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Client	Verte	Last modified	05/06/2015
Address	03 Hanway Street 03 BE LEAN, London		

### 1. Overall dwelling dimensions

	Area (m <sup>2</sup> )	Average storey height (m)	Volume (m <sup>3</sup> )
Lowest occupied	82.50 (1a) x	2.25 (2a) =	185.63 (3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =		82.50 (4)
Dwelling volume	(3a) + (3b) + (3c) + (3d)...(3n) =		185.63 (5)

### 2. Ventilation rate

	m <sup>3</sup> per hour	
Number of chimneys	0 x 40 =	0 (6a)
Number of open flues	0 x 20 =	0 (6b)
Number of intermittent fans	0 x 10 =	0 (7a)
Number of passive vents	0 x 10 =	0 (7b)
Number of flueless gas fires	0 x 40 =	0 (7c)

	Air changes per hour		
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0 ÷ (5) =	0.00 (8)

If a pressurisation test has been carried out or is intended, proceed to (17), otherwise continue from (9) to (16)

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00 (17)	
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15 (18)	
Number of sides on which the dwelling is sheltered	3 (19)	
Shelter factor	1 - [0.075 x (19)] =	0.78 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.12 (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	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70

Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18
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Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.11	0.12	0.12	0.13	0.14
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Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90 (23c)

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]	0.25	0.25	0.24	0.23	0.23	0.21	0.21	0.21	0.22	0.23	0.23	0.24
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Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)	0.25	0.25	0.24	0.23	0.23	0.21	0.21	0.21	0.22	0.23	0.23	0.24
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### 3. Heat losses and heat loss parameter

Element	Gross area, m <sup>2</sup>	Openings m <sup>2</sup>	Net area A, m <sup>2</sup>	U-value W/m <sup>2</sup> K	A x U W/K	k-value, kJ/m <sup>2</sup> .K	A x k, kJ/K
Window			10.41	1.37	14.27		(27)
External wall			79.19	0.14	10.69		(29a)
Party wall			10.00	0.00	0.00		(32)
Roof			82.00	0.14	11.07		(30)
Total area of external elements ΣA, m <sup>2</sup>			171.60				(31)
Fabric heat loss, W/K = Σ(A x U)					(26)...(30) + (32) =		36.03 (33)
Heat capacity Cm = Σ(A x k)					(28)...(30) + (32) + (32a)...(32e) =		N/A (34)
Thermal mass parameter (TMP) in kJ/m <sup>2</sup> K							250.00 (35)
Thermal bridges: Σ(L x Ψ) calculated using Appendix K							11.01 (36)
Total fabric heat loss					(33) + (36) =		47.03 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	15.24	15.06	14.88	13.99	13.81	12.92	12.92	12.74	13.28	13.81	14.17	14.52

Heat transfer coefficient, W/K (37)m + (38)m	62.27	62.09	61.91	61.02	60.85	59.95	59.95	59.78	60.31	60.85	61.20	61.56
Average = Σ(39)1...12/12 =	60.98 (39)											

Heat loss parameter (HLP), W/m <sup>2</sup> K (39)m ÷ (4)	0.75	0.75	0.75	0.74	0.74	0.73	0.73	0.72	0.73	0.74	0.74	0.75
Average = Σ(40)1...12/12 =	0.74 (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
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### 4. Water heating energy requirement

Assumed occupancy, N	2.51 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	93.78 (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)	103.16	99.41	95.65	91.90	88.15	84.40	84.40	88.15	91.90	95.65	99.41	103.16
Σ(44)1...12 =	1125.35 (44)											

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	152.98	133.80	138.07	120.37	115.50	99.66	92.35	105.98	107.24	124.98	136.43	148.15
Σ(45)1...12 =	1475.51 (45)											

Distribution loss 0.15 x (45)m	22.95	20.07	20.71	18.06	17.32	14.95	13.85	15.90	16.09	18.75	20.46	22.22
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Water storage loss calculated for each month (55) x (41)m	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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If the vessel contains dedicated solar storage or dedicated WWHRs (56)m x [(47) - Vs] ÷ (47), else (56)	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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Primary circuit loss for each month from Table 3	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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Combi loss for each month from Table 3a, 3b or 3c	37.52	33.89	37.52	36.31	37.52	37.52	37.52	36.31	37.52	36.31	37.52	37.52
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Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m	190.50	167.69	175.59	156.68	153.02	135.98	129.88	143.50	143.56	162.51	172.74	185.67
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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	0.00
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Flue gas heat recovery system 1 input (Appendix G1)

-25.79	-22.00	-20.89	-16.38	-14.62	-12.49	-11.78	-13.22	-13.29	-16.64	-21.34	-25.47
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Output from water heater for each month (kWh/month) (62)m + (63)m

164.71	145.69	154.70	140.30	138.40	123.49	118.10	130.28	130.26	145.87	151.40	160.20
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$$\sum(64)1...12 = 1703.40 \quad (64)$$

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

60.25	52.96	55.29	49.10	47.78	42.22	40.09	44.62	44.74	50.94	54.44	58.64
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### 5. Internal gains

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

150.52	150.52	150.52	150.52	150.52	150.52	150.52	150.52	150.52	150.52	150.52	150.52
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Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

56.84	50.48	41.06	31.08	23.23	19.62	21.20	27.55	36.98	46.95	54.80	58.42
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Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

335.20	338.68	329.92	311.26	287.70	265.56	250.77	247.29	256.06	274.72	298.27	320.41
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

52.56	52.56	52.56	52.56	52.56	52.56	52.56	52.56	52.56	52.56	52.56	52.56
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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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Losses e.g. evaporation (Table 5)

-100.34	-100.34	-100.34	-100.34	-100.34	-100.34	-100.34	-100.34	-100.34	-100.34	-100.34	-100.34
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Water heating gains (Table 5)

80.98	78.81	74.31	68.20	64.23	58.63	53.88	59.97	62.13	68.46	75.61	78.82
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Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

578.75	573.71	551.02	516.27	480.89	449.54	431.58	440.55	460.90	495.87	534.42	563.38
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### 6. Solar gains

	Access factor Table 6d	Area m <sup>2</sup>	Solar flux W/m <sup>2</sup>	g specific data or Table 6b	FF specific data or Table 6c	Gains W
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South  $0.77 \times 5.68 \times 46.75 \times 0.9 \times 0.63 \times 0.60 = 69.56 \quad (78)$

North  $0.77 \times 4.73 \times 10.63 \times 0.9 \times 0.63 \times 0.60 = 13.18 \quad (74)$

Solar gains in watts  $\sum(74)m...(82)m$

82.74	139.10	187.90	232.74	263.49	263.59	253.24	229.48	203.04	152.85	98.71	71.09
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Total gains - internal and solar (73)m + (83)m

661.49	712.81	738.92	749.01	744.38	713.13	684.82	670.03	663.94	648.72	633.13	634.48
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### 7. Mean internal temperature (heating season)

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

$$21.00 \quad (85)$$

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	0.97	0.94	0.87	0.73	0.54	0.39	0.41	0.62	0.87	0.97	0.99
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Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

20.52	20.62	20.76	20.90	20.97	21.00	21.00	21.00	20.99	20.91	20.71	20.50
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Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)

20.29	20.29	20.30	20.31	20.31	20.32	20.32	20.31	20.31	20.30	20.30
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Utilisation factor for gains for rest of dwelling n2,m

0.98	0.97	0.93	0.84	0.69	0.48	0.33	0.35	0.56	0.83	0.96	0.99
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Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

19.87	19.97	20.09	20.23	20.29	20.32	20.32	20.32	20.31	20.25	20.06	19.85
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Living area fraction

$$\text{Living area} \div (4) = 0.42 \quad (91)$$

Mean internal temperature for the whole dwelling fLA x T1 + (1 - fLA) x T2

20.15	20.25	20.37	20.51	20.58	20.61	20.61	20.61	20.60	20.53	20.33	20.13
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Apply adjustment to the mean internal temperature from Table 4e where appropriate

20.15	20.25	20.37	20.51	20.58	20.61	20.61	20.61	20.60	20.53	20.33	20.13
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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, ηm

0.98	0.97	0.93	0.85	0.71	0.50	0.35	0.38	0.59	0.85	0.96	0.98
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Useful gains, ηmGm, W (94)m x (84)m

648.40	687.94	689.32	639.02	524.91	358.89	240.16	251.42	388.62	548.63	606.36	624.45
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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
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Heat loss rate for mean internal temperature, Lm, W [(39)m x (93)m - (96)m]

986.71	952.81	858.96	708.54	540.41	360.05	240.23	251.53	392.04	604.19	809.80	980.36
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Space heating requirement, kWh/month  $0.024 \times [(97)m - (95)m] \times (41)m$

251.70	177.99	126.21	50.06	11.53	0.00	0.00	0.00	41.34	146.48	264.79
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$$\sum(98)1...5, 10...12 = 1070.09 \quad (98)$$

Space heating requirement kWh/m<sup>2</sup>/year

$$(98) \div (4) = 12.97 \quad (99)$$

### 8c. Space cooling requirement

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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Heat loss rate Lm

0.00	0.00	0.00	0.00	0.00	563.58	443.67	454.30	0.00	0.00	0.00	0.00
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Utilisation factor for loss ηm

0.00	0.00	0.00	0.00	0.00	0.97	0.99	0.99	0.00	0.00	0.00	0.00
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Useful loss ηmLm (watts) (100)m x (101)m

0.00	0.00	0.00	0.00	0.00	545.41	438.96	447.90	0.00	0.00	0.00	0.00
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Gains

0.00	0.00	0.00	0.00	0.00	754.63	724.57	705.77	0.00	0.00	0.00	0.00
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Space cooling requirement, whole dwelling, continuous (kWh)  $0.024 \times [(103)m - (102)m] \times (41)m$

0.00	0.00	0.00	0.00	0.00	150.65	212.50	191.85	0.00	0.00	0.00	0.00
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$$\sum(104)6...8 = 555.00 \quad (104)$$

Cooled fraction

$$\text{cooled area} \div (4) = 0.85 \quad (105)$$

Intermittency factor (Table 10)

0.00	0.00	0.00	0.00	0.00	0.25	0.25	0.25	0.00	0.00	0.00	0.00
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$$\sum(106)6...8 = 0.75 \quad (106)$$

Space cooling requirement (104)m x (105) x (106)m

0.00	0.00	0.00	0.00	0.00	31.96	45.08	40.70	0.00	0.00	0.00	0.00
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$$\sum(107)6...8 = 117.73 \quad (107)$$

Space cooling requirement kWh/m<sup>2</sup>/year

$$(107) \div (4) = 1.43 \quad (108)$$

### 9a. Energy requirements - individual heating systems including micro-CHP

Space heating

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

$$0.00 \quad (201)$$

Fraction of space heat from main system(s)	1 - (201) =	<input type="text" value="1.00"/>	(202)
Fraction of space heat from main system 2		<input type="text" value="0.00"/>	(202)
Fraction of total space heat from main system 1	(202) x [1 - (203)] =	<input type="text" value="1.00"/>	(204)
Fraction of total space heat from main system 2	(202) x (203) =	<input type="text" value="0.00"/>	(205)
Efficiency of main system 1 (%)		<input type="text" value="85.70"/>	(206)
Cooling system energy efficiency ratio (Table 10c)		<input type="text" value="4.32"/>	(209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Space heating fuel (main system 1), kWh/month	<input type="text" value="293.69"/>	<input type="text" value="207.69"/>	<input type="text" value="147.27"/>	<input type="text" value="58.41"/>	<input type="text" value="13.45"/>	<input type="text" value="0.00"/>	<input type="text" value="0.00"/>	<input type="text" value="0.00"/>	<input type="text" value="0.00"/>	<input type="text" value="48.23"/>	<input type="text" value="170.92"/>	<input type="text" value="308.97"/>		
	$\Sigma(211)1...5, 10...12 =$												<input type="text" value="1248.65"/>	(211)

<b>Water heating</b>													
Efficiency of water heater	<input type="text" value="89.57"/>	<input type="text" value="89.42"/>	<input type="text" value="89.14"/>	<input type="text" value="88.62"/>	<input type="text" value="88.11"/>	<input type="text" value="87.90"/>	<input type="text" value="87.90"/>	<input type="text" value="87.90"/>	<input type="text" value="87.90"/>	<input type="text" value="88.50"/>	<input type="text" value="89.25"/>	<input type="text" value="89.62"/>	(217)

Water heating fuel, kWh/month	<input type="text" value="183.89"/>	<input type="text" value="162.93"/>	<input type="text" value="173.55"/>	<input type="text" value="158.32"/>	<input type="text" value="157.08"/>	<input type="text" value="140.49"/>	<input type="text" value="134.36"/>	<input type="text" value="148.21"/>	<input type="text" value="148.20"/>	<input type="text" value="164.82"/>	<input type="text" value="169.63"/>	<input type="text" value="178.75"/>		
	$\Sigma(219a)1...12 =$												<input type="text" value="1920.21"/>	(219)

Space cooling fuel, kWh/month	<input type="text" value="0.00"/>	<input type="text" value="0.00"/>	<input type="text" value="0.00"/>	<input type="text" value="0.00"/>	<input type="text" value="0.00"/>	<input type="text" value="7.40"/>	<input type="text" value="10.43"/>	<input type="text" value="9.42"/>	<input type="text" value="0.00"/>	<input type="text" value="0.00"/>	<input type="text" value="0.00"/>	<input type="text" value="0.00"/>		
	$\Sigma(221)6...8 =$												<input type="text" value="27.25"/>	(221)

<b>Annual totals</b>			
Space heating fuel - main system 1	<input type="text" value="1248.65"/>		
Water heating fuel	<input type="text" value="1920.21"/>		
Space cooling fuel	<input type="text" value="27.25"/>		
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	<input type="text" value="121.72"/>	(230a)	
central heating pump or water pump within warm air heating unit	<input type="text" value="30.00"/>	(230c)	
boiler flue fan	<input type="text" value="45.00"/>	(230e)	
Total electricity for the above, kWh/year	<input type="text" value="196.72"/>	(231)	
Electricity for lighting (Appendix L)	<input type="text" value="401.53"/>	(232)	
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	<input type="text" value="3794.36"/>	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	<input type="text" value="1248.65"/>	x	<input type="text" value="3.48"/>	x 0.01 =	<input type="text" value="43.45"/>	(240)
Water heating	<input type="text" value="1920.21"/>	x	<input type="text" value="3.48"/>	x 0.01 =	<input type="text" value="66.82"/>	(247)
Space cooling	<input type="text" value="27.25"/>	x	<input type="text" value="13.19"/>	x 0.01 =	<input type="text" value="3.59"/>	(248)
Pumps and fans	<input type="text" value="196.72"/>	x	<input type="text" value="13.19"/>	x 0.01 =	<input type="text" value="25.95"/>	(249)
Electricity for lighting	<input type="text" value="401.53"/>	x	<input type="text" value="13.19"/>	x 0.01 =	<input type="text" value="52.96"/>	(250)
Additional standing charges					<input type="text" value="120.00"/>	(251)
Total energy cost			(240)...(242) + (245)...(254) =		<input type="text" value="312.78"/>	(255)

### 11a. SAP rating - individual heating systems including micro-CHP

Energy cost deflator (Table 12)	<input type="text" value="0.42"/>	(256)
Energy cost factor (ECF)	<input type="text" value="1.03"/>	(257)
SAP value	<input type="text" value="85.63"/>	
SAP rating (section 13)	<input type="text" value="86"/>	(258)
SAP band	<input type="text" value="B"/>	

### 12a. CO<sub>2</sub> emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO <sub>2</sub> /kWh		Emissions kg CO <sub>2</sub> /year	
Space heating - main system 1	<input type="text" value="1248.65"/>	x	<input type="text" value="0.22"/>	=	<input type="text" value="269.71"/>	(261)
Water heating	<input type="text" value="1920.21"/>	x	<input type="text" value="0.22"/>	=	<input type="text" value="414.77"/>	(264)
Space and water heating			(261) + (262) + (263) + (264) =		<input type="text" value="684.47"/>	(265)
Space cooling	<input type="text" value="27.25"/>	x	<input type="text" value="0.52"/>	=	<input type="text" value="14.14"/>	(266)
Pumps and fans	<input type="text" value="196.72"/>	x	<input type="text" value="0.52"/>	=	<input type="text" value="102.10"/>	(267)
Electricity for lighting	<input type="text" value="401.53"/>	x	<input type="text" value="0.52"/>	=	<input type="text" value="208.39"/>	(268)
Total CO <sub>2</sub> , kg/year			(265)...(271) =		<input type="text" value="1009.11"/>	(272)
Dwelling CO <sub>2</sub> emission rate			(272) ÷ (4) =		<input type="text" value="12.23"/>	(273)
El value					<input type="text" value="89.39"/>	
El rating (section 14)					<input type="text" value="89"/>	(274)
El band					<input type="text" value="B"/>	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	<input type="text" value="1248.65"/>	x	<input type="text" value="1.22"/>	=	<input type="text" value="1523.35"/>	(261)
Water heating	<input type="text" value="1920.21"/>	x	<input type="text" value="1.22"/>	=	<input type="text" value="2342.66"/>	(264)
Space and water heating			(261) + (262) + (263) + (264) =		<input type="text" value="3866.01"/>	(265)
Space cooling	<input type="text" value="27.25"/>	x	<input type="text" value="3.07"/>	=	<input type="text" value="3.07"/>	(266)
Pumps and fans	<input type="text" value="196.72"/>	x	<input type="text" value="3.07"/>	=	<input type="text" value="603.94"/>	(267)
Electricity for lighting	<input type="text" value="401.53"/>	x	<input type="text" value="3.07"/>	=	<input type="text" value="1232.68"/>	(268)
Primary energy kWh/year					<input type="text" value="5786.30"/>	(272)
Dwelling primary energy rate kWh/m <sup>2</sup> /year					<input type="text" value="70.14"/>	(273)