

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Andrew Hart	Assessor number	3652
Client		Last modified	14/02/2017
Address	Crowick House Belle Free Lane, Cudworth, Barnsley, S72 8LU		

1. Overall dwelling dimensions

	Area (m ²)	Average storey height (m)	Volume (m ³)
Lowest occupied	<input type="text" value="168.75"/> (1a) x	<input type="text" value="3.34"/> (2a) =	<input type="text" value="563.63"/> (3a)
+1	<input type="text" value="130.43"/> (1b) x	<input type="text" value="2.87"/> (2b) =	<input type="text" value="374.33"/> (3b)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) = <input type="text" value="299.18"/> (4)		
Dwelling volume	(3a) + (3b) + (3c) + (3d)...(3n) =		<input type="text" value="937.96"/> (5)

2. Ventilation rate

		m ³ per hour
Number of chimneys	<input type="text" value="0"/> x 40 =	<input type="text" value="0"/> (6a)
Number of open flues	<input type="text" value="0"/> x 20 =	<input type="text" value="0"/> (6b)
Number of intermittent fans	<input type="text" value="0"/> x 10 =	<input type="text" value="0"/> (7a)
Number of passive vents	<input type="text" value="0"/> x 10 =	<input type="text" value="0"/> (7b)
Number of flueless gas fires	<input type="text" value="0"/> x 40 =	<input type="text" value="0"/> (7c)
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) = <input type="text" value="0"/> ÷ (5) =	<input type="text" value="0.00"/> (8)
<i>If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)</i>		
Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		<input type="text" value="10.00"/> (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		<input type="text" value="0.50"/> (18)
Number of sides on which the dwelling is sheltered		<input type="text" value="1"/> (19)
Shelter factor	1 - [0.075 x (19)] =	<input type="text" value="0.93"/> (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	<input type="text" value="0.46"/> (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly average wind speed from Table U2	<input type="text" value="5.10"/>	<input type="text" value="5.00"/>	<input type="text" value="4.90"/>	<input type="text" value="4.40"/>	<input type="text" value="4.30"/>	<input type="text" value="3.80"/>	<input type="text" value="3.80"/>	<input type="text" value="3.70"/>	<input type="text" value="4.00"/>	<input type="text" value="4.30"/>	<input type="text" value="4.50"/>	<input type="text" value="4.70"/>

Wind factor (22)m ÷ 4	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	<input type="text" value="1.28"/>	<input type="text" value="1.25"/>	<input type="text" value="1.23"/>	<input type="text" value="1.10"/>	<input type="text" value="1.08"/>	<input type="text" value="0.95"/>	<input type="text" value="0.95"/>	<input type="text" value="0.93"/>	<input type="text" value="1.00"/>	<input type="text" value="1.08"/>	<input type="text" value="1.13"/>	<input type="text" value="1.18"/>

Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	<input type="text" value="0.59"/>	<input type="text" value="0.58"/>	<input type="text" value="0.57"/>	<input type="text" value="0.51"/>	<input type="text" value="0.50"/>	<input type="text" value="0.44"/>	<input type="text" value="0.44"/>	<input type="text" value="0.43"/>	<input type="text" value="0.46"/>	<input type="text" value="0.50"/>	<input type="text" value="0.52"/>	<input type="text" value="0.54"/>

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system (23a)

If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	<input type="text" value="0.71"/>	<input type="text" value="0.70"/>	<input type="text" value="0.68"/>	<input type="text" value="0.63"/>	<input type="text" value="0.61"/>	<input type="text" value="0.56"/>	<input type="text" value="0.56"/>	<input type="text" value="0.55"/>	<input type="text" value="0.58"/>	<input type="text" value="0.61"/>	<input type="text" value="0.64"/>	<input type="text" value="0.66"/>

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)

0.71	0.70	0.68	0.63	0.61	0.56	0.56	0.55	0.58	0.61	0.64	0.66	(25)
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3. Heat losses and heat loss parameter

Element	Gross area, m ²	Openings m ²	Net area A, m ²	U-value W/m ² K	A x U W/K	k-value, kJ/m ² .K	A x κ, kJ/K							
Window			104.34	0.78	80.88									
Door			4.53	0.80	3.62									
Exposed floor			9.89	0.15	1.48									
Ground floor			168.75	0.09	15.19									
External wall			194.13	0.13	25.24									
External wall			57.95	0.16	9.27									
Roof			166.65	0.15	25.00									
Roof			14.39	0.16	2.30									
Total area of external elements ΣA, m ²			720.63											
Fabric heat loss, W/K = Σ(A x U)					(26)...(30) + (32) =		162.99							
Heat capacity Cm = Σ(A x κ)					(28)...(30) + (32) + (32a)...(32e) =		N/A							
Thermal mass parameter (TMP) in kJ/m ² K							250.00							
Thermal bridges: Σ(L x Ψ) calculated using Appendix K							43.65							
Total fabric heat loss					(33) + (36) =		206.64							
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	218.89	215.31	211.74	193.84	190.26	172.37	172.37	168.79	179.53	190.26	197.42	204.58	(38)	
Heat transfer coefficient, W/K (37)m + (38)m	425.53	421.95	418.38	400.48	396.90	379.01	379.01	375.43	386.17	396.90	404.06	411.22		
	Average = Σ(39)1...12/12 =												399.59	(39)
Heat loss parameter (HLP), W/m ² K (39)m ÷ (4)	1.42	1.41	1.40	1.34	1.33	1.27	1.27	1.25	1.29	1.33	1.35	1.37		
	Average = Σ(40)1...12/12 =												1.34	(40)
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)	

4. Water heating energy requirement

Assumed occupancy, N													3.13	(42)	
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36														108.56	(43)
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	119.41	115.07	110.73	106.39	102.04	97.70	97.70	102.04	106.39	110.73	115.07	119.41			
	Σ(44)1...12 =												1302.70	(44)	
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	177.09	154.88	159.82	139.34	133.70	115.37	106.91	122.68	124.14	144.68	157.93	171.50			
	Σ(45)1...12 =												1708.04	(45)	
Distribution loss 0.15 x (45)m	26.56	23.23	23.97	20.90	20.05	17.31	16.04	18.40	18.62	21.70	23.69	25.72		(46)	
Storage volume (litres) including any solar or WWHRS storage within same vessel														300.00	(47)
Water storage loss:															
b) Manufacturer's declared loss factor is not known															
Hot water storage loss factor from Table 2 (kWh/litre/day)														0.01	(51)
Volume factor from Table 2a														0.74	(52)
Temperature factor from Table 2b														0.54	(53)

Energy lost from water storage (kWh/day) $(47) \times (51) \times (52) \times (53)$ (54)

Enter (50) or (54) in (55) (55)

Water storage loss calculated for each month (55) x (41)m

44.26	39.98	44.26	42.83	44.26	42.83	44.26	44.26	42.83	44.26	42.83	44.26
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 (56)

If the vessel contains dedicated solar storage or dedicated WWHRs $(56)m \times [(47) - V_s] \div (47)$, else (56)

44.26	39.98	44.26	42.83	44.26	42.83	44.26	44.26	42.83	44.26	42.83	44.26
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 (57)

Primary circuit loss for each month from Table 3

37.30	33.69	37.30	36.09	37.30	36.09	37.30	37.30	36.09	37.30	36.09	37.30
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 (59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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 (61)

Total heat required for water heating calculated for each month $0.85 \times (45)m + (46)m + (57)m + (59)m + (61)m$

258.65	228.55	241.38	218.27	215.26	194.30	188.47	204.24	203.07	226.24	236.86	253.06
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 (62)

Solar DHW input calculated using Appendix G or Appendix H

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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 (63)

Output from water heater for each month (kWh/month) (62)m + (63)m

258.65	228.55	241.38	218.27	215.26	194.30	188.47	204.24	203.07	226.24	236.86	253.06
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$\Sigma(64)1...12 =$ (64)

Heat gains from water heating (kWh/month) $0.25 \times [0.85 \times (45)m + (61)m] + 0.8 \times [(46)m + (57)m + (59)m]$

124.13	110.43	118.39	109.47	109.70	101.50	100.80	106.04	104.42	113.35	115.65	122.27
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 (65)

5. Internal gains

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Metabolic gains (Table 5)

187.85	187.85	187.85	187.85	187.85	187.85	187.85	187.85	187.85	187.85	187.85	187.85
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 (66)

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

101.99	90.59	73.67	55.77	41.69	35.20	38.03	49.43	66.35	84.25	98.33	104.82
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 (67)

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

682.99	690.07	672.21	634.19	586.20	541.09	510.95	503.87	521.73	559.75	607.74	652.85
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 (68)

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

56.92	56.92	56.92	56.92	56.92	56.92	56.92	56.92	56.92	56.92	56.92	56.92
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 (69)

Pump and fan gains (Table 5a)

3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
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 (70)

Losses e.g. evaporation (Table 5)

-125.23	-125.23	-125.23	-125.23	-125.23	-125.23	-125.23	-125.23	-125.23	-125.23	-125.23	-125.23
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 (71)

Water heating gains (Table 5)

166.84	164.33	159.13	152.05	147.45	140.98	135.48	142.53	145.03	152.36	160.63	164.34
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 (72)

Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

1074.35	1067.52	1027.54	964.54	897.87	839.80	807.00	818.36	855.64	918.89	989.24	1044.55
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 (73)

6. Solar gains

	Access factor Table 6d	Area m ²	Solar flux W/m ²	g specific data or Table 6b	FF specific data or Table 6c	Gains W
South	<input type="text" value="0.77"/>	x <input type="text" value="51.64"/>	x <input type="text" value="46.75"/>	x 0.9 x <input type="text" value="0.63"/>	x <input type="text" value="1.00"/>	= <input type="text" value="1171.17"/> (78)
SouthWest	<input type="text" value="0.77"/>	x <input type="text" value="1.47"/>	x <input type="text" value="36.79"/>	x 0.9 x <input type="text" value="0.63"/>	x <input type="text" value="1.00"/>	= <input type="text" value="26.24"/> (79)
East	<input type="text" value="0.77"/>	x <input type="text" value="30.13"/>	x <input type="text" value="19.64"/>	x 0.9 x <input type="text" value="0.63"/>	x <input type="text" value="1.00"/>	= <input type="text" value="287.06"/> (76)
NorthEast	<input type="text" value="0.77"/>	x <input type="text" value="2.82"/>	x <input type="text" value="11.28"/>	x 0.9 x <input type="text" value="0.63"/>	x <input type="text" value="1.00"/>	= <input type="text" value="15.43"/> (75)
NorthWest	<input type="text" value="0.77"/>	x <input type="text" value="16.62"/>	x <input type="text" value="11.28"/>	x 0.9 x <input type="text" value="0.63"/>	x <input type="text" value="1.00"/>	= <input type="text" value="90.97"/> (81)
West	<input type="text" value="0.77"/>	x <input type="text" value="1.66"/>	x <input type="text" value="19.64"/>	x 0.9 x <input type="text" value="0.63"/>	x <input type="text" value="1.00"/>	= <input type="text" value="15.82"/> (80)

Solar gains in watts $\Sigma(74)m \dots (82)m$

1606.68	2771.84	3870.40	4901.13	5567.92	5557.24	5345.82	4847.03	4228.83	3085.94	1931.19	1370.41	(83)
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Total gains - internal and solar (73)m + (83)m

2681.03	3839.36	4897.94	5865.67	6465.79	6397.04	6152.81	5665.39	5084.47	4004.82	2920.43	2414.97	(84)
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7. Mean internal temperature (heating season)

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

21.00	(85)
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Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Utilisation factor for gains for living area n1,m (see Table 9a)

0.99	0.96	0.89	0.73	0.55	0.38	0.27	0.30	0.51	0.83	0.97	0.99	(86)
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Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

19.94	20.24	20.55	20.81	20.91	20.94	20.94	20.94	20.93	20.76	20.31	19.92	(87)
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Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)

19.75	19.76	19.76	19.81	19.82	19.87	19.87	19.88	19.85	19.82	19.80	19.78	(88)
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Utilisation factor for gains for rest of dwelling n2,m

0.99	0.95	0.86	0.68	0.49	0.31	0.20	0.23	0.43	0.78	0.96	0.99	(89)
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

18.36	18.80	19.23	19.60	19.71	19.78	19.78	19.79	19.75	19.55	18.94	18.36	(90)
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Living area fraction

Living area ÷ (4) =	0.40	(91)
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Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2

18.99	19.37	19.75	20.08	20.18	20.24	20.24	20.25	20.22	20.03	19.48	18.98	(92)
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Apply adjustment to the mean internal temperature from Table 4e where appropriate

18.99	19.37	19.75	20.08	20.18	20.24	20.24	20.25	20.22	20.03	19.48	18.98	(93)
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8. Space heating requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Utilisation factor for gains, η_m

0.98	0.94	0.86	0.69	0.51	0.33	0.22	0.25	0.46	0.79	0.96	0.99	(94)
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Useful gains, $\eta_m G_m$, W (94)m x (84)m

2638.74	3625.39	4203.97	4064.57	3278.18	2128.10	1378.63	1442.19	2323.80	3159.99	2801.92	2388.94	(95)
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Monthly average external temperature from Table U1

4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
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Heat loss rate for mean internal temperature, Lm, W [(39)m x ((93)m - (96)m)]

6249.32	6104.83	5544.10	4476.49	3366.82	2136.76	1379.65	1443.96	2361.87	3742.04	5002.75	6076.84	(97)
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Space heating requirement, kWh/month $0.024 \times [(07)m - (95)m] \times (41)m$

2686.27	1666.19	997.05	296.58	65.95	0.00	0.00	0.00	0.00	433.05	1584.59	2743.80	(98)
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$\Sigma(98)1 \dots 5, 10 \dots 12 =$	10473.48	(98)
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Space heating requirement kWh/m²/year

(98) ÷ (4)	35.01	(99)
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9a. Energy requirements - individual heating systems including micro-CHP

Space heating

Fraction of space heat from secondary/supplementary system (table 11)

0.00	(201)
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Fraction of space heat from main system(s)

1 - (201) =	1.00	(202)
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Fraction of space heat from main system 2

0.10	(202)
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Fraction of total space heat from main system 1

(202) x [1 - (203)] =	0.90	(204)
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Fraction of total space heat from main system 2

(202) x (203) =	0.10	(205)
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Efficiency of main system 1 (%)

90.00	(206)
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Efficiency of main system 2 (%)

100.00	(207)
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Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Space heating fuel (main system 1), kWh/month

2686.27	1666.19	997.05	296.58	65.95	0.00	0.00	0.00	0.00	433.05	1584.59	2743.80	
$\Sigma(211)1...5, 10...12 =$											10473.48	(211)

Space heating fuel (main system 2), kWh/month

268.63	166.62	99.71	29.66	6.60	0.00	0.00	0.00	0.00	43.30	158.46	274.38	
$\Sigma(213)1...5, 10...12 =$											1047.35	(213)

Water heating

Efficiency of water heater

90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00
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Water heating fuel, kWh/month

287.39	253.94	268.20	242.52	239.18	215.89	209.41	226.93	225.64	251.38	263.17	281.18	
$\Sigma(219a)1...12 =$											2964.83	(219)

Annual totals

Space heating fuel - main system 1 10473.48

Space heating fuel - main system 2 1047.35

Water heating fuel 2964.83

Electricity for pumps, fans and electric keep-hot (Table 4f)

 mechanical ventilation fans - balanced, extract or positive input from outside 1072.79 (230a)

 central heating pump or water pump within warm air heating unit 30.00 (230c)

Total electricity for the above, kWh/year 1102.79 (231)

Electricity for lighting (Appendix L) 720.46 (232)

Energy saving/generation technologies

 electricity generated by PV (Appendix M) -9125.91 (233)

Total delivered energy for all uses (211)...(221) + (231) + (232)...(237b) = 7182.99 (238)

10a. Fuel costs - individual heating systems including micro-CHP

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	10473.48	x	5.26	x 0.01 =	550.90	(240)
Space heating - main system 2	1047.35	x	13.19	x 0.01 =	138.15	(241)
Water heating	2964.83	x	5.26	x 0.01 =	155.95	(247)
Pumps and fans	1102.79	x	13.19	x 0.01 =	145.46	(249)
Electricity for lighting	720.46	x	13.19	x 0.01 =	95.03	(250)
Additional standing charges					0.00	(251)
Energy saving/generation technologies						
pv savings	-9125.91	x	13.19	x 0.01 =	-1203.71	(252)
Total energy cost				(240)...(242) + (245)...(254) =	-118.22	(255)

11a. SAP rating - Individual heating systems including micro-CHP

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	-0.14	(257)
SAP value	102.01	
SAP rating (section 13)	102	(258)
SAP band	A	

12a. CO₂ emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO ₂ /kWh		Emissions kg CO ₂ /year	
Space heating - main system 1	10473.48	x	0.039	=	408.47	(261)

Space heating - main system 2	1047.35	x	0.519	=	543.57	(262)
Water heating	2964.83	x	0.039	=	115.63	(264)
Space and water heating				(261) + (262) + (263) + (264) =	1067.67	(265)
Pumps and fans	1102.79	x	0.519	=	572.35	(267)
Electricity for lighting	720.46	x	0.519	=	373.92	(268)
Energy saving/generation technologies						
pv savings	-9125.91	x	0.519	=	-4736.35	(269)
Total CO ₂ , kg/year				(265)...(271) =	-2722.41	(272)
Dwelling CO ₂ emission rate				(272) ÷ (4) =	-9.10	(273)
EI value					110.60	
EI rating (section 14)					111	(274)
EI band					A	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	10473.48	x	1.26	=	13196.58	(261)
Space heating - main system 2	1047.35	x	3.07	=	3215.36	(262)
Water heating	2964.83	x	1.26	=	3735.69	(264)
Space and water heating				(261) + (262) + (263) + (264) =	20147.63	(265)
Pumps and fans	1102.79	x	3.07	=	3385.57	(267)
Electricity for lighting	720.46	x	3.07	=	2211.81	(268)
Energy saving/generation technologies						
Electricity generated - PVs	-9125.91	x	3.07	=	-28016.55	(269)
Primary energy kWh/year					-2271.55	(272)
Dwelling primary energy rate kWh/m ² /year					-7.59	(273)