5260	19.6063	20.1282	20.6151	21.1492	20.9299	(38)
Heat transfer coeff	74.6084	74.1243	73.7811	72.9492	72.7601	72.4907	72.1579	72.2383	72.7601	73.2470	73.7811	73.5618	(39)
Average = Sum(39)m / 12 =												73.2050	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1094	2.0957	2.0860	2.0625	2.0571	2.0495	2.0401	2.0424	2.0571	2.0709	2.0860	2.0798	(40)
HLP (average)												2.0697	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895	(42)
Average daily hot water use (litres/day)	64.8244	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0500	(48)

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

Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.5670	(55)
Total storage loss													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(56)
If cylinder contains dedicated solar storage													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(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													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(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													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
								Total per year (kWh/year) = Sum(64)m =				1500.7919	(64)
Heat gains from water heating, kWh/month													
	67.8321	60.2614	64.4045	59.2832	59.2173	54.5246	53.8982	57.0294	56.2664	61.3974	62.9741	66.7226	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.5364	21.7931	17.7233	13.4177	10.0299	8.4676	9.1496	11.8930	15.9627	20.2684	23.6562	25.2184	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	164.3130	166.0181	161.7214	152.5743	141.0276	130.1755	122.9255	121.2205	125.5172	134.6643	146.2109	157.0631	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	91.1722	89.6747	86.5651	82.3377	79.5931	75.7286	72.4438	76.6525	78.1478	82.5233	87.4640	89.6810	(72)
Total internal gains													
	352.8368	350.3010	338.8250	321.1448	303.4658	287.1868	277.3341	282.5811	292.4429	310.2711	330.1462	344.7776	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.3300	19.0327	0.7200	0.7000	0.7700	28.7840	(76)
South	9.1400	46.2981	0.7200	0.7000	0.7700	147.7996	(78)
West	3.1200	19.0327	0.7200	0.7000	0.7700	20.7404	(80)

Solar gains	197.3240	339.6308	491.5717	618.5759	690.7157	658.1417	642.6356	597.9534	527.3562	379.4219	231.5438	166.7843	(83)
Total gains	550.1608	689.9318	830.3967	939.7207	994.1815	945.3285	919.9697	880.5344	819.7991	689.6930	561.6900	511.5619	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	16.2980	16.4045	16.4808	16.6687	16.7120	16.7741	16.8515	16.8328	16.7120	16.6009	16.4808	16.5299	
alpha	2.0865	2.0936	2.0987	2.1112	2.1141	2.1183	2.1234	2.1222	2.1141	2.1067	2.0987	2.1020	
util living area													
	0.9012	0.8533	0.7865	0.7016	0.6094	0.5189	0.4312	0.4517	0.5838	0.7534	0.8688	0.9131	(86)
MIT	18.1252	18.5922	19.1844	19.7975	20.2753	20.6140	20.7986	20.7753	20.4901	19.7837	18.7938	18.0200	(87)
Th 2	19.9453	19.9522	19.9570	19.9688	19.9714	19.9753	19.9800	19.9788	19.9714	19.9646	19.9570	19.9601	(88)
util rest of house													
	0.8912	0.8395	0.7673	0.6756	0.5748	0.4724	0.3743	0.3942	0.5380	0.7252	0.8542	0.9043	(89)
MIT 2	17.3211	17.7784	18.3516	18.9420	19.3871	19.6946	19.8523	19.8345	19.5908	18.9432	17.9876	17.2283	(90)
Living area fraction										fLA = Living area / (4) =		0.5900	(91)
MIT	17.7955	18.2586	18.8430	19.4468	19.9112	20.2371	20.4107	20.3896	20.1214	19.4391	18.4633	17.6954	(92)
Temperature adjustment												0.0000	
adjusted MIT	17.7955	18.2586	18.8430	19.4468	19.9112	20.2371	20.4107	20.3896	20.1214	19.4391	18.4633	17.6954	(93)

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8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8659	0.8131	0.7442	0.6613	0.5727	0.4847	0.3990	0.4180	0.5451	0.7092	0.8291	0.8801	(94)
Useful gains	476.3600	560.9792	618.0063	621.4178	569.3620	458.2298	367.0730	368.0976	446.8438	489.1542	465.7044	450.2068	(95)
Ext temp.	3.1000	3.6000	5.0000	7.2000	9.8000	12.7000	14.7000	14.6000	12.4000	9.1000	5.7000	2.9000	(96)
Heat loss rate W													
	1096.4094	1086.5562	1021.3495	893.3926	735.6914	546.3676	412.0699	418.2341	561.8108	757.3104	941.6914	1088.3774	(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													
	461.3168	353.1877	300.0873	195.8219	123.7491	0.0000	0.0000	0.0000	0.0000	199.5082	342.7106	474.7990	(98)
Space heating												2451.1806	(98)
Space heating per m2											(98) / (4) =	69.3011	(99)

8c. Space cooling requirement

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

Not applicable

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

Fraction of space heat from secondary/supplementary system (Table 11)												0.0000	(201)
Fraction of space heat from main system(s)												1.0000	(202)
Efficiency of main space heating system 1 (in %)												175.1000	(206)
Efficiency of secondary/supplementary heating system, %												0.0000	(208)
Space heating requirement												1399.8747	(211)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement													
	461.3168	353.1877	300.0873	195.8219	123.7491	0.0000	0.0000	0.0000	0.0000	199.5082	342.7106	474.7990	(98)
Space heating efficiency (main heating system 1)													
	175.1000	175.1000	175.1000	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175.1000	175.1000	(210)
Space heating fuel (main heating system)													
	263.4590	201.7063	171.3805	111.8343	70.6734	0.0000	0.0000	0.0000	0.0000	113.9396	195.7228	271.1588	(211)
Water heating requirement													
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement													
	146.5855	129.3734	136.2768	122.7267	120.6763	108.4151	104.6790	114.0963	113.6538	127.2329	133.8273	143.2488	(64)
Efficiency of water heater												175.1000	(216)
(217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(217)
Fuel for water heating, kWh/month													
	83.7153	73.8854	77.8280	70.0895	68.9185	61.9161	59.7824	65.1607	64.9080	72.6630	76.4290	81.8097	(219)
Water heating fuel used												857.1056	(219)
Annual totals kWh/year													
Space heating fuel - main system												1399.8747	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
Total electricity for the above, kWh/year												30.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Total delivered energy for all uses												2460.3088	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1399.8747	18.7000	261.7766	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	857.1056	18.7000	160.2787	(247)
Pumps and fans for heating	30.0000	18.7000	5.6100	(249)
Energy for lighting	173.3285	18.7000	32.4124	(250)
Additional standing charges			0.0000	(251)
Total energy cost			460.0777	(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	1399.8747	0.5190	726.5350	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	857.1056	0.5190	444.8378	(264)
Space and water heating			1171.3728	(265)
Pumps and fans	30.0000	0.5190	15.5700	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Total kg/year			1276.9003	(272)

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

	Energy kWh/year	Primary energy factor kg CO2/kWh	Primary energy kWh/year	
Space heating - main system 1	1399.8747	3.0700	4297.6153	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	857.1056	3.0700	2631.3142	(264)
Space and water heating			6928.9294	(265)
Pumps and fans	30.0000	3.0700	92.1000	(267)
Energy for lighting	173.3285	3.0700	532.1186	(268)
Primary energy kWh/year			7553.1480	(272)
Primary energy kWh/m2/year			213.5467	(273)

SAP 2012 EPC IMPROVEMENTS

Current energy efficiency rating: C 79
Current environmental impact rating: B 81

(For testing purposes):

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

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

Recommended measures:	SAP change	Cost change	CO2 change
N Solar water heating	+ 3.6	-£ 71	-196 kg (15.4%)
U Solar photovoltaic panels	+ 16.6	-£ 326	-906 kg (83.8%)

	Typical annual savings		Energy efficiency	Environmental impact
Recommended measures				
Solar water heating	£71	5.55 kg/m²	B 82	B 84
Solar photovoltaic panels	£326	25.62 kg/m²	A 99	A 99
Total Savings	£397	31.16 kg/m²		

Potential energy efficiency rating: A 99
Potential environmental impact rating: A 99

Fuel prices for cost data on this page from database revision number 465 TEST (04 Sep 2020)
Recommendation texts revision number 4.9c (22 Feb 2014)

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

	Current	Potential	Saving
Electricity	£460	£389	£71
Space heating	£267	£268	-£0
Water heating	£160	£89	£71
Lighting	£32	£32	£0
Generated (PV)	-£0	-£326	£326
Total cost of fuels	£460	£63	£397
Total cost of uses	£459	£63	£397
Delivered energy	70 kWh/m²	10 kWh/m²	60 kWh/m²
Carbon dioxide emissions	1.3 tonnes	0.2 tonnes	1.1 tonnes
CO2 emissions per m²	36 kg/m²	5 kg/m²	31 kg/m²
Primary energy	214 kWh/m²	29 kWh/m²	184 kWh/m²

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3424	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2910	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	5.1000	5.0000	4.9000	4.4000	4.3000	3.8000	3.8000	3.7000	4.0000	4.3000	4.5000	4.7000	(22)
Wind factor	1.2750	1.2500	1.2250	1.1000	1.0750	0.9500	0.9500	0.9250	1.0000	1.0750	1.1250	1.1750	(22a)
Adj infilt rate	0.3711	0.3638	0.3565	0.3201	0.3129	0.2765	0.2765	0.2692	0.2910	0.3129	0.3274	0.3420	(22b)
Effective ac	0.5688	0.5662	0.5636	0.5512	0.5489	0.5382	0.5382	0.5362	0.5424	0.5489	0.5536	0.5585	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2000	7.0740	75.0000	2652.7500	(28b)
Main	57.3800	16.5900	40.7900	0.2300	9.3817	9.0000	367.1100	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			128.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	44.8166			(33)
Party Wall 1			17.3600	0.0000	0.0000	20.0000	347.2000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)

Heat capacity Cm = Sum(A x k)	(28)...(30) + (32) + (32a)...(32e) =	4377.4900 (34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K		123.7628 (35)
Thermal bridges (User defined value 0.061 * total exposed area)		7.8153 (36)
Total fabric heat loss	(33) + (36) =	52.6319 (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	20.3173	20.2218	20.1282	19.6886	19.6063	19.2235	19.2235	19.1526	19.3709	19.6063	19.7727	19.9467	(38)
Heat transfer coeff	72.9492	72.8537	72.7601	72.3205	72.2383	71.8554	71.8554	71.7845	72.0029	72.2383	72.4047	72.5786	(39)
Average = Sum(39)m / 12 =												72.3201	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.0625	2.0598	2.0571	2.0447	2.0424	2.0315	2.0315	2.0295	2.0357	2.0424	2.0471	2.0520	(40)
HLP (average)												2.0447	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895 (42)
Average daily hot water use (litres/day)	64.8244 (43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)

Water storage loss:	
Store volume	125.0000 (47)
a) If manufacturer declared loss factor is known (kWh/day):	1.0500 (48)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Temperature factor from Table 2b												0.5400	(49)
Enter (49) or (54) in (55)												0.5670	(55)
Total storage loss													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(56)
If cylinder contains dedicated solar storage													
	17.5770	15.8760	17.5770	17.0100	17.5770	17.0100	17.5770	17.5770	17.0100	17.5770	17.0100	17.5770	(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													
	146.5855	129.3734	134.8811	115.9731	107.8819	95.8084	91.6521	101.9999	108.2509	125.8372	133.8273	143.2488	(62)
Aperture area of solar collector												3.0000	(H1)
Zero-loss collector efficiency												0.7000	(H2)
Collector heat loss coefficient												1.8000	(H3)
Collector 2nd order heat loss coefficient												0.0050	(H3a)
Collector effective heat loss coefficient												1.8063	(H3b)
Collector performance ratio												2.5804	(H4)
Annual solar radiation per m2												1079.5246	(H5)
Overshading factor												0.8000	(H6)
Solar energy available												1813.6014	(H7)
Adjustment factor for showers												1.0000	(H7a)
Solar-to-load ratio												1.7781	(H8)
Utilisation factor												0.4302	(H9)
Collector performance factor												0.8793	(H10)
Dedicated solar storage volume												75.0000	(H11)
Effective solar volume												75.0000	(H13)
Daily hot water demand												64.8244	(H14)
Volume ratio Veff/V												1.1570	(H15)
Solar storage volume factor												1.0000	(H16)
Solar input												-685.9569	(H17)
Solar input	-19.8914	-33.1930	-56.5315	-75.7633	-93.5992	-92.0229	-90.8068	-79.3384	-62.1378	-42.4328	-23.5940	-16.6457	(63)
								Solar input (sum of months) = Sum(63)m =				-685.9569	(63)
Output from w/h													
	126.6941	96.1804	78.3496	40.2098	14.2827	3.7855	0.8453	22.6615	46.1131	83.4043	110.2332	126.6031	(64)
								Total per year (kWh/year) = Sum(64)m =				749.3626	(64)
Heat gains from water heating, kWh/month													
	67.8321	60.2614	63.2879	53.8803	48.9818	44.4392	43.4766	47.3523	51.9441	60.2808	62.9741	66.7226	(65)

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

Metabolic gains (Table 5), Watts	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(66)m	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	77.3670	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
	24.5364	21.7931	17.7233	13.4177	10.0299	8.4676	9.1496	11.8930	15.9627	20.2684	23.6562	25.2184	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
	164.3130	166.0181	161.7214	152.5743	141.0276	130.1755	122.9255	121.2205	125.5172	134.6643	146.2109	157.0631	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	44.0262	(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)													
	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	-51.5780	(71)
Water heating gains (Table 5)													
	91.1722	89.6747	85.0643	74.8337	65.8358	61.7211	58.4363	63.6455	72.1446	81.0225	87.4640	89.6810	(72)
Total internal gains													
	352.8368	350.3010	337.3242	313.6408	289.7085	273.1794	263.3266	269.5742	286.4397	308.7703	330.1462	344.7776	(73)

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6. Solar gains

[Jan]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Access factor Table 6d	Gains W	
East	4.3300	19.6403	0.7200	0.7000	0.7700	29.7029	(76)
South	9.1400	46.7521	0.7200	0.7000	0.7700	149.2488	(78)
West	3.1200	19.6403	0.7200	0.7000	0.7700	21.4026	(80)

Solar gains	200.3542	344.4042	476.0033	592.0262	660.9841	654.1505	631.6077	581.2134	516.7390	382.2683	240.6332	170.9913	(83)
Total gains	553.1910	694.7052	813.3275	905.6670	950.6926	927.3299	894.9343	850.7876	803.1787	691.0387	570.7794	515.7689	(84)

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7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1 (C)												21.0000	(85)
Utilisation factor for gains for living area, nil,m (see Table 9a)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
tau	16.6687	16.6906	16.7120	16.8136	16.8328	16.9225	16.9225	16.9392	16.8878	16.8328	16.7941	16.7538	
alpha	2.1112	2.1127	2.1141	2.1209	2.1222	2.1282	2.1282	2.1293	2.1259	2.1222	2.1196	2.1169	
util living area													
	0.8872	0.8323	0.7620	0.6678	0.5567	0.4327	0.3273	0.3547	0.5092	0.7076	0.8432	0.8998	(86)
MIT	18.4817	18.9399	19.4912	20.0605	20.5042	20.7955	20.9190	20.9009	20.6940	20.0877	19.1753	18.3790	(87)
Th 2	19.9688	19.9701	19.9714	19.9777	19.9788	19.9842	19.9842	19.9852	19.9821	19.9788	19.9765	19.9740	(88)
util rest of house													
	0.8755	0.8161	0.7397	0.6371	0.5150	0.3767	0.2591	0.2856	0.4534	0.6730	0.8251	0.8892	(89)
MIT 2	17.6884	18.1309	18.6592	19.1983	19.6015	19.8534	19.9450	19.9349	19.7752	19.2398	18.3734	17.5924	(90)
Living area fraction									fLA = Living area / (4) =			0.5900	(91)
MIT	18.1565	18.6082	19.1501	19.7071	20.1342	20.4093	20.5197	20.5049	20.3174	19.7401	18.8466	18.0565	(92)
Temperature adjustment												0.0000	
adjusted MIT	18.1565	18.6082	19.1501	19.7071	20.1342	20.4093	20.5197	20.5049	20.3174	19.7401	18.8466	18.0565	(93)

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8. Space heating requirement

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8502	0.7911	0.7198	0.6283	0.5216	0.4008	0.2958	0.3218	0.4725	0.6641	0.8016	0.8646	(94)
Useful gains	470.3490	549.6039	585.4325	569.0561	495.8945	371.6741	264.7112	273.7661	379.5115	458.9212	457.5355	445.9355	(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	1010.8224	998.6959	920.4235	781.5723	609.2692	417.4266	281.6509	294.6687	447.6682	660.2653	850.5082	1005.6882	(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	402.1122	301.7898	249.2333	153.0116	84.3508	0.0000	0.0000	0.0000	0.0000	149.8001	282.9404	416.4560	(98)

Space heating 2039.6942 (98)
Space heating per m2 (98) / (4) = 57.6674 (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 %) 175.1000 (206)
Efficiency of secondary/supplementary heating system, % 0.0000 (208)
Space heating requirement 1164.8739 (211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	402.1122	301.7898	249.2333	153.0116	84.3508	0.0000	0.0000	0.0000	0.0000	149.8001	282.9404	416.4560	(98)
Space heating efficiency (main heating system 1)	175.1000	175.1000	175.1000	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175.1000	175.1000	(210)
Space heating fuel (main heating system)	229.6472	172.3528	142.3377	87.3853	48.1729	0.0000	0.0000	0.0000	0.0000	85.5512	161.5879	237.8390	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	126.6941	96.1804	78.3496	40.2098	14.2827	3.7855	0.8453	22.6615	46.1131	83.4043	110.2332	126.6031	(64)
Efficiency of water heater												175.1000	(216)
(217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(217)
Fuel for water heating, kWh/month	72.3553	54.9288	44.7456	22.9639	8.1569	2.1619	0.4827	12.9420	26.3353	47.6324	62.9544	72.3033	(219)

Water heating fuel used 427.9626 (219)
Annual totals kWh/year
Space heating fuel - main system 1164.8739 (211)
Space heating fuel - secondary 0.0000 (215)

Electricity for pumps and fans:
central heating pump 30.0000 (230c)
pump for solar water heating 50.0000 (230g)
Total electricity for the above, kWh/year 80.0000 (231)
Electricity for lighting (calculated in Appendix L) 173.3285 (232)

Energy saving/generation technologies (Appendices M ,N and Q)
PV Unit 0 (0.80 * 2.50 * 1080 * 0.80) = -1727.2394 -1727.2394 (233)
Total delivered energy for all uses 118.9257 (238)

10a. Fuel costs - using Table 12 prices

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1164.8739	13.1900	153.6469	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	427.9626	13.1900	56.4483	(247)
Pumps and fans for heating	30.0000	13.1900	3.9570	(249)
Pump for solar water heating	50.0000	13.1900	6.5950	(249)
Energy for lighting	173.3285	13.1900	22.8620	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-1727.2394	13.1900	-227.8229	(252)
Total energy cost			15.6863	(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] = 0.0820 (257)
SAP value 98.8565
SAP rating (Section 12) 99 (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	1164.8739	0.5190	604.5696	(261)

CALCULATION OF ENERGY RATINGS FOR IMPROVED DWELLING 09 Jan 2014

Space heating - secondary	0.0000	0.0000	0.0000 (263)
Water heating (other fuel)	427.9626	0.5190	222.1126 (264)
Space and water heating			826.6822 (265)
Pumps and fans	80.0000	0.5190	41.5200 (267)
Energy for lighting	173.3285	0.5190	89.9575 (268)
Energy saving/generation technologies			
PV Unit	-1727.2394	0.5190	-896.4372 (269)
Total kg/year			61.7224 (272)
CO2 emissions per m2			1.7500 (273)
EI value			98.9709
EI rating			99 (274)
EI band			A

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

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

1. Overall dwelling dimensions

	Area (m2)		Storey height (m)		Volume (m3)	
Ground floor	35.3700 (1b)	x	3.0600 (2b)	=	108.2322	(1b) - (3b)
Total floor area TFA = (1a)+(1b)+(1c)+(1d)+(1e)...(1n)	35.3700					(4)
Dwelling volume			(3a)+(3b)+(3c)+(3d)+(3e)...(3n)	=	108.2322	(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							1 * 10 =	10.0000	(7a)
Number of passive vents							0 * 10 =	0.0000	(7b)
Number of flueless gas fires							0 * 40 =	0.0000	(7c)

		Air changes per hour	
Infiltration due to chimneys, flues and fans = (6a)+(6b)+(7a)+(7b)+(7c) =	10.0000 / (5) =	0.0924	(8)
Pressure test		Yes	
Measured/design AP50		5.0000	
Infiltration rate		0.3424	(18)
Number of sides sheltered		2	(19)
Shelter factor	(20) = 1 - [0.075 x (19)] =	0.8500	(20)
Infiltration rate adjusted to include shelter factor	(21) = (18) x (20) =	0.2910	(21)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Wind speed	6.6000	6.2000	5.9000	5.1000	4.9000	4.6000	4.2000	4.3000	4.9000	5.4000	5.9000	5.7000	(22)
Wind factor	1.6500	1.5500	1.4750	1.2750	1.2250	1.1500	1.0500	1.0750	1.2250	1.3500	1.4750	1.4250	(22a)
Adj infilt rate	0.4802	0.4511	0.4293	0.3711	0.3565	0.3347	0.3056	0.3129	0.3565	0.3929	0.4293	0.4147	(22b)
Effective ac	0.6153	0.6017	0.5921	0.5688	0.5636	0.5560	0.5467	0.5489	0.5636	0.5772	0.5921	0.5860	(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	
Window (Uw = 1.40)			16.5900	1.3258	21.9943			(27)
GF			35.3700	0.2000	7.0740	75.0000	2652.7500	(28b)
Main	57.3800	16.5900	40.7900	0.2300	9.3817	9.0000	367.1100	(29a)
Flat	35.3700		35.3700	0.1800	6.3666	9.0000	318.3300	(30)
Total net area of external elements Aum(A, m2)			128.1200					(31)
Fabric heat loss, W/K = Sum (A x U)				(26)...(30) + (32) =	44.8166			(33)
Party Wall 1			17.3600	0.0000	0.0000	20.0000	347.2000	(32)
Internal Wall 1			76.9000			9.0000	692.1000	(32c)
Heat capacity Cm = Sum(A x k)					(28)...(30) + (32) + (32a)...(32e) =		4377.4900	(34)
Thermal mass parameter (TMP = Cm / TFA) in kJ/m2K							123.7628	(35)
Thermal bridges (User defined value 0.061 * total exposed area)							7.8153	(36)
Total fabric heat loss					(33) + (36) =		52.6319	(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	21.9764	21.4924	21.1492	20.3173	20.1282	19.8588	19.5260	19.6063	20.1282	20.6151	21.1492	20.9299	(38)
Heat transfer coeff	74.6084	74.1243	73.7811	72.9492	72.7601	72.4907	72.1579	72.2383	72.7601	73.2470	73.7811	73.5618	(39)
Average = Sum(39)m / 12 =												73.2050	(39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
HLP	2.1094	2.0957	2.0860	2.0625	2.0571	2.0495	2.0401	2.0424	2.0571	2.0709	2.0860	2.0798	(40)
HLP (average)												2.0697	(40)
Days in month	31	28	31	30	31	30	31	31	30	31	30	31	(41)

4. Water heating energy requirements (kWh/year)

Assumed occupancy	1.2895	(42)
Average daily hot water use (litres/day)	64.8244	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Daily hot water use	71.3069	68.7139	66.1209	63.5280	60.9350	58.3420	58.3420	60.9350	63.5280	66.1209	68.7139	71.3069	(44)
Energy conte	105.7461	92.4862	95.4374	83.2047	79.8369	68.8931	63.8396	73.2569	74.1318	86.3935	94.3053	102.4094	(45)
Energy content (annual)										Total = Sum(45)m =		1019.9409	(45)
Distribution loss (46)m = 0.15 x (45)m	15.8619	13.8729	14.3156	12.4807	11.9755	10.3340	9.5759	10.9885	11.1198	12.9590	14.1458	15.3614	(46)
Water storage loss:													
Store volume												125.0000	(47)
a) If manufacturer declared loss factor is known (kWh/day):												1.0500	(48)

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

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  Temperature factor from Table 2b                                                                                0.5400 (49)
Enter (49) or (54) in (55)                                                                                        0.5670 (55)
Total storage loss
               17.5770    15.8760    17.5770    17.0100    17.5770    17.0100    17.5770    17.5770    17.0100    17.5770    17.0100    17.5770 (56)
If cylinder contains dedicated solar storage
               17.5770    15.8760    17.5770    17.0100    17.5770    17.0100    17.5770    17.5770    17.0100    17.5770    17.0100    17.5770 (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
              146.5855   129.3734   134.8811   115.9731   107.8819    95.8084    91.6521   101.9999   108.2509   125.8372   133.8273   143.2488 (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                                                                                  1091.0709 (H5)
Overshading factor                                                                                                0.8000 (H6)
Solar energy available                                                                                         1832.9992 (H7)
Adjustment factor for showers                                                                                     1.0000 (H7a)
Solar-to-load ratio                                                                                               1.7972 (H8)
Utilisation factor                                                                                                0.4267 (H9)
Collector performance factor                                                                                      0.8793 (H10)
Dedicated solar storage volume                                                                                   75.0000 (H11)
Effective solar volume                                                                                           75.0000 (H13)
Daily hot water demand                                                                                           64.8244 (H14)
Volume ratio Veff/V                                                                                               1.1570 (H15)
Solar storage volume factor                                                                                       1.0000 (H16)
Solar input                                                                                                    -687.8113 (H17)
Solar input    -19.2686   -32.1683   -57.3554   -77.8632   -96.3853   -91.3308   -91.0993   -80.3442   -62.3188   -41.3797   -22.3236   -15.9741 (63)
                                                                    Solar input (sum of months) = Sum(63)m =   -687.8113 (63)
Output from w/h
              127.3169    97.2050    77.5257    38.1099    11.4966     4.4776     0.5528    21.6557    45.9322    84.4575   111.5037   127.2747 (64)
                                                                     Total per year (kWh/year) = Sum(64)m =    747.5082 (64)
Heat gains from water heating, kWh/month
               67.8321    60.2614    63.2879    53.8803    48.9818    44.4392    43.4766    47.3523    51.9441    60.2808    62.9741    66.7226 (65)
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5. Internal gains (see Table 5 and 5a)

```
Metabolic gains (Table 5), Watts
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
(66)m          77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670    77.3670 (66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5
               24.5364    21.7931    17.7233    13.4177    10.0299     8.4676     9.1496    11.8930    15.9627    20.2684    23.6562    25.2184 (67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5
              164.3130   166.0181   161.7214   152.5743   141.0276   130.1755   122.9255   121.2205   125.5172   134.6643   146.2109   157.0631 (68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5
               44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262    44.0262 (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)
              -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780   -51.5780 (71)
Water heating gains (Table 5)
               91.1722    89.6747    85.0643    74.8337    65.8358    61.7211    58.4363    63.6455    72.1446    81.0225    87.4640    89.6810 (72)
Total internal gains
              352.8368   350.3010   337.3242   313.6408   289.7085   273.1794   263.3266   269.5742   286.4397   308.7703   330.1462   344.7776 (73)
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6. Solar gains

```
[Jan]                                    Area          Solar flux              g                FF            Access            Gains
                                          m2           Table 6a      Specific data      Specific data       factor                W
                                                          W/m2        or Table 6b        or Table 6c      Table 6d
-------------------------------------------------------------------------------------------------------------------
East                                    4.3300           19.0327            0.7200             0.7000            0.7700           28.7840 (76)
South                                   9.1400           46.2981            0.7200             0.7000            0.7700          147.7996 (78)
West                                    3.1200           19.0327            0.7200             0.7000            0.7700           20.7404 (80)
-------------------------------------------------------------------------------------------------------------------

Solar gains   197.3240   339.6308   491.5717   618.5759   690.7157   658.1417   642.6356   597.9534   527.3562   379.4219   231.5438   166.7843 (83)
Total gains   550.1608   689.9318   828.8959   932.2167   980.4241   931.3210   905.9623   867.5275   813.7959   688.1922   561.6900   511.5619 (84)
```

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7. Mean internal temperature (heating season)

```
Temperature during heating periods in the living area from Table 9, Th1 (C)                                    21.0000 (85)
Utilisation factor for gains for living area, nil,m (see Table 9a)
                Jan        Feb        Mar        Apr        May        Jun        Jul        Aug        Sep        Oct        Nov        Dec
tau            16.2980    16.4045    16.4808    16.6687    16.7120    16.7741    16.8515    16.8328    16.7120    16.6009    16.4808    16.5299
alpha           2.0865     2.0936     2.0987     2.1112     2.1141     2.1183     2.1234     2.1222     2.1141     2.1067     2.0987     2.1020
util living area
                0.9012     0.8533     0.7870     0.7043     0.6144     0.5242     0.4364     0.4568     0.5865     0.7540     0.8688     0.9131 (86)

MIT            18.1252    18.5922    19.1817    19.7878    20.2632    20.6060    20.7938    20.7703    20.4854    19.7814    18.7938    18.0200 (87)
Th 2           19.9453    19.9522    19.9570    19.9688    19.9714    19.9753    19.9800    19.9788    19.9714    19.9646    19.9570    19.9601 (88)
util rest of house
                0.8912     0.8395     0.7679     0.6783     0.5798     0.4776     0.3790     0.3989     0.5407     0.7259     0.8542     0.9043 (89)
MIT 2          17.3211    17.7784    18.3491    18.9332    19.3767    19.6884    19.8491    19.8311    19.5870    18.9410    17.9876    17.2283 (90)
Living area fraction                                                                    fLA = Living area / (4) =      0.5900 (91)
MIT            17.7955    18.2586    18.8404    19.4375    19.8998    20.2298    20.4065    20.3852    20.1171    19.4369    18.4633    17.6954 (92)
Temperature adjustment                                                                                            0.0000
adjusted MIT   17.7955    18.2586    18.8404    19.4375    19.8998    20.2298    20.4065    20.3852    20.1171    19.4369    18.4633    17.6954 (93)
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8. Space heating requirement

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation	0.8659	0.8131	0.7447	0.6638	0.5773	0.4896	0.4037	0.4227	0.5475	0.7099	0.8291	0.8801	(94)
Useful gains	476.3600	560.9792	617.3011	618.7878	566.0002	456.0092	365.7528	366.7076	445.5581	488.5293	465.7044	450.2068	(95)
Ext temp.	3.1000	3.6000	5.0000	7.2000	9.8000	12.7000	14.7000	14.6000	12.4000	9.1000	5.7000	2.9000	(96)
Heat loss rate W	1096.4094	1086.5562	1021.1602	892.7128	734.8594	545.8429	411.7708	417.9163	561.4971	757.1454	941.6914	1088.3774	(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	461.3168	353.1877	300.4712	197.2260	125.6313	0.0000	0.0000	0.0000	0.0000	199.8504	342.7106	474.7990	(98)
Space heating												2455.1930	(98)
Space heating per m2											(98) / (4) =	69.4146	(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 %)	175.1000	(206)
Efficiency of secondary/supplementary heating system, %	0.0000	(208)
Space heating requirement	1402.1662	(211)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating requirement	461.3168	353.1877	300.4712	197.2260	125.6313	0.0000	0.0000	0.0000	0.0000	199.8504	342.7106	474.7990	(98)
Space heating efficiency (main heating system 1)	175.1000	175.1000	175.1000	175.1000	175.1000	0.0000	0.0000	0.0000	0.0000	175.1000	175.1000	175.1000	(210)
Space heating fuel (main heating system)	263.4590	201.7063	171.5998	112.6362	71.7483	0.0000	0.0000	0.0000	0.0000	114.1350	195.7228	271.1588	(211)
Water heating requirement	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	(215)
Water heating													
Water heating requirement	127.3169	97.2050	77.5257	38.1099	11.4966	4.4776	0.5528	21.6557	45.9322	84.4575	111.5037	127.2747	(64)
Efficiency of water heater												175.1000	(216)
(217)m	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	175.1000	(217)
Fuel for water heating, kWh/month	72.7109	55.5140	44.2751	21.7646	6.5657	2.5572	0.3157	12.3676	26.2320	48.2338	63.6800	72.6869	(219)
Water heating fuel used												426.9036	(219)
Annual totals kWh/year													
Space heating fuel - main system												1402.1662	(211)
Space heating fuel - secondary												0.0000	(215)
Electricity for pumps and fans:													
central heating pump												30.0000	(230c)
pump for solar water heating												50.0000	(230g)
Total electricity for the above, kWh/year												80.0000	(231)
Electricity for lighting (calculated in Appendix L)												173.3285	(232)
Energy saving/generation technologies (Appendices M ,N and Q)													
PV Unit 0 (0.80 * 2.50 * 1091 * 0.80) =										-1745.7135		-1745.7135	(233)
Total delivered energy for all uses												336.6848	(238)

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

	Fuel kWh/year	Fuel price p/kWh	Fuel cost £/year	
Space heating - main system 1	1402.1662	18.7000	262.2051	(240)
Space heating - secondary	0.0000	0.0000	0.0000	(242)
Water heating (other fuel)	426.9036	18.7000	79.8310	(247)
Pumps and fans for heating	30.0000	18.7000	5.6100	(249)
Pump for solar water heating	50.0000	18.7000	9.3500	(249)
Energy for lighting	173.3285	18.7000	32.4124	(250)
Additional standing charges			0.0000	(251)
Energy saving/generation technologies				
PV Unit	-1745.7135	18.7000	-326.4484	(252)
Total energy cost			62.9601	(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	1402.1662	0.5190	727.7243	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	426.9036	0.5190	221.5630	(264)
Space and water heating			949.2872	(265)
Pumps and fans	80.0000	0.5190	41.5200	(267)
Energy for lighting	173.3285	0.5190	89.9575	(268)
Energy saving/generation technologies				
PV Unit	-1745.7135	0.5190	-906.0253	(269)
Total kg/year			174.7394	(272)

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

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	1402.1662	3.0700	4304.6502	(261)
Space heating - secondary	0.0000	0.0000	0.0000	(263)
Water heating (other fuel)	426.9036	3.0700	1310.5940	(264)
Space and water heating			5615.2442	(265)
Pumps and fans	80.0000	3.0700	245.6000	(267)
Energy for lighting	173.3285	3.0700	532.1186	(268)
Energy saving/generation technologies				
PV Unit	-1745.7135	3.0700	-5359.3404	(269)
Primary energy kWh/year			1033.6224	(272)
Primary energy kWh/m2/year			29.2231	(273)

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

Overheating Calculation Input Data

Dwelling type	SemiDetached Bungalow
Number of storeys	1
Cross ventilation possible	Yes
SAP Region	North East England
Front of dwelling faces	West
Overshading	Average or unknown
Thermal mass parameter	123.8 (calculated from construction elements)
Night ventilation	No
Ventilation rate during hot weather (ach)	6.00 (Windows fully open)

Overheating Calculation

Summer ventilation heat loss coefficient		214.30 (P1)
Transmission heat loss coefficient		52.63 (37)
Summer heat loss coefficient		266.93 (P2)

Overhangs

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

Solar shading

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

[Jul]	Area m2	Solar flux Table 6a W/m2	g Specific data or Table 6b	FF Specific data or Table 6c	Shading	Gains W
East	4.3300	111.2086	0.7200	0.7000	0.9000	196.5811
South	9.1400	110.4126	0.7200	0.7000	0.9000	411.9841
West	3.1200	111.2086	0.7200	0.7000	0.9000	141.6474
total:						750.2126

	Jun	Jul	Aug	
Solar gains	765	750	685	(P3)
Internal gains	284	274	280	
Total summer gains	1049	1025	964	(P5)
Summer gain/loss ratio	3.93	3.84	3.61	(P6)
Summer external temperature	13.80	15.80	15.60	
Thermal mass temperature increment (TMP = 123.8)	1.13	1.13	1.13	
Threshold temperature	18.86	20.77	20.35	(P7)
Likelihood of high internal temperature	Not significant	Slight	Not significant	

Assessment of likelihood of high internal temperature: Slight

PREDICTED ENERGY ASSESSMENT

Anderson Goddard Ltd

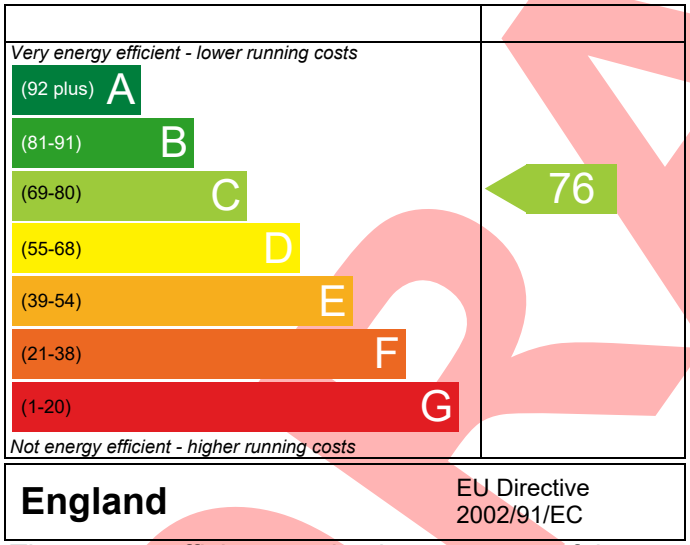
Woodlands Room 1,
Raithwaite Bay,
WHITBY,
YO21 3ST

Dwelling type:	Bungalow, Detached
Date of assessment:	07/10/2020
Produced by:	Anderson Goddard Limited
Total floor area:	35.37 m²

This document is a Predicted Energy Assessment for properties marketed when they are incomplete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, this rating will be updated and an official Energy Performance Certificate will be created for the property. This will include more detailed information about the energy performance of the completed property.

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

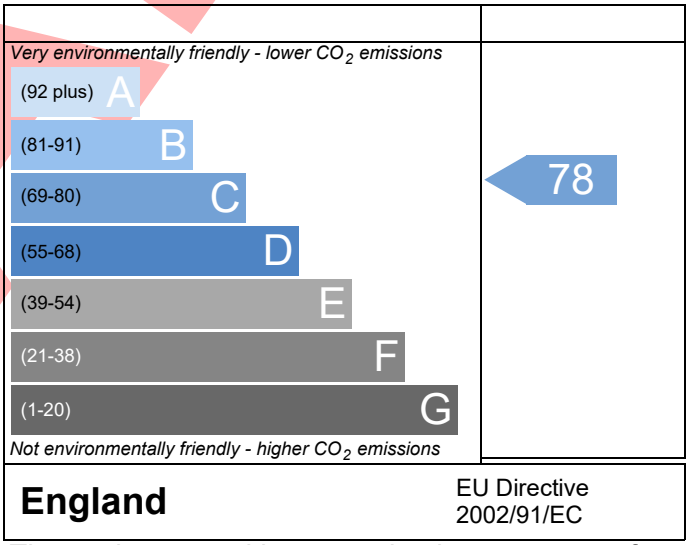
Energy Efficiency Rating



England EU Directive 2002/91/EC

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

Environmental Impact (CO_2) Rating



England EU Directive 2002/91/EC

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO_2) emissions. The higher the rating the less impact it has on the environment.

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

PREDICTED ENERGY ASSESSMENT

Anderson Goddard Ltd

Woodlands Room 2,
Raithwaite Bay,
WHITBY,
YO21 3ST

Dwelling type:	Bungalow, Detached
Date of assessment:	07/10/2020
Produced by:	Anderson Goddard Limited
Total floor area:	35.37 m²

This document is a Predicted Energy Assessment for properties marketed when they are incomplete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, this rating will be updated and an official Energy Performance Certificate will be created for the property. This will include more detailed information about the energy performance of the completed property.

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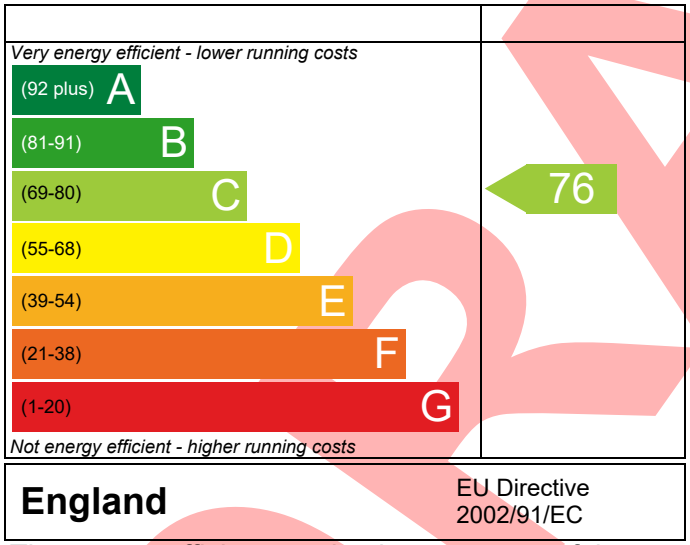
Energy Efficiency Rating



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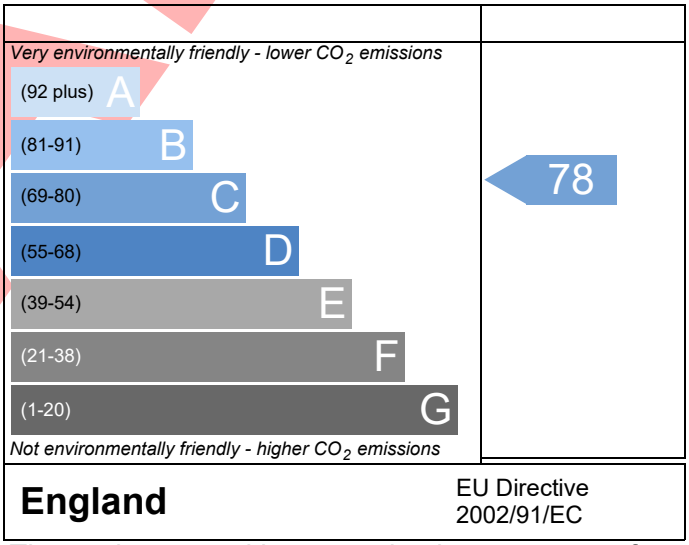
Environmental Impact (CO_2) Rating



England EU Directive 2002/91/EC

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PREDICTED ENERGY ASSESSMENT

Anderson Goddard Ltd

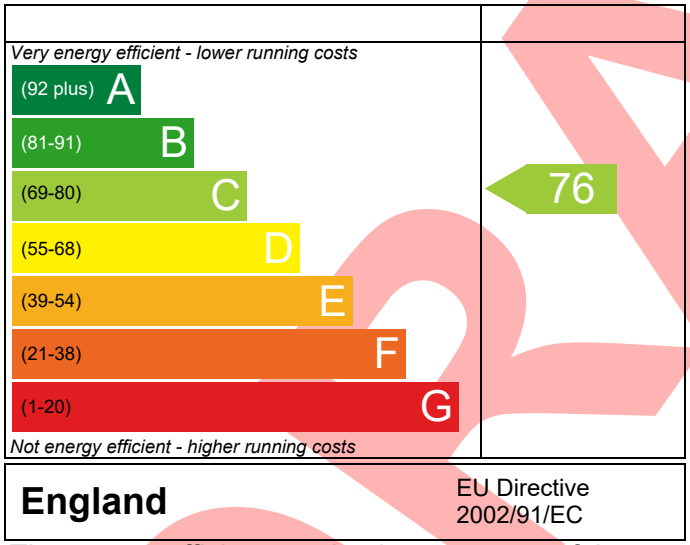
Woodlands Room 3,
Raithwaite Bay,
WHITBY,
YO21 3ST

Dwelling type:	Bungalow, Detached
Date of assessment:	07/10/2020
Produced by:	Anderson Goddard Limited
Total floor area:	35.37 m²

This document is a Predicted Energy Assessment for properties marketed when they are incomplete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, this rating will be updated and an official Energy Performance Certificate will be created for the property. This will include more detailed information about the energy performance of the completed property.

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

Energy Efficiency Rating



England EU Directive 2002/91/EC

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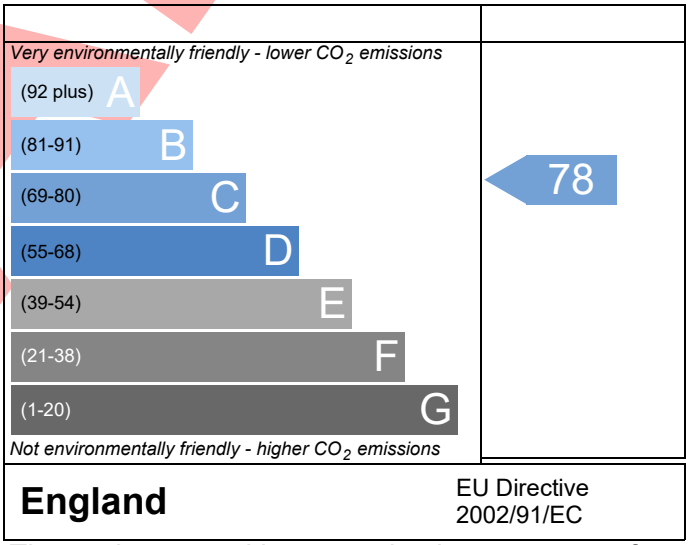
Environmental Impact (CO_2) Rating



England EU Directive 2002/91/EC

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO_2) emissions. The higher the rating the less impact it has on the environment.

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

PREDICTED ENERGY ASSESSMENT

Anderson Goddard Ltd

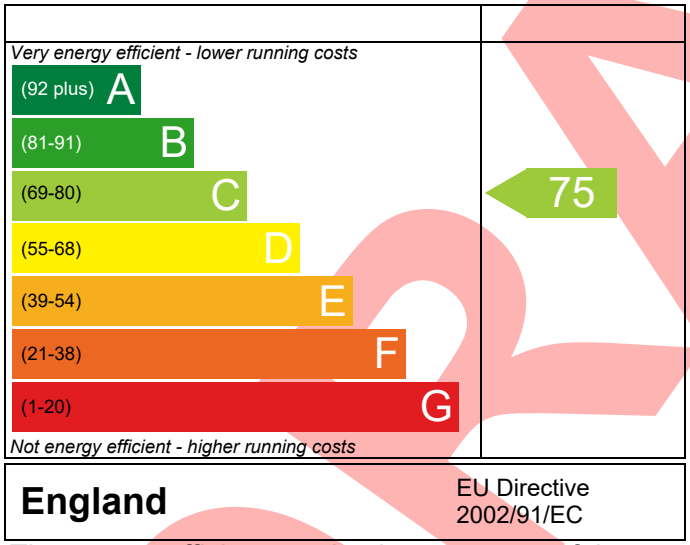
Woodlands Room 4,
Raithwaite Bay,
WHITBY,
YO21 3ST

Dwelling type:	Bungalow, Detached
Date of assessment:	07/10/2020
Produced by:	Anderson Goddard Limited
Total floor area:	35.37 m²

This document is a Predicted Energy Assessment for properties marketed when they are incomplete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, this rating will be updated and an official Energy Performance Certificate will be created for the property. This will include more detailed information about the energy performance of the completed property.

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

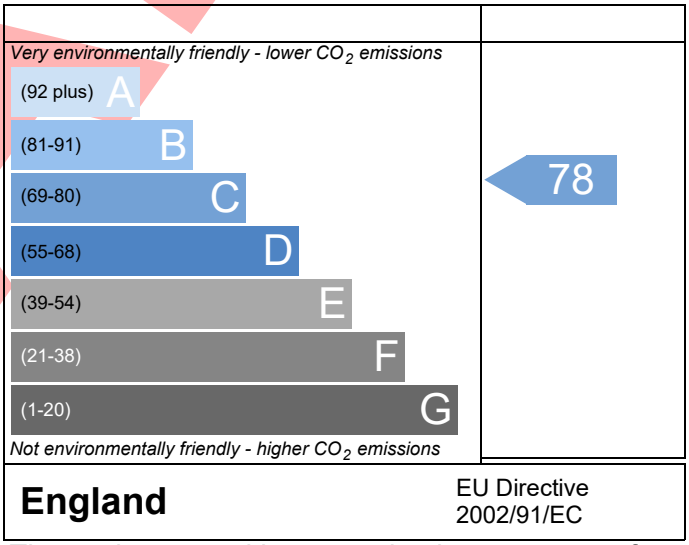
Energy Efficiency Rating



England EU Directive 2002/91/EC

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

Environmental Impact (CO_2) Rating



England EU Directive 2002/91/EC

The environmental impact rating is a measure of a home's impact on the environment in terms of carbon dioxide (CO_2) emissions. The higher the rating the less impact it has on the environment.

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

PREDICTED ENERGY ASSESSMENT

Anderson Goddard Ltd

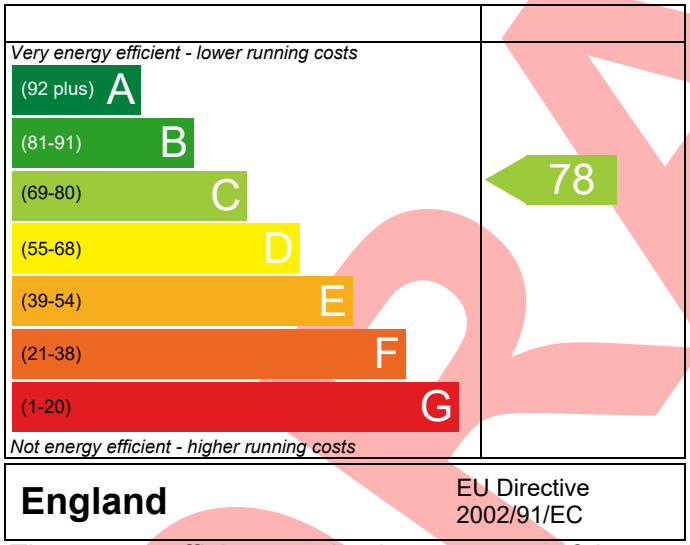
Woodlands Room 5,
Raithwaite Bay,
WHITBY,
YO21 3ST

Dwelling type:	Bungalow, Semi-Detached
Date of assessment:	07/10/2020
Produced by:	Anderson Goddard Limited
Total floor area:	35.37 m²

This document is a Predicted Energy Assessment for properties marketed when they are incomplete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, this rating will be updated and an official Energy Performance Certificate will be created for the property. This will include more detailed information about the energy performance of the completed property.

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

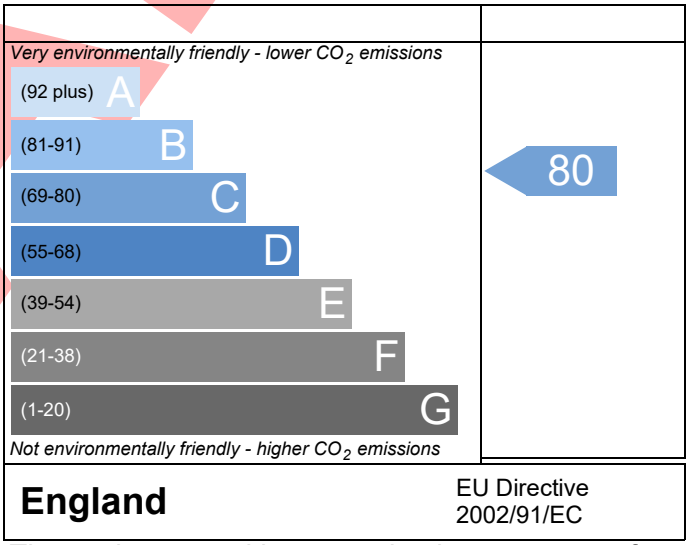
Energy Efficiency Rating



England EU Directive 2002/91/EC

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

Environmental Impact (CO_2) Rating



England EU Directive 2002/91/EC

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PREDICTED ENERGY ASSESSMENT

Anderson Goddard Ltd

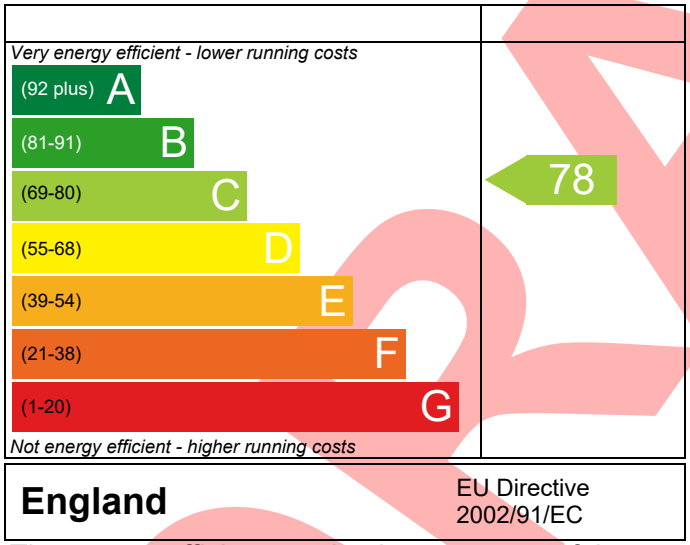
Woodlands Room 6,
Raithwaite Bay,
WHITBY,
YO21 3ST

Dwelling type:	Bungalow, Semi-Detached
Date of assessment:	07/10/2020
Produced by:	Anderson Goddard Limited
Total floor area:	35.37 m²

This document is a Predicted Energy Assessment for properties marketed when they are incomplete. It includes a predicted energy rating which might not represent the final energy rating of the property on completion. Once the property is completed, this rating will be updated and an official Energy Performance Certificate will be created for the property. This will include more detailed information about the energy performance of the completed property.

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

Energy Efficiency Rating



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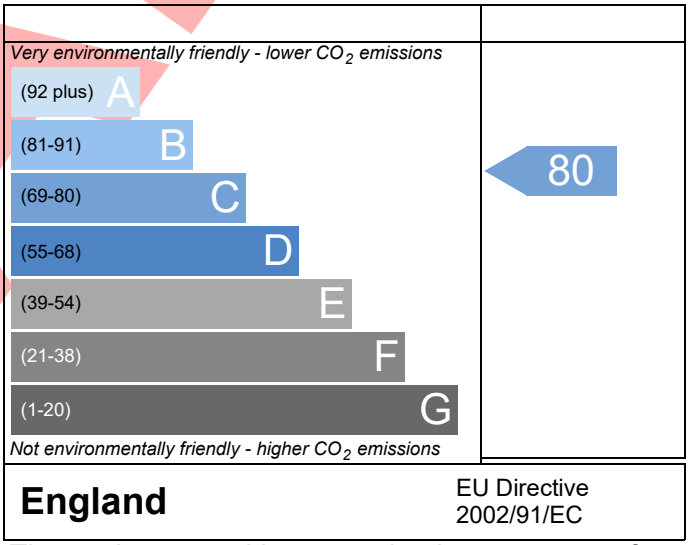
Environmental Impact (CO_2) Rating



England EU Directive 2002/91/EC

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PREDICTED ENERGY ASSESSMENT

Anderson Goddard Ltd

Woodlands Room 7,
Raithwaite Bay,
WHITBY,
YO21 3ST

Dwelling type:	Bungalow, Semi-Detached
Date of assessment:	07/10/2020
Produced by:	Anderson Goddard Limited
Total floor area:	35.37 m²

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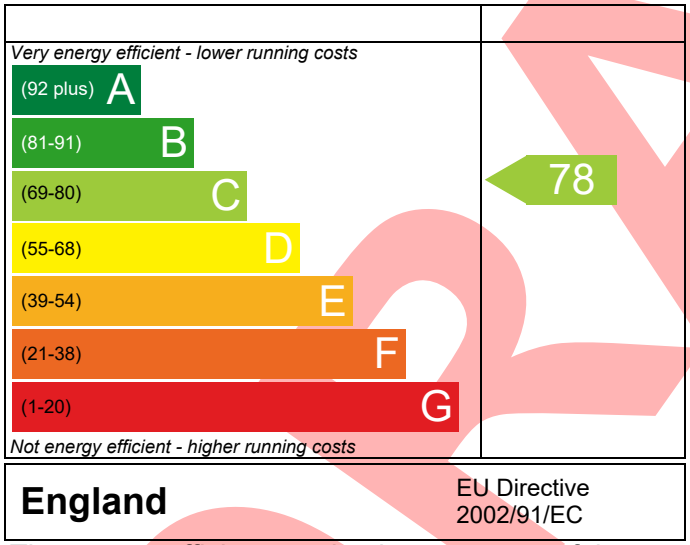
The energy performance has been assessed using the Government approved SAP2012 methodology and is rated in terms of the energy use per square meter of floor area; the energy efficiency is based on fuel costs and the environmental impact is based on carbon dioxide (CO_2) emissions.

Energy Efficiency Rating



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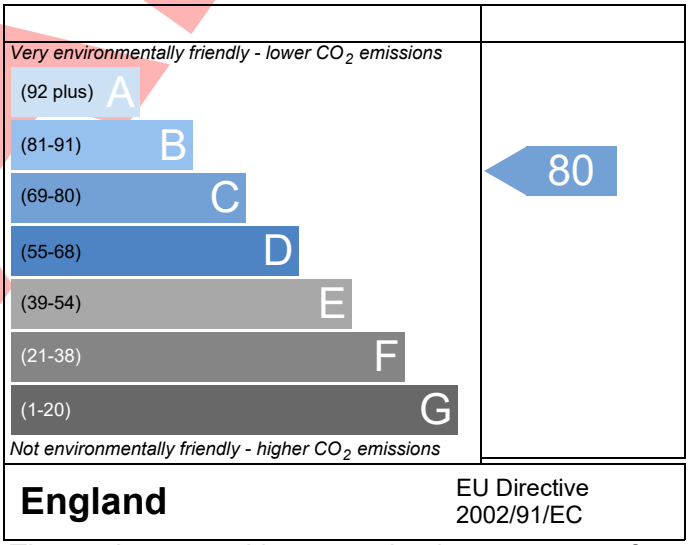
Environmental Impact (CO_2) Rating



England EU Directive 2002/91/EC

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PREDICTED ENERGY ASSESSMENT

Anderson Goddard Ltd

Woodlands Room 8,
Raithwaite Bay,
WHITBY,
YO21 3ST

Dwelling type:	Bungalow, Semi-Detached
Date of assessment:	07/10/2020
Produced by:	Anderson Goddard Limited
Total floor area:	35.37 m²

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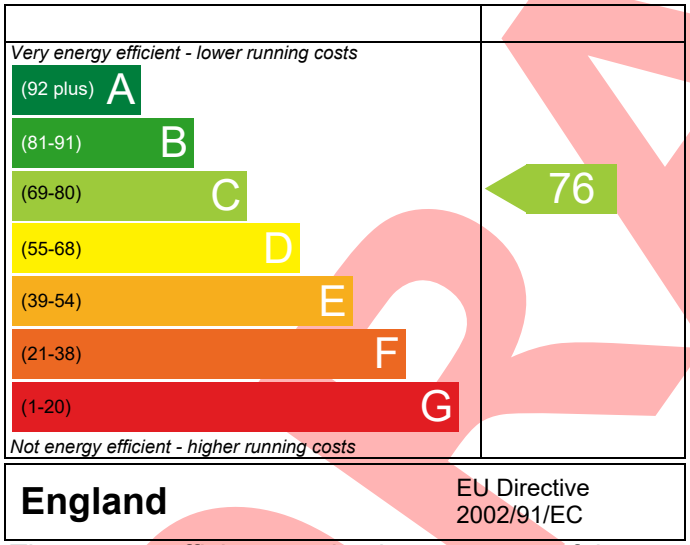
Energy Efficiency Rating



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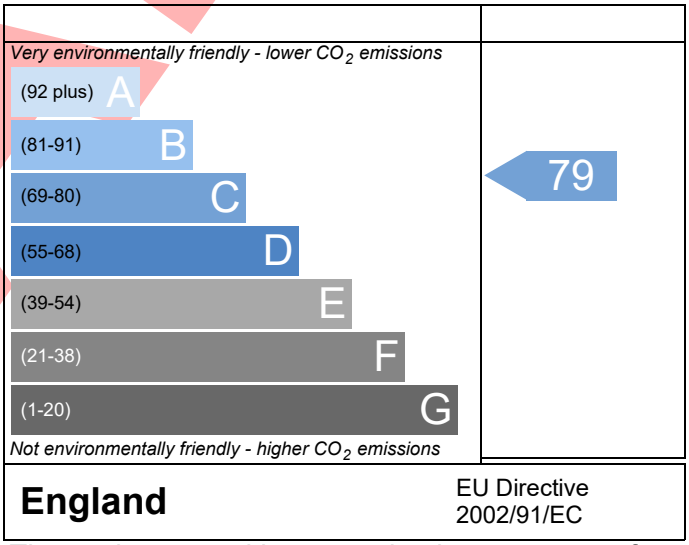
Environmental Impact (CO_2) Rating



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PREDICTED ENERGY ASSESSMENT

Anderson Goddard Ltd

Woodlands Room 9,
Raithwaite Bay,
WHITBY,
YO21 3ST

Dwelling type:	Bungalow, Semi-Detached
Date of assessment:	07/10/2020
Produced by:	Anderson Goddard Limited
Total floor area:	35.37 m²

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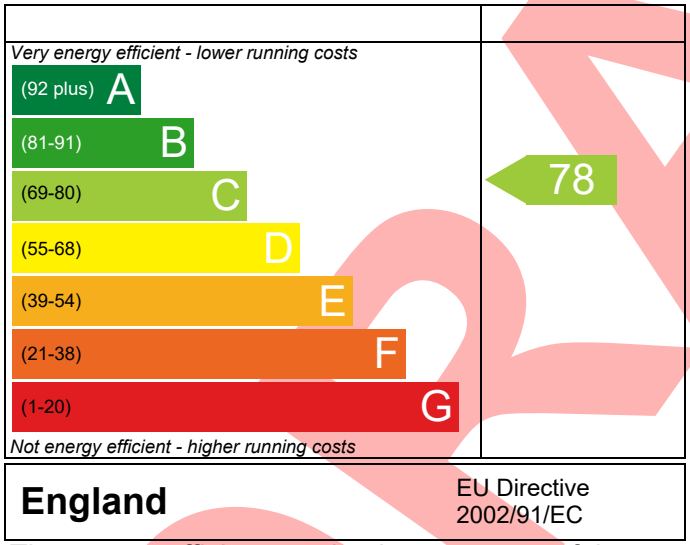
Energy Efficiency Rating



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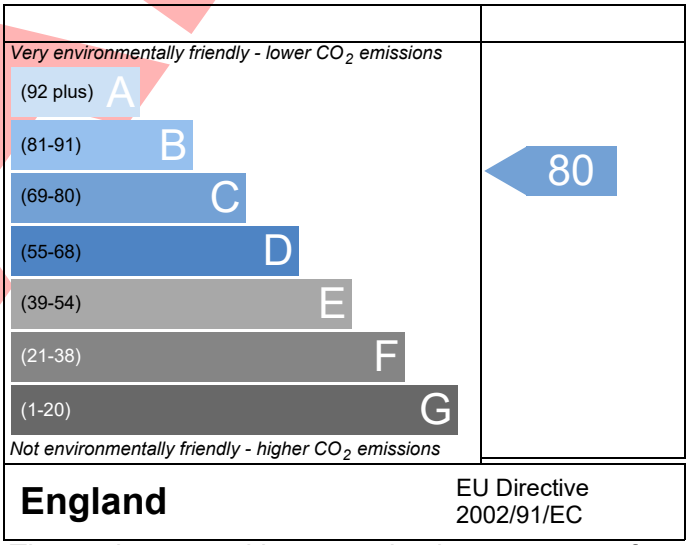
Environmental Impact (CO_2) Rating



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PREDICTED ENERGY ASSESSMENT

Anderson Goddard Ltd

Woodlands Room 10,
Raithwaite Bay,
WHITBY,
YO21 3ST

Dwelling type:	Bungalow, Semi-Detached
Date of assessment:	07/10/2020
Produced by:	Anderson Goddard Limited
Total floor area:	35.37 m²

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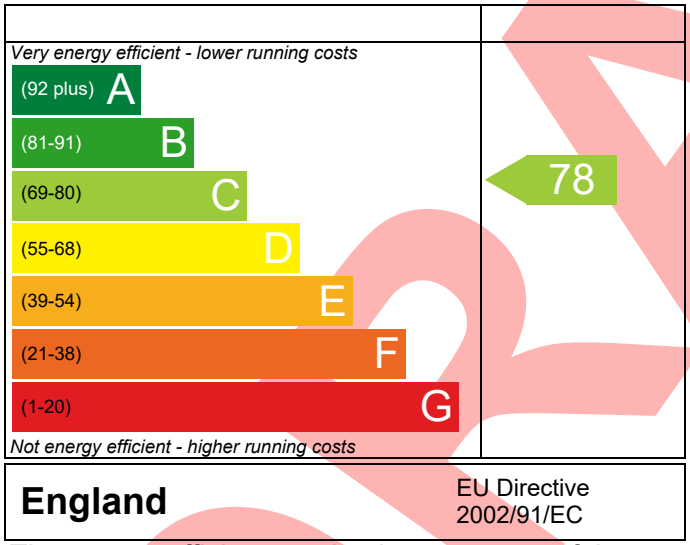
Energy Efficiency Rating



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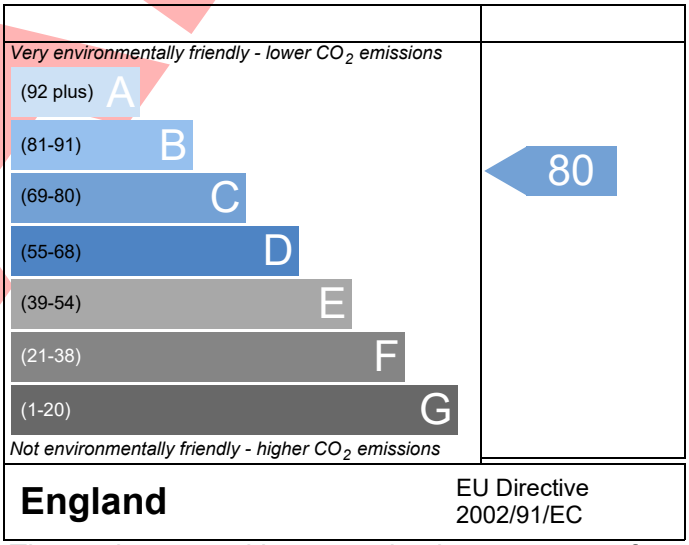
Environmental Impact (CO_2) Rating



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PREDICTED ENERGY ASSESSMENT

Anderson Goddard Ltd

Woodlands Room 11,
Raithwaite Bay,
WHITBY,
YO21 3ST

Dwelling type:	Bungalow, Semi-Detached
Date of assessment:	07/10/2020
Produced by:	Anderson Goddard Limited
Total floor area:	35.37 m²

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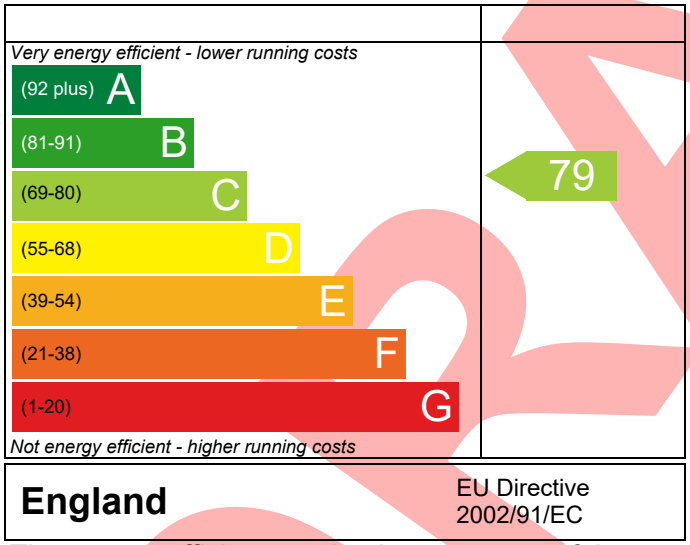
Energy Efficiency Rating



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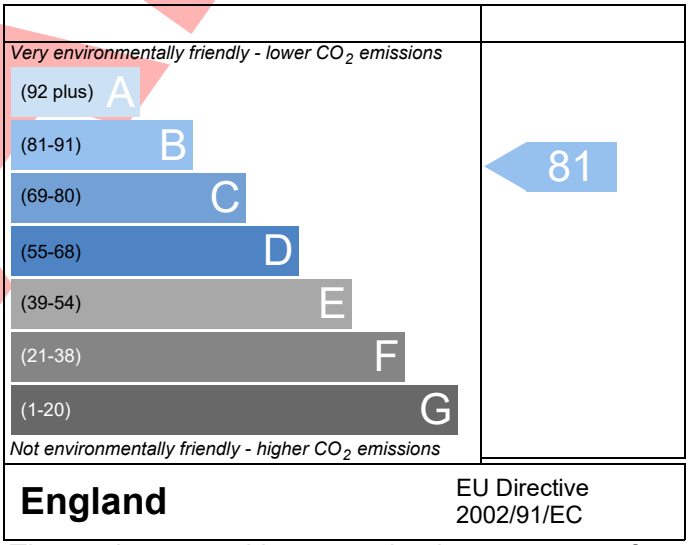
Environmental Impact (CO_2) Rating



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PREDICTED ENERGY ASSESSMENT

Anderson Goddard Ltd

Woodlands Room 12,
Raithwaite Bay,
WHITBY,
YO21 3ST

Dwelling type:	Bungalow, Semi-Detached
Date of assessment:	07/10/2020
Produced by:	Anderson Goddard Limited
Total floor area:	35.37 m²

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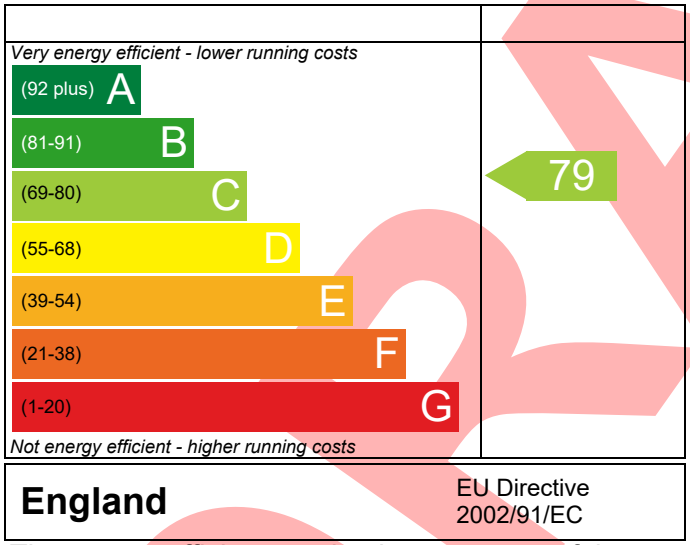
Energy Efficiency Rating



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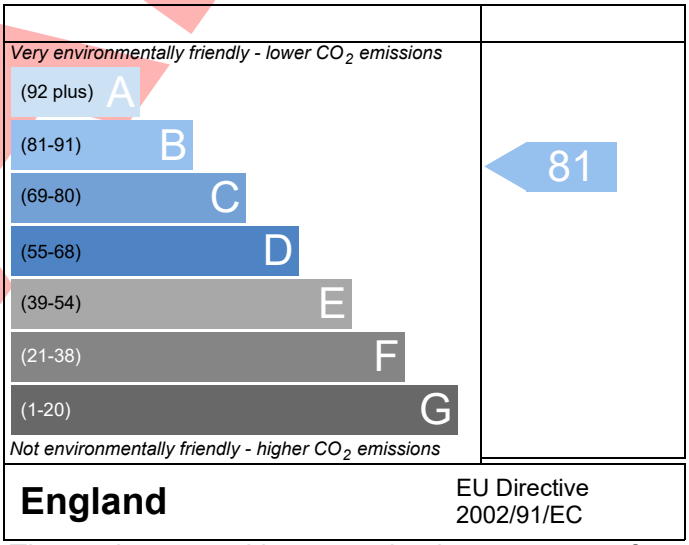
Environmental Impact (CO_2) Rating



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