TER Worksheet
Design - Draft

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	Dr Foroutan Parand	Assessor number	4550
Client	London Borough of Camden	Last modified	18/11/2014
Address	CREC Crogsland Road, Camden, London, NW1 8AY		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		55.30	(1a)	x	2.85	(2a)	=	157.61	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	55.30	(4)						
Dwelling volume						(3a) + (3b) + (3c) + (3d)...(3n) =		157.61	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	2	x 10 =	20	(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) =	20	÷ (5) =	0.13	(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		5.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.38	(18)
Number of sides on which the dwelling is sheltered		2	(19)
Shelter factor	1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.32	(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	(22)
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	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.41	0.40	0.39	0.35	0.34	0.30	0.30	0.30	0.32	0.34	0.36	0.38	(22b)

Calculate effective air change rate for the applicable case:

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
d) natural ventilation or whole house positive input ventilation from loft	0.58	0.58	0.58	0.56	0.56	0.55	0.55	0.54	0.55	0.56	0.56	0.57	(24d)
Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)	0.58	0.58	0.58	0.56	0.56	0.55	0.55	0.54	0.55	0.56	0.56	0.57	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Door			2.20	x	1.00	=	2.20			(26)
Window			11.62	x	1.33	=	15.41			(27)
External wall			27.79	x	0.18	=	5.00			(29a)
Party wall			49.02	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			41.61							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	22.61	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K		250.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		2.78	(36)
Total fabric heat loss	(33) + (36) =	25.39	(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)	30.34	30.18	30.01	29.23	29.09	28.41	28.41	28.29	28.67	29.09	29.38	29.69	(38)
Heat transfer coefficient, W/K (37)m + (38)m	55.73	55.57	55.40	54.62	54.48	53.80	53.80	53.68	54.06	54.48	54.77	55.08	
Average = ∑(39)1...12/12 =												54.62	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.01	1.00	1.00	0.99	0.99	0.97	0.97	0.97	0.98	0.99	0.99	1.00	
Average = ∑(40)1...12/12 =												0.99	(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	1.85	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	78.05	(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)	85.85	82.73	79.61	76.49	73.36	70.24	70.24	73.36	76.49	79.61	82.73	85.85	
∑(44)1...12 =												936.55	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	127.31	111.35	114.90	100.17	96.12	82.94	76.86	88.20	89.25	104.01	113.54	123.30	
∑(45)1...12 =												1227.97	(45)
Distribution loss 0.15 x (45)m	19.10	16.70	17.24	15.03	14.42	12.44	11.53	13.23	13.39	15.60	17.03	18.49	(46)
Storage volume (litres) including any solar or WWHRS storage within same vessel												150.00	(47)
Water storage loss:													
a) If manufacturer's declared loss factor is known (kWh/day)												1.39	(48)
Temperature factor from Table 2b												0.54	(49)
Energy lost from water storage (kWh/day) (48) x (49)												0.75	(50)
Enter (50) or (54) in (55)												0.75	(55)
Water storage loss calculated for each month (55) x (41)m	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

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)

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)

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

173.91	153.44	161.50	145.27	142.72	128.04	123.46	134.79	134.34	150.61	158.63	169.89	(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	(63)

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

173.91	153.44	161.50	145.27	142.72	128.04	123.46	134.79	134.34	150.61	158.63	169.89	

∑(64)1...12 = 1776.58 (64)

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

79.61	70.69	75.48	69.38	69.24	63.65	62.83	66.60	65.75	71.86	73.83	78.27	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	92.31	92.31	92.31	92.31	92.31	92.31	92.31	92.31	92.31	92.31	92.31	92.31	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	14.39	12.78	10.39	7.87	5.88	4.97	5.37	6.97	9.36	11.89	13.87	14.79	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	160.96	162.63	158.42	149.46	138.15	127.52	120.42	118.75	122.95	131.92	143.23	153.86	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.23	32.23	32.23	32.23	32.23	32.23	32.23	32.23	32.23	32.23	32.23	32.23	(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	(70)
Losses e.g. evaporation (Table 5)	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	(71)
Water heating gains (Table 5)	107.00	105.20	101.45	96.36	93.06	88.41	84.45	89.52	91.32	96.59	102.54	105.20	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	336.04	334.30	323.96	307.38	290.78	274.58	263.92	268.93	277.33	294.08	313.33	327.54	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
East	0.77	x	1.94	x	19.64	x 0.9 x	0.63	x	0.70	=	11.64	(76)
West	0.77	x	9.68	x	19.64	x 0.9 x	0.63	x	0.70	=	58.10	(80)

Solar gains in watts ∑(74)m...(82)m

69.75	136.44	224.70	327.71	401.62	411.13	391.41	336.22	261.33	161.90	86.97	57.36	(83)

Total gains - internal and solar (73)m + (83)m

405.79	470.74	548.65	635.09	692.40	685.71	655.33	605.15	538.66	455.98	400.29	384.90	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	

Utilisation factor for gains for living area n1,m (see Table 9a)

0.99	0.99	0.96	0.87	0.69	0.50	0.36	0.41	0.66	0.93	0.99	1.00	(86)

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

20.08	20.25	20.52	20.81	20.95	20.99	21.00	21.00	20.97	20.75	20.36	20.05	(87)

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

20.08	20.08	20.08	20.09	20.10	20.11	20.11	20.11	20.10	20.10	20.09	20.09	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.99	0.98	0.95	0.83	0.64	0.43	0.29	0.33	0.59	0.90	0.98	0.99	(89)

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

18.86	19.11	19.49	19.88	20.06	20.10	20.11	20.11	20.08	19.82	19.28	18.83	(90)

Living area fraction — Living area ÷ (4) = 0.47 (91)

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

19.43	19.64	19.97	20.32	20.48	20.52	20.53	20.53	20.50	20.26	19.79	19.40	(92)

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

19.43	19.64	19.97	20.32	20.48	20.52	20.53	20.53	20.50	20.26	19.79	19.40	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.99	0.98	0.95	0.84	0.66	0.46	0.32	0.37	0.62	0.90	0.98	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	402.24	461.54	519.02	535.15	458.64	316.54	211.01	221.07	335.80	412.34	392.68	382.30	(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	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	843.49	819.26	746.33	623.69	478.23	318.62	211.22	221.50	346.11	526.06	694.84	837.40	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	328.29	240.39	169.12	63.75	14.58	0.00	0.00	0.00	0.00	84.61	217.56	338.59	

∑(98)1...5, 10...12 = 1456.87 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) 26.34 (99)

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

Space heating

Fraction of space heat from secondary/supplementary system (table 11)		0.00	(201)
Fraction of space heat from main system(s)	1 - (201) =	1.00	(202)
Fraction of space heat from main system 2		0.00	(202)
Fraction of total space heat from main system 1	(202) x [1- (203)] =	1.00	(204)
Fraction of total space heat from main system 2	(202) x (203) =	0.00	(205)
Efficiency of main system 1 (%)		93.50	(206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating fuel (main system 1), kWh/month	351.11	257.10	180.87	68.18	15.59	0.00	0.00	0.00	0.00	90.49	232.68	362.13

∑(211)1...5, 10...12 = 1558.15 (211)

Water heating

Efficiency of water heater	86.48	86.01	84.94	82.79	80.68	79.80	79.80	79.80	79.80	83.34	85.66	86.62	(217)
Water heating fuel, kWh/month	201.09	178.40	190.14	175.47	176.88	160.45	154.71	168.91	168.35	180.71	185.19	196.14	

∑(219a)1...12 = 2136.43 (219)

Annual totals

Space heating fuel - main system 1 — 1558.15

Water heating fuel					2136.43	
Electricity for pumps, fans and electric keep-hot (Table 4f)						
central heating pump or water pump within warm air heating unit			30.00			(230c)
boiler flue fan			45.00			(230e)
Total electricity for the above, kWh/year					75.00	(231)
Electricity for lighting (Appendix L)					254.10	(232)
Total delivered energy for all uses				(211)...(221) + (231) + (232)...(237b) =	4023.69	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	1558.15	x	3.48	x 0.01 =	54.22	(240)
Water heating	2136.43	x	3.48	x 0.01 =	74.35	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	254.10	x	13.19	x 0.01 =	33.52	(250)
Additional standing charges					120.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	291.98	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.22	(257)
SAP value	82.94	
SAP rating (section 13)	83	(258)
SAP band	B	

12a. CO_2 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	1558.15	x	0.22	=	336.56	(261)
Water heating	2136.43	x	0.22	=	461.47	(264)
Space and water heating				(261) + (262) + (263) + (264) =	798.03	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	254.10	x	0.52	=	131.88	(268)
Total CO_2, kg/year				(265)...(271) =	968.83	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	17.52	(273)
EI value					87.06	
EI rating (section 14)					87	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	1558.15	x	1.22	=	1900.95	(261)
Water heating	2136.43	x	1.22	=	2606.45	(264)
Space and water heating				(261) + (262) + (263) + (264) =	4507.39	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	254.10	x	3.07	=	780.09	(268)
Primary energy kWh/year					5517.74	(272)
Dwelling primary energy rate kWh/m2/year					99.78	(273)

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Assessor name	Dr Foroutan Parand	Assessor number	4550
Client	London Borough of Camden	Last modified	18/11/2014
Address	CREC Crogsland Road, Camden, London, NW1 8AY		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		55.30	(1a)	x	2.85	(2a)	=	157.61	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	55.30	(4)						
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =			157.61	(5)

2. Ventilation rate

				m³ 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		2	(19)
Shelter factor	1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13	(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	(22)
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	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

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	68.85	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]	0.32	0.32	0.31	0.30	0.29	0.28	0.28	0.27	0.28	0.29	0.30	0.31	(24a)
Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)	0.32	0.32	0.31	0.30	0.29	0.28	0.28	0.27	0.28	0.29	0.30	0.31	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Door			2.20	x	1.00	=	2.20			(26)
Window			16.71	x	1.33	=	22.15			(27)
External wall			22.70	x	0.18	=	4.09			(29a)
Party wall			49.02	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			41.61							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	28.44	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K		100.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		5.76	(36)
Total fabric heat loss	(33) + (36) =	34.20	(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)	16.56	16.39	16.22	15.39	15.23	14.40	14.40	14.23	14.73	15.23	15.56	15.89	(38)
Heat transfer coefficient, W/K (37)m + (38)m	50.76	50.59	50.43	49.60	49.43	48.60	48.60	48.44	48.94	49.43	49.76	50.10	
Average = ∑(39)1...12/12 =												49.56	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	0.92	0.91	0.91	0.90	0.89	0.88	0.88	0.88	0.88	0.89	0.90	0.91	
Average = ∑(40)1...12/12 =												0.90	(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	1.85	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	78.05	(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)	85.85	82.73	79.61	76.49	73.36	70.24	70.24	73.36	76.49	79.61	82.73	85.85	
∑(44)1...12 =												936.55	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	127.31	111.35	114.90	100.17	96.12	82.94	76.86	88.20	89.25	104.01	113.54	123.30	
∑(45)1...12 =												1227.97	(45)
Distribution loss 0.15 x (45)m	19.10	16.70	17.24	15.03	14.42	12.44	11.53	13.23	13.39	15.60	17.03	18.49	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	110.00	(47)
Water storage loss:		
b) Manufacturer's declared loss factor is not known		
Hot water storage loss factor from Table 2 (kWh/litre/day)	0.02	(51)
Volume factor from Table 2a	1.03	(52)
Temperature factor from Table 2b	0.60	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	1.03	(54)
Enter (50) or (54) in (55)	1.03	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water storage loss calculated for each month (55) x (41)m	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)
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)
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)
Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m	182.59	161.28	170.18	153.67	151.40	136.44	132.14	143.48	142.75	159.29	167.03	178.57	(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	(63)
Output from water heater for each month (kWh/month) (62)m + (63)m	182.59	161.28	170.18	153.67	151.40	136.44	132.14	143.48	142.75	159.29	167.03	178.57	

∑(64)1...12 = 1878.81 (64)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]	86.55	76.97	82.43	76.10	76.18	70.37	69.78	73.55	72.47	78.81	80.55	85.22	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	92.31	92.31	92.31	92.31	92.31	92.31	92.31	92.31	92.31	92.31	92.31	92.31	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	14.35	12.75	10.37	7.85	5.87	4.95	5.35	6.96	9.34	11.85	13.83	14.75	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	160.96	162.63	158.42	149.46	138.15	127.52	120.42	118.75	122.95	131.92	143.23	153.86	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.23	32.23	32.23	32.23	32.23	32.23	32.23	32.23	32.23	32.23	32.23	32.23	(69)
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)
Losses e.g. evaporation (Table 5)	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	(71)
Water heating gains (Table 5)	116.34	114.53	110.79	105.70	102.39	97.74	93.79	98.85	100.65	105.92	111.87	114.54	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	342.34	340.60	330.27	313.70	297.10	280.90	270.25	275.25	283.64	300.38	319.62	333.84	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
East	0.77	x	2.79	x	19.64	x 0.9 x	0.65	x	0.75	=	18.51	(76)
West	0.77	x	13.92	x	19.64	x 0.9 x	0.65	x	0.75	=	92.36	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains in watts ∑(74)m...(82)m	110.87	216.89	357.19	520.95	638.44	653.56	622.21	534.47	415.43	257.36	138.25	91.18	(83)
Total gains - internal and solar (73)m + (83)m	453.21	557.49	687.46	834.64	935.54	934.46	892.46	809.72	699.07	557.75	457.87	425.01	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Utilisation factor for gains for living area n1,m (see Table 9a)

0.92	0.87	0.77	0.62	0.46	0.33	0.24	0.27	0.46	0.72	0.88	0.93	(86)

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

19.49	19.84	20.30	20.71	20.90	20.98	20.99	20.99	20.93	20.61	19.98	19.43	(87)

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

20.15	20.15	20.16	20.17	20.17	20.19	20.19	20.19	20.18	20.17	20.17	20.16	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.91	0.86	0.75	0.59	0.43	0.29	0.19	0.22	0.41	0.69	0.87	0.93	(89)

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

18.14	18.64	19.27	19.82	20.07	20.16	20.18	20.18	20.11	19.71	18.85	18.06	(90)

Living area fraction — Living area ÷ (4) = 0.47 (91)

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

18.78	19.21	19.76	20.24	20.46	20.55	20.56	20.56	20.50	20.13	19.38	18.71	(92)

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

18.78	19.21	19.76	20.24	20.46	20.55	20.56	20.56	20.50	20.13	19.38	18.71	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm													
	0.90	0.84	0.74	0.59	0.44	0.30	0.21	0.25	0.43	0.69	0.85	0.91	(94)
Useful gains, ηmGm, W (94)m x (84)m													
	406.04	468.06	509.61	493.88	410.18	283.72	191.32	199.55	298.14	383.52	389.10	386.10	(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	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]													
	734.88	723.87	668.49	562.31	432.99	288.97	192.61	201.55	313.12	471.23	611.33	726.70	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m													
	244.66	171.91	118.21	49.27	16.97	0.00	0.00	0.00	0.00	65.26	160.01	253.41	

∑(98)1...5, 10...12 = 1079.69 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 19.52 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		1.00	(303a)
Fraction of total space heat from community boilers	(302) x (303a) =	1.00	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	1079.69			(98)
Space heat from boilers		(98) x (304a) x (305) x (306) =	1133.67	(307a)

Water heating

Annual water heating requirement	1878.81			(64)
Water heat from boilers		(64) x (303a) x (305a) x (306) =	1972.75	(310a)
Electricity used for heat distribution		0.01 × [(307a)...(307e) + (310a)...(310e)] =	31.06	(313)

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

mechanical ventilation fans - balanced, extract or positive input from outside		187.47	(330a)
Total electricity for the above, kWh/year		187.47	(331)
Electricity for lighting (Appendix L)		253.42	(332)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	3547.31	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	1133.67	x	4.24	x 0.01 =	48.07	(340a)
Water heating from boilers	1972.75	x	4.24	x 0.01 =	83.64	(342a)
Pumps and fans	187.47	x	13.19	x 0.01 =	24.73	(349)
Electricity for lighting	253.42	x	13.19	x 0.01 =	33.43	(350)
Additional standing charges					120.00	(351)
Total energy cost			(340a)...(342e) + (345)...(354) =		309.87	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.30	(357)
SAP value	81.90	
SAP rating (section 13)	82	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

		Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)							
Efficiency of boilers		94.00					(367a)
CO2 emissions from boilers	[(307a)+(310a)] x 100 ÷ (367a) =	3304.70	x	0.216	=	713.81	(367)
Electrical energy for community heat distribution		31.06	x	0.52	=	16.12	(372)
Total CO2 associated with community systems						729.94	(373)
Total CO2 associated with space and water heating						729.94	(376)
Pumps and fans		187.47	x	0.52	=	97.30	(378)
Electricity for lighting		253.42	x	0.52	=	131.52	(379)
Total CO_2, kg/year					(376)..(382) =	958.76	(383)
Dwelling CO_2 emission rate					(383) ÷ (4) =	17.34	(384)
EI value						87.19	
EI rating (section 14)						87	(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 boilers		94.00					(367a)
Primary energy from boilers	[(307a)+(310a)] x 100 ÷ (367a) =	3304.70	x	1.22	=	4031.73	(367)
Electrical energy for community heat distribution		31.06	x	3.07	=	95.37	(372)
Total primary energy associated with community systems						4127.10	(373)
Total primary energy associated with space and water heating						4127.10	(376)
Pumps and fans		187.47	x	3.07	=	575.54	(378)
Electricity for lighting		253.42	x	3.07	=	777.99	(379)

Primary energy kWh/year	5480.63	(383)
Dwelling primary energy rate kWh/m2/year	99.11	(384)

DER Worksheet
Design - Draft

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	Dr Antonino Saporito	Assessor number	5798
Client	London Borough of Camden	Last modified	27/01/2015
Address	CREC Crogsland Road, Camden, London, NW1 8AY		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		55.30	(1a)	x	2.85	(2a)	=	157.61	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	55.30	(4)						
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =			157.61	(5)

2. Ventilation rate

			m³ 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		2	(19)
Shelter factor	1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13	(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	(22)
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	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

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	68.85	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]	0.32	0.32	0.31	0.30	0.29	0.28	0.28	0.27	0.28	0.29	0.30	0.31	(24a)
Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)	0.32	0.32	0.31	0.30	0.29	0.28	0.28	0.27	0.28	0.29	0.30	0.31	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Door			2.20	x	1.00	=	2.20			(26)
Window			16.71	x	1.33	=	22.15			(27)
External wall			22.70	x	0.18	=	4.09			(29a)
Party wall			49.02	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			41.61							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	28.44	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K		100.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		5.76	(36)
Total fabric heat loss	(33) + (36) =	34.20	(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)	16.56	16.39	16.22	15.39	15.23	14.40	14.40	14.23	14.73	15.23	15.56	15.89	(38)
Heat transfer coefficient, W/K (37)m + (38)m	50.76	50.59	50.43	49.60	49.43	48.60	48.60	48.44	48.94	49.43	49.76	50.10	
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	0.92	0.91	0.91	0.90	0.89	0.88	0.88	0.88	0.88	0.89	0.90	0.91	
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)

Heat transfer coefficient: Average = ∑(39)1...12/12 = 49.56 (39)

Heat loss parameter: Average = ∑(40)1...12/12 = 0.90 (40)

4. Water heating energy requirement

Assumed occupancy, N	1.85	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	78.05	(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)	85.85	82.73	79.61	76.49	73.36	70.24	70.24	73.36	76.49	79.61	82.73	85.85	
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	127.31	111.35	114.90	100.17	96.12	82.94	76.86	88.20	89.25	104.01	113.54	123.30	
Distribution loss 0.15 x (45)m	19.10	16.70	17.24	15.03	14.42	12.44	11.53	13.23	13.39	15.60	17.03	18.49	(46)

Hot water usage: ∑(44)1...12 = 936.55 (44)

Energy content: ∑(45)1...12 = 1227.97 (45)

Storage volume (litres) including any solar or WWHRS storage within same vessel	110.00	(47)

Water storage loss:

b) Manufacturer's declared loss factor is not known

Hot water storage loss factor from Table 2 (kWh/litre/day)	0.02	(51)
Volume factor from Table 2a	1.03	(52)
Temperature factor from Table 2b	0.60	(53)
Energy lost from water storage (kWh/day) (47) x (51) x (52) x (53)	1.03	(54)
Enter (50) or (54) in (55)	1.03	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water storage loss calculated for each month (55) x (41)m	32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(56)

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

32.01	28.92	32.01	30.98	32.01	30.98	32.01	32.01	30.98	32.01	30.98	32.01	(57)

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)

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)

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

182.59	161.28	170.18	153.67	151.40	136.44	132.14	143.48	142.75	159.29	167.03	178.57	(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	(63)

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

182.59	161.28	170.18	153.67	151.40	136.44	132.14	143.48	142.75	159.29	167.03	178.57	

∑(64)1...12 = 1878.81 (64)

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

86.55	76.97	82.43	76.10	76.18	70.37	69.78	73.55	72.47	78.81	80.55	85.22	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	92.31	92.31	92.31	92.31	92.31	92.31	92.31	92.31	92.31	92.31	92.31	92.31	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	14.35	12.75	10.37	7.85	5.87	4.95	5.35	6.96	9.34	11.85	13.83	14.75	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	160.96	162.63	158.42	149.46	138.15	127.52	120.42	118.75	122.95	131.92	143.23	153.86	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.23	32.23	32.23	32.23	32.23	32.23	32.23	32.23	32.23	32.23	32.23	32.23	(69)
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)
Losses e.g. evaporation (Table 5)	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	-73.85	(71)
Water heating gains (Table 5)	116.34	114.53	110.79	105.70	102.39	97.74	93.79	98.85	100.65	105.92	111.87	114.54	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	342.34	340.60	330.27	313.70	297.10	280.90	270.25	275.25	283.64	300.38	319.62	333.84	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
East	0.77	x	2.79	x	19.64	x 0.9 x	0.65	x	0.75	=	18.51	(76)
West	0.77	x	13.92	x	19.64	x 0.9 x	0.65	x	0.75	=	92.36	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains in watts ∑(74)m...(82)m	110.87	216.89	357.19	520.95	638.44	653.56	622.21	534.47	415.43	257.36	138.25	91.18	(83)
Total gains - internal and solar (73)m + (83)m	453.21	557.49	687.46	834.64	935.54	934.46	892.46	809.72	699.07	557.75	457.87	425.01	(84)

7. Mean internal temperature (heating season)

Temperature during heating periods in the living area from Table 9, Th1(˚C) 21.00 (85)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Utilisation factor for gains for living area n1,m (see Table 9a)

0.92	0.87	0.77	0.62	0.46	0.33	0.24	0.27	0.46	0.72	0.88	0.93	(86)

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

19.49	19.84	20.30	20.71	20.90	20.98	20.99	20.99	20.93	20.61	19.98	19.43	(87)

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

20.15	20.15	20.16	20.17	20.17	20.19	20.19	20.19	20.18	20.17	20.17	20.16	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.91	0.86	0.75	0.59	0.43	0.29	0.19	0.22	0.41	0.69	0.87	0.93	(89)

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

18.14	18.64	19.27	19.82	20.07	20.16	20.18	20.18	20.11	19.71	18.85	18.06	(90)

Living area fraction — Living area ÷ (4) = 0.47 (91)

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

18.78	19.21	19.76	20.24	20.46	20.55	20.56	20.56	20.50	20.13	19.38	18.71	(92)

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

18.78	19.21	19.76	20.24	20.46	20.55	20.56	20.56	20.50	20.13	19.38	18.71	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm													
	0.90	0.84	0.74	0.59	0.44	0.30	0.21	0.25	0.43	0.69	0.85	0.91	(94)
Useful gains, ηmGm, W (94)m x (84)m													
	406.04	468.06	509.61	493.88	410.18	283.72	191.32	199.55	298.14	383.52	389.10	386.10	(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	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]													
	734.88	723.87	668.49	562.31	432.99	288.97	192.61	201.55	313.12	471.23	611.33	726.70	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m													
	244.66	171.91	118.21	49.27	16.97	0.00	0.00	0.00	0.00	65.26	160.01	253.41	

∑(98)1...5, 10...12 = 1079.69 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) 19.52 (99)

9b. Energy requirements - community heating scheme

Fraction of space heat from secondary/supplementary system (table 11)	'0' if none	0.00	(301)
Fraction of space heat from community system	1 - (301) =	1.00	(302)
Fraction of community heat from boilers		1.00	(303a)
Fraction of total space heat from community boilers	(302) x (303a) =	1.00	(304a)
Factor for control and charging method (Table 4c(3)) for community space heating		1.00	(305)
Factor for charging method (Table 4c(3)) for community water heating		1.00	(305a)
Distribution loss factor (Table 12c) for community heating system		1.05	(306)

Space heating

Annual space heating requirement	1079.69			(98)
Space heat from boilers		(98) x (304a) x (305) x (306) =	1133.67	(307a)

Water heating

Annual water heating requirement	1878.81			(64)
Water heat from boilers		(64) x (303a) x (305a) x (306) =	1972.75	(310a)
Electricity used for heat distribution		0.01 × [(307a)...(307e) + (310a)...(310e)] =	31.06	(313)

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

mechanical ventilation fans - balanced, extract or positive input from outside	187.47			(330a)
Total electricity for the above, kWh/year			187.47	(331)
Electricity for lighting (Appendix L)			253.42	(332)
Energy saving/generation technologies				
electricity generated by PV (Appendix M)			-608.39	(333)
Total delivered energy for all uses		(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	2938.91	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	1133.67	x	4.24	x 0.01 =	48.07	(340a)
Water heating from boilers	1972.75	x	4.24	x 0.01 =	83.64	(342a)
Pumps and fans	187.47	x	13.19	x 0.01 =	24.73	(349)
Electricity for lighting	253.42	x	13.19	x 0.01 =	33.43	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-608.39	x	13.19	x 0.01 =	0.00	(352)
Total energy cost			(340a)...(342e) + (345)...(354) =		309.87	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.30	(357)
SAP value	81.90	
SAP rating (section 13)	82	(358)
SAP band	B	

12b. CO_2 emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	94.00					(367a)
CO2 emissions from boilers [(307a)+(310a)] x 100 ÷ (367a) =	3304.70	x	0.216	=	713.81	(367)
Electrical energy for community heat distribution	31.06	x	0.52	=	16.12	(372)
Total CO2 associated with community systems					729.94	(373)
Total CO2 associated with space and water heating					729.94	(376)
Pumps and fans	187.47	x	0.52	=	97.30	(378)
Electricity for lighting	253.42	x	0.52	=	131.52	(379)
Energy saving/generation technologies						
pv savings	-608.39	x	0.52	=	-315.76	(380)
Total CO_2, kg/year				(376)..(382) =	643.00	(383)
Dwelling CO_2 emission rate				(383) ÷ (4) =	11.63	(384)
EI value					91.41	
EI rating (section 14)					91	(385)
EI band					B	

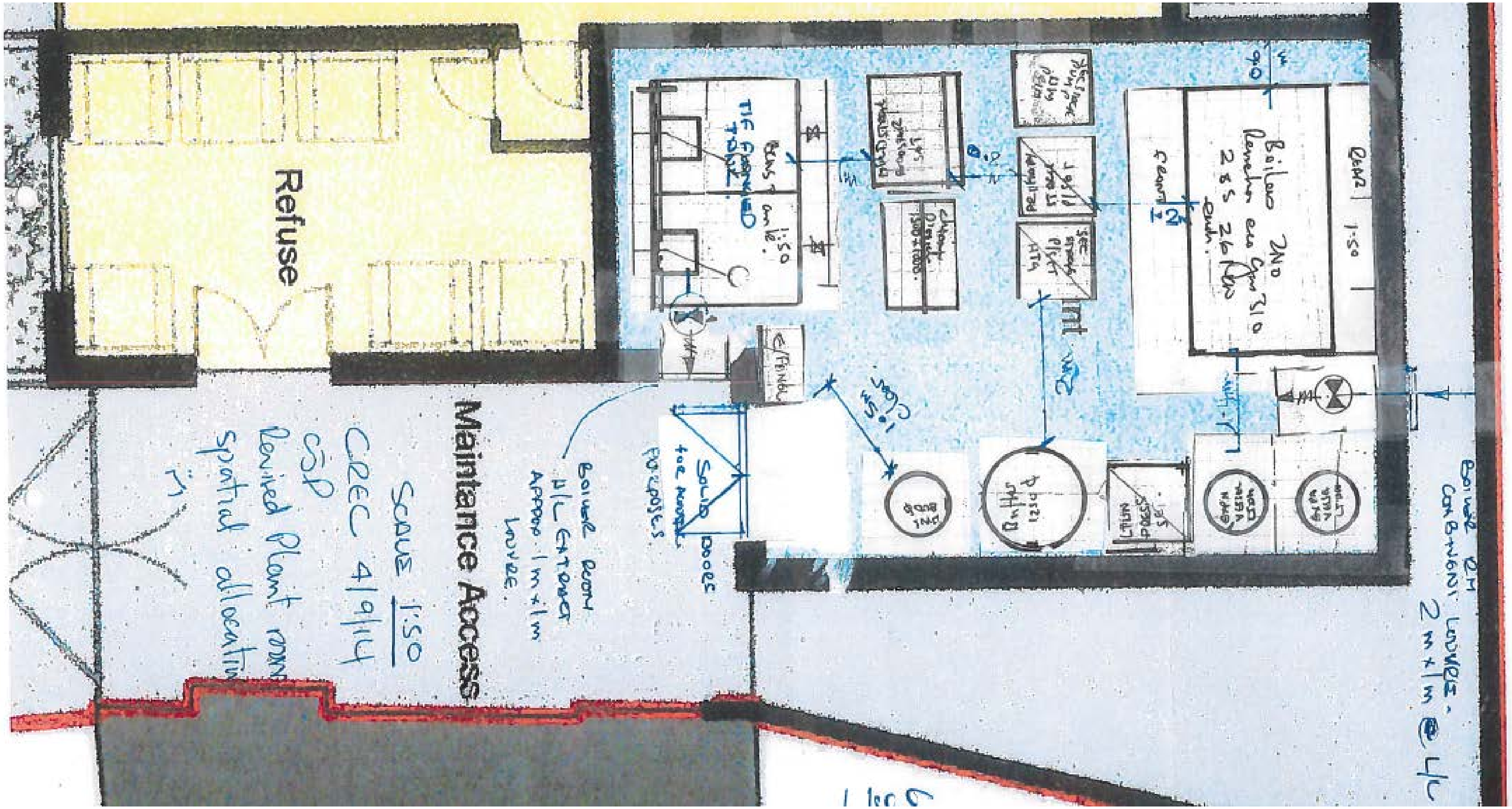
13b. Primary energy - community heating scheme

	Energy kWh/year	Primary factor	Primary energy (kWh/year)	
Primary energy from other sources (space heating)				
Efficiency of boilers	94.00			(367a)
[(307a)+(310a)] x 100 ÷ (367a) =				

Primary energy from boilers	3304.70	x	1.22	=	4031.73	(367)
Electrical energy for community heat distribution	31.06	x	3.07	=	95.37	(372)
Total primary energy associated with community systems					4127.10	(373)
Total primary energy associated with space and water heating					4127.10	(376)
Pumps and fans	187.47	x	3.07	=	575.54	(378)
Electricity for lighting	253.42	x	3.07	=	777.99	(379)
Energy saving/generation technologies						
Electricity generated - PVs	-608.39	x	3.07	=	-1867.77	(380)
Primary energy kWh/year					3612.86	(383)
Dwelling primary energy rate kWh/m2/year					65.33	(384)

APPENDIX B – LONDON HEAT MAP

APPENDIX C – PLANT ROOM LAYOUT



APPENDIX D – APPRAISAL OF RENEWABLE ENERGY TECHNOLOGIES NOT FEASIBLE FOR THE SCHEME

In line with the Mayor's Energy Hierarchy the feasibility of renewable energy technologies has been carried out for the Proposed Development. Overall, there are a number of constraints associated with the application site when considering their installation. Please refer to Section 8 and the table below.

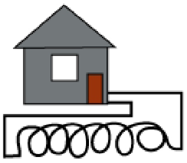
The following table presents a summary of the technologies considered unsuitable for the site. The technologies have been considered as:

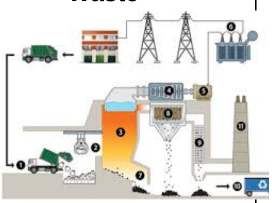
H – High feasibility;

M – Medium feasibility; significant issues would need to be addressed; and

L – Low feasibility; development site not suitable to support the technology.

Technology	Feasibility			Comments
	H	M	L	
1. Solar Hot Water (SHW) Systems 		✔		Active solar hot water technology uses the Sun's energy to heat fluid passing through a collector in an active process. For the Proposed Development, space implications associated with the installation of hot water storage tanks in the basement level plant room or the individual units, as well as the complexity and increased cost resulting from the pipe and plumbing connection, make the SHW system unviable for the scheme. In addition, the roof will be fully utilized from the PV panels and therefore there will be no additional roof area available for further solar technologies' installation. Therefore a solar hot water system is not considered feasible for the site.

Technology	Feasibility			Comments
	H	M	L	
2. Ground Source Heat Pump (GSHP) 			✔	GSHP technology exploits seasonal temperature differences between ground and air temperatures to provide heating in the winter and air conditioning in the summer. GSHP systems use some electricity to run the heat pump, but as most of the energy for heating is taken from the ground, they produce less greenhouse gas than conventional heating systems. Pipe work is placed either horizontally or vertically in the ground. Fluid pumped through the pipes takes up heat which is then extracted by the heat pump and released at a higher temperature to drive a space heating system. Horizontal systems are considered most suitable for large open-space developments and are therefore not appropriate for the Proposed Development. Vertical systems are considered most appropriate for developments with site area restrictions. Typical vertical systems, utilising flow-return water closed-loop configurations, can achieve outputs of approximately 50W/m depth. The Proposed Development could accommodate pile depths of circa 20m each, resulting in around 1kW output per pile. Appropriate spacing arrangements should be made between piles to ensure thermal breakthrough is prevented. Such spacing at the Proposed Development suggests that a maximum of 4 piles could be supported onsite, making the maximum output of the system as a whole to be approximately 4kW. The expected 3,000 hour heating season means 12MWh of heat could be extracted annually. Typical GSHP seasonal efficiencies of around 350%, displacing currently proposed heating systems, would therefore result in CO_2 savings of approximately 1 tonne per year. These modest CO_2 savings should be balanced against the significant cost implications and design coordination complications of its adoption – it is considered an unviable solution for the Proposed Development, particularly in light of the modest savings that its implementation would achieve. Additionally, a GSHP system will not be compatible with any future connection to a DH network, which is being safeguarded onsite. Furthermore, a detailed geological survey, including test boreholes, would be required to verify the suitability of ground conditions and accurately estimate the potential capacity of GSHP scheme. Due to the constraints mentioned above and due to the increased installation and connection costs, GSHP technology is not considered suitable for this site.

Technology	Feasibility			Comments
	H	M	L	
3. Wind Power 			✓	Micro wind turbines can be fitted to the roof of any selected building (given appropriate structural measures). Mast-mounted wind turbines can be located in an open area away from obstructions such as buildings and tall trees. A report by BRE[4] highlighted inherent problems and the poor performance to date of urban micro wind installations. Both technologies are considered marginally viable in built environments by the majority of small wind turbine manufacturers[5] due to the relatively low (and turbulent) wind speed prevailing in an urban environment. The DECC database indicates a predicted wind speed of 4.9 m/s @ 10m above ground level at nearest postcode. Hence, due to the relatively low wind speed and lack of suitable space in this built environment, the use of these technologies is not considered feasible.
4. Biomass Heating 			✓	Biomass boilers work on the principle that the combustion of wood chip or pellets can create heat for space heating and hot water loads. There are several factors that strongly disadvantage this technology, namely: • On-site fuel storage space requirements; • The impact on local air quality (concerns exist over the level of Nitrogen dioxide (NO_2) and particulate matter PM_{10} emissions from biomass boiler installations, particularly in air quality management areas); • Fuel sourcing and the cost of fuel; • Traffic movement and access arrangements for regular fuel deliveries; and • Regular ash removal and maintenance requirements. Biomass boilers are therefore not further considered for the Proposed Development.
5. Energy from Waste 			✓	Methane gas from sewage or waste can be captured and used for firing boilers. The Proposed Development will not generate sufficient waste to make this option worthwhile. Moreover plant space requirements and emissions (air quality and odour) would be an issue. This option is therefore not considered feasible.

[4] Micro wind turbine in urban environments, Richard Phillips, Paul Blackmore, Jane Anderson, Michael Clift, Antonio Aguiló-Rullán and Steve Pester, BRE 2007 ISBN 978-1-84806-021-0.

[5] A report by Poyry on behalf of *Department for Energy and Climate Change* concludes that a wind system of 1.5-15 kW would require an average wind speed of 5.5 m/s to achieve circa 7% load factor.

APPENDIX E – ROOF LAYOUT