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Assessor name	Miss Michelle Wang	Assessor number	2018
Client		Last modified	05/11/2019
Address	Manor Road Richmond Block 4, Richmond, TW9		

1. Overall dwelling dimensions

	Area (m ²)		Average storey height (m)		Volume (m ³)
Lowest occupied	<input type="text" value="51.06"/>	(1a) x	<input type="text" value="2.61"/>	(2a) =	<input type="text" value="133.27"/>
+1	<input type="text" value="51.26"/>	(1b) x	<input type="text" value="2.59"/>	(2b) =	<input type="text" value="132.76"/>
+2	<input type="text" value="33.10"/>	(1c) x	<input type="text" value="2.58"/>	(2c) =	<input type="text" value="85.40"/>
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =		<input type="text" value="135.42"/>	(4)	
Dwelling volume				(3a) + (3b) + (3c) + (3d)...(3n) =	<input type="text" value="351.43"/>

2. Ventilation rate

			m ³ per hour
Number of chimneys	<input type="text" value="0"/>	x 40 =	<input type="text" value="0"/>
Number of open flues	<input type="text" value="0"/>	x 20 =	<input type="text" value="0"/>
Number of intermittent fans	<input type="text" value="0"/>	x 10 =	<input type="text" value="0"/>
Number of passive vents	<input type="text" value="0"/>	x 10 =	<input type="text" value="0"/>
Number of flueless gas fires	<input type="text" value="0"/>	x 40 =	<input type="text" value="0"/>

			Air changes per hour
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =		<input type="text" value="0"/>
		÷ (5) =	<input type="text" value="0.00"/>

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 (17)

If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16) (18)

Number of sides on which the dwelling is sheltered (19)

Shelter factor 1 - [0.075 x (19)] = (20)

Infiltration rate incorporating shelter factor (18) x (20) = (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="0.16"/>	<input type="text" value="0.16"/>	<input type="text" value="0.16"/>	<input type="text" value="0.14"/>	<input type="text" value="0.14"/>	<input type="text" value="0.12"/>	<input type="text" value="0.12"/>	<input type="text" value="0.12"/>	<input type="text" value="0.13"/>	<input type="text" value="0.14"/>	<input type="text" value="0.14"/>	<input type="text" value="0.15"/>

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="0.28"/>	<input type="text" value="0.28"/>	<input type="text" value="0.27"/>	<input type="text" value="0.26"/>	<input type="text" value="0.25"/>	<input type="text" value="0.24"/>	<input type="text" value="0.24"/>	<input type="text" value="0.24"/>	<input type="text" value="0.25"/>	<input type="text" value="0.25"/>	<input type="text" value="0.26"/>	<input type="text" value="0.27"/>

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

0.28	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.25	0.25	0.26	0.27
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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	κ-value, kJ/m ² .K	A x κ, kJ/K					
Window			38.33	1.33	50.82							
Ground floor			51.06	0.13	6.64							
External wall			66.07	0.15	9.91							
Party wall			131.96	0.00	0.00							
Roof			33.10	0.16	5.30							
Total area of external elements ΣA, m ²			188.56									
Fabric heat loss, W/K = Σ(A × U)					(26)...(30) + (32) =	72.66						
Heat capacity Cm = Σ(A × κ)					(28)...(30) + (32) + (32a)...(32e) =	N/A						
Thermal mass parameter (TMP) in kJ/m ² K						100.00						
Thermal bridges: Σ(L × Ψ) calculated using Appendix K						23.61						
Total fabric heat loss						(33) + (36) =	96.27					
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	32.48	32.11	31.74	29.89	29.52	27.67	27.67	27.30	28.41	29.52	30.26	31.00
Heat transfer coefficient, W/K (37)m + (38)m	128.75	128.38	128.01	126.16	125.79	123.94	123.94	123.57	124.68	125.79	126.53	127.27
	Average = Σ(39)1...12/12 =											126.07
Heat loss parameter (HLP), W/m ² K (39)m ÷ (4)	0.95	0.95	0.95	0.93	0.93	0.92	0.92	0.91	0.92	0.93	0.93	0.94
	Average = Σ(40)1...12/12 =											0.93
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

4. Water heating energy requirement

Assumed occupancy, N													2.91	
Annual average hot water usage in litres per day Vd,average = (25 × N) + 36														103.26
	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)	113.59	109.46	105.33	101.20	97.06	92.93	92.93	97.06	101.20	105.33	109.46	113.59		
	Σ(44)1...12 =											1239.12		
Energy content of hot water used = 4.18 × Vd,m × nm × Tm/3600 kWh/month (see Tables 1b, 1c 1d)	168.45	147.32	152.02	132.54	127.17	109.74	101.69	116.69	118.09	137.62	150.22	163.13		
	Σ(45)1...12 =											1624.69		
Distribution loss 0.15 x (45)m	25.27	22.10	22.80	19.88	19.08	16.46	15.25	17.50	17.71	20.64	22.53	24.47		
Storage volume (litres) including any solar or WWHRS storage within same vessel														194.00
Water storage loss:														
a) If manufacturer's declared loss factor is known (kWh/day)														1.61
Temperature factor from Table 2b														0.60
Energy lost from water storage (kWh/day) (48) x (49)														0.97
Enter (50) or (54) in (55)														0.97
Water storage loss calculated for each month (55) x (41)m	29.95	27.05	29.95	28.98	29.95	28.98	29.95	29.95	28.98	29.95	28.98	29.95		

If the vessel contains dedicated solar storage or dedicated WWHRs (56)m x [(47) - Vs] ÷ (47), else (56)

29.95	27.05	29.95	28.98	29.95	28.98	29.95	29.95	28.98	29.95	28.98	29.95	(57)
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Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)
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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	(61)
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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

221.65	195.38	205.23	184.03	180.38	161.23	154.90	169.90	169.58	190.83	201.71	216.34	(62)
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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	(63)
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Output from water heater for each month (kWh/month) (62)m + (63)m

221.65	195.38	205.23	184.03	180.38	161.23	154.90	169.90	169.58	190.83	201.71	216.34	(64)
$\Sigma(64)1...12 =$											2251.17	

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

98.57	87.43	93.11	85.26	84.85	77.68	76.38	81.37	80.46	88.32	91.14	96.81	(65)
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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)

145.39	145.39	145.39	145.39	145.39	145.39	145.39	145.39	145.39	145.39	145.39	145.39	(66)
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Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5

27.11	24.08	19.59	14.83	11.08	9.36	10.11	13.14	17.64	22.40	26.14	27.87	(67)
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Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5

304.14	307.30	299.34	282.41	261.04	240.95	227.53	224.38	232.33	249.26	270.63	290.72	(68)
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Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5

37.54	37.54	37.54	37.54	37.54	37.54	37.54	37.54	37.54	37.54	37.54	37.54	(69)
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Pump and fan gains (Table 5a)

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
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Losses e.g. evaporation (Table 5)

-116.31	-116.31	-116.31	-116.31	-116.31	-116.31	-116.31	-116.31	-116.31	-116.31	-116.31	-116.31	(71)
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Water heating gains (Table 5)

132.49	130.11	125.15	118.42	114.05	107.89	102.66	109.36	111.75	118.72	126.59	130.12	(72)
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Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m

530.37	528.11	510.70	482.28	452.79	424.82	406.92	413.50	428.33	456.99	489.98	515.32	(73)
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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
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SouthEast $\frac{0.77}{0.77} \times \frac{25.73}{12.60} \times \frac{36.79}{11.28} \times 0.9 \times \frac{0.40}{0.40} \times \frac{0.90}{0.90} = \frac{236.18}{35.47}$ (77)

NorthWest $\frac{0.77}{0.77} \times \frac{25.73}{12.60} \times \frac{36.79}{11.28} \times 0.9 \times \frac{0.40}{0.40} \times \frac{0.90}{0.90} = \frac{236.18}{35.47}$ (81)

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

271.65	474.50	680.53	895.66	1051.09	1064.54	1017.57	898.39	754.52	532.86	327.52	231.09	(83)
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Total gains - internal and solar (73)m + (83)m

802.02	1002.61	1191.23	1377.94	1503.88	1489.36	1424.49	1311.90	1182.86	989.86	817.50	746.41	(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)

0.97	0.94	0.88	0.79	0.65	0.49	0.37	0.41	0.62	0.84	0.94	0.97
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(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

19.05	19.40	19.86	20.37	20.72	20.91	20.97	20.96	20.82	20.32	19.59	18.99
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(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)

20.12	20.13	20.13	20.14	20.14	20.15	20.15	20.16	20.15	20.14	20.14	20.13
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(88)

Utilisation factor for gains for rest of dwelling n2,m

0.96	0.93	0.87	0.76	0.61	0.44	0.30	0.34	0.57	0.82	0.93	0.97
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(89)

Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)

17.49	18.00	18.65	19.37	19.84	20.08	20.14	20.13	19.97	19.32	18.29	17.41
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(90)

Living area fraction

Living area ÷ (4) = 0.27 (91)

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

17.92	18.38	18.98	19.64	20.08	20.31	20.37	20.36	20.21	19.60	18.64	17.84
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(92)

Apply adjustment to the mean internal temperature from Table 4e where appropriate

17.92	18.38	18.98	19.64	20.08	20.31	20.37	20.36	20.21	19.60	18.64	17.84
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(93)

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

0.94	0.91	0.84	0.74	0.61	0.45	0.32	0.36	0.57	0.80	0.91	0.95
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(94)

Useful gains, ηmGm, W (94)m x (84)m

756.58	907.50	1006.28	1023.66	910.53	666.00	455.81	473.30	674.45	789.26	746.72	710.50
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(95)

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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(96)

Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]

1753.61	1730.63	1597.90	1354.93	1054.03	707.12	466.68	489.03	761.22	1131.70	1460.75	1736.45
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(97)

Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m

741.79	553.14	440.16	238.52	106.77	0.00	0.00	0.00	0.00	254.77	514.10	763.31
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Σ(98)1...5, 10...12 = 3612.57 (98)

Space heating requirement kWh/m²/year

(98) ÷ (4) = 26.68 (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	1165.07	917.19	939.17	0.00	0.00	0.00	0.00
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(100)

Utilisation factor for loss ηm

0.00	0.00	0.00	0.00	0.00	0.89	0.93	0.91	0.00	0.00	0.00	0.00
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(101)

Useful loss ηmLm (watts) (100)m x (101)m

0.00	0.00	0.00	0.00	0.00	1038.67	852.04	856.32	0.00	0.00	0.00	0.00
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(102)

Gains

0.00	0.00	0.00	0.00	0.00	1848.70	1770.42	1640.69	0.00	0.00	0.00	0.00
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(103)

Space cooling requirement, whole dwelling, continuous (kWh) 0.024 x [(103)m - (102)m] x (41)m

0.00	0.00	0.00	0.00	0.00	583.22	683.27	583.57	0.00	0.00	0.00	0.00
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Σ(104)6...8 = 1850.07 (104)

Cooled fraction

cooled area ÷ (4) = 0.27 (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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Σ(106)6...8 = 0.75 (106)

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

0.00	0.00	0.00	0.00	0.00	39.95	46.80	39.97	0.00	0.00	0.00	0.00
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$$\Sigma(107)6\dots8 = \boxed{126.71} \quad (107)$$

Space cooling requirement kWh/m²/year

$$(107) \div (4) = \boxed{0.94} \quad (108)$$

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	<input type="text" value="0.00"/>	(301)
Fraction of space heat from community system	1 - (301) =	<input type="text" value="1.00"/>	(302)
Fraction of community heat from heat pump		<input type="text" value="1.00"/>	(303a)
Fraction of total space heat from community heat pump	(302) x (303a) =	<input type="text" value="1.00"/>	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating		<input type="text" value="1.00"/>	(305)
Factor for charging method (Table 4c(3)) for community water heating		<input type="text" value="1.00"/>	(305a)
Distribution loss factor (Table 12c) for community heating system		<input type="text" value="1.07"/>	(306)

Space heating

Annual space heating requirement	<input type="text" value="3612.57"/>	(98)
Space heat from heat pump	(98) x (304a) x (305) x (306) =	<input type="text" value="3865.45"/> (307a)

Water heating

Annual water heating requirement	<input type="text" value="2251.17"/>	(64)
Water heat from heat pump	(64) x (303a) x (305a) x (306) =	<input type="text" value="2408.76"/> (310a)
Electricity used for heat distribution	0.01 x [(307a)...(307e) + (310a)...(310e)] =	<input type="text" value="62.74"/> (313)

Cooling System Energy Efficiency Ratio	<input type="text" value="4.05"/>	(314)
Space cooling (if there is a fixed cooling system, if not enter 0)	(107) ÷ (314)	<input type="text" value="31.29"/> (315)
Electricity for pumps, fans and electric keep-hot (Table 4f)		
mechanical ventilation fans - balanced, extract or positive input from outside	<input type="text" value="330.13"/>	(330a)
Total electricity for the above, kWh/year	<input type="text" value="330.13"/>	(331)
Electricity for lighting (Appendix L)	<input type="text" value="478.85"/>	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	<input type="text" value="7114.48"/> (338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from heat pump	<input type="text" value="3865.45"/>	x	<input type="text" value="4.24"/>	x 0.01 =	<input type="text" value="163.90"/>	(340a)
Water heating from heat pump	<input type="text" value="2408.76"/>	x	<input type="text" value="4.24"/>	x 0.01 =	<input type="text" value="102.13"/>	(342a)
Space cooling	<input type="text" value="31.29"/>	x	<input type="text" value="13.19"/>	x 0.01 =	<input type="text" value="4.13"/>	(348)
Pumps and fans	<input type="text" value="330.13"/>	x	<input type="text" value="13.19"/>	x 0.01 =	<input type="text" value="43.54"/>	(349)
Electricity for lighting	<input type="text" value="478.85"/>	x	<input type="text" value="13.19"/>	x 0.01 =	<input type="text" value="63.16"/>	(350)
Additional standing charges					<input type="text" value="120.00"/>	(351)
Total energy cost				(340a)...(342e) + (345)...(354) =	<input type="text" value="496.86"/>	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	<input type="text" value="0.42"/>	(356)
Energy cost factor (ECF)	<input type="text" value="1.16"/>	(357)
SAP value	<input type="text" value="83.86"/>	
SAP rating (section 13)	<input type="text" value="84"/>	(358)
SAP band	<input type="text" value="B"/>	

12b. CO₂ emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)
Emissions from other sources (space heating)					
Efficiency of heat pump	180.00				(367a)
CO ₂ emissions from heat pump [(307a)+(310a)] x 100 ÷ (367a) =	3485.67	x	0.519	=	1809.06 (367)
Electrical energy for community heat distribution	62.74	x	0.519	=	32.56 (372)
Total CO ₂ associated with community systems					1841.63 (373)
Total CO ₂ associated with space and water heating					1841.63 (376)
Space cooling	31.29	x	0.519	=	16.24 (377)
Pumps and fans	330.13	x	0.519	=	171.34 (378)
Electricity for lighting	478.85	x	0.519	=	248.52 (379)
Total CO ₂ , kg/year				(376)..(382) =	2277.73 (383)
Dwelling CO ₂ emission rate				(383) ÷ (4) =	16.82 (384)
EI value					83.08
EI rating (section 14)					83 (385)
EI band					B

13b. Primary energy - community heating scheme

	Energy kWh/year		Primary factor		Primary energy (kWh/year)
Primary energy from other sources (space heating)					
Efficiency of heat pump	180.00				(367a)
Primary energy from heat pump [(307a)+(310a)] x 100 ÷ (367a) =	3485.67	x	3.07	=	10701.01 (367)
Electrical energy for community heat distribution	62.74	x	3.07	=	192.62 (372)
Total primary energy associated with community systems					10893.63 (373)
Total primary energy associated with space and water heating					10893.63 (376)
Space cooling	31.29	x	3.07	=	96.05 (377)
Pumps and fans	330.13	x	3.07	=	1013.50 (378)
Electricity for lighting	478.85	x	3.07	=	1470.07 (379)
Primary energy kWh/year					13473.25 (383)
Dwelling primary energy rate kWh/m ² /year					99.49 (384)