

Energy saving/generation technologies

electricity generated by PV (Appendix M)

-259.09 (333)

Total delivered energy for all uses

(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) = 3835.09 (338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from heat pump	1229.87	x	4.24	x 0.01 =	52.15	(340a)
Water heating from heat pump	2298.83	x	4.24	x 0.01 =	97.47	(342a)
Pumps and fans	194.04	x	13.19	x 0.01 =	25.59	(349)
Electricity for lighting	371.44	x	13.19	x 0.01 =	48.99	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-259.09	x	13.19	x 0.01 =	0.00	(352)
Total energy cost				(340a)...(342e) + (345)...(354) =	344.20	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.08	(357)
SAP value	84.87	
SAP rating (section 13)	85	(358)
SAP band	8	

12b. CO₂ emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of heat pump	300.00					(367a)
CO ₂ emissions from heat pump [(307a)+(310a)] x 100 ÷ (367a) =	1176.23	x	0.519	=	610.46	(367)
Electrical energy for community heat distribution	35.29	x	0.519	=	18.31	(372)
Total CO ₂ associated with community systems					628.78	(373)
Total CO ₂ associated with space and water heating					628.78	(376)
Pumps and fans	194.04	x	0.519	=	100.71	(378)
Electricity for lighting	371.44	x	0.519	=	192.78	(379)
Energy saving/generation technologies						
pv savings	-259.09	x	0.519	=	-134.47	(380)
Total CO ₂ , kg/year				(376)...(382) =	787.80	(383)
Dwelling CO ₂ emission rate				(383) ÷ (4) =	8.92	(384)
EI value					92.08	
EI rating (section 14)					92	(385)
EI band					A	

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	300.00					(367a)
Primary energy from heat pump [(307a)+(310a)] x 100 ÷ (367a) =	1176.23	x	3.07	=	3611.03	(367)
Electrical energy for community heat distribution	35.29	x	3.07	=	108.33	(372)
Total primary energy associated with community systems					3719.36	(373)

Total primary energy associated with space and water heating					3719.36	(376)
Pumps and fans	194.04	x	3.07	=	595.71	(378)
Electricity for lighting	371.44	x	3.07	=	1140.32	(379)
Energy saving/generation technologies						
Electricity generated - PVs	-259.09	x	3.07	=	-795.39	(380)
Primary energy kWh/year					4659.99	(383)
Dwelling primary energy rate kWh/m2/year					52.77	(384)

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 AECOM Planner	Assessor number	101
Client	Default Client	Last modified	30/08/2018
Address	2.12 redYellow 42, London		

1. Overall dwelling dimensions

	Area (m ²)	Average storey height (m)	Volume (m ³)
Lowest occupied	94.46 (1a) x	2.62 (2a) =	247.49 (3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) = 94.46 (4)		
Dwelling volume		(3a) + (3b) + (3c) + (3d)...(3n) =	247.49 (5)

2. Ventilation rate

		m ³ 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, q ₅₀ , 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

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
-----------------------	------	------	------	------	------	------	------	------	------	------	------	------

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
---	------	------	------	------	------	------	------	------	------	------	------	------

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	76.50 (23c)
--	-------------

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

	0.28	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.25	0.25	0.26	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
--	------	------	------	------	------	------	------	------	------	------	------	------

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			18.06	1.33	23.94		(27)						
External wall			39.26	0.18	7.07		(29a)						
Party wall			64.37	0.00	0.00		(32)						
Total area of external elements ΣA, m ²			57.32				(31)						
Fabric heat loss, W/K = Σ(A x U)					(26)...(30) + (32) =	31.01	(33)						
Heat capacity Cm = Σ(A x κ)					(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)						
Thermal mass parameter (TMP) in kJ/m ² K						100.00	(35)						
Thermal bridges: Σ(L x Ψ) calculated using Appendix K						8.60	(36)						
Total fabric heat loss					(33) + (36) =	39.61	(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)	22.87	22.61	22.35	21.05	20.79	19.49	19.49	19.23	20.01	20.79	21.31	21.83	(38)
Heat transfer coefficient, W/K (37)m + (38)m	62.48	62.22	61.96	60.66	60.40	59.10	59.10	58.84	59.62	60.40	60.92	61.44	
	Average = Σ(39)1...12/12 =											60.59	(39)
Heat loss parameter (HLP), W/m ² K (39)m ÷ (4)	0.66	0.66	0.66	0.64	0.64	0.63	0.63	0.62	0.63	0.64	0.64	0.65	
	Average = Σ(40)1...12/12 =											0.64	(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												2.68	(42)	
Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$												97.90	(43)	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage in litres per day for each month $V_{d,m} = \text{factor from Table 1c} \times (43)$														
	107.69	103.77	99.86	95.94	92.02	88.11	88.11	92.02	95.94	99.86	103.77	107.69		
												$\Sigma(44)_{1...12} =$	1174.77	(44)
Energy content of hot water used = $4.18 \times V_{d,m} \times n_m \times T_m / 3600$ kWh/month (see Tables 1b, 1c 1d)														
	159.70	139.67	144.13	125.65	120.57	104.04	96.41	110.63	111.95	130.47	142.42	154.66		
												$\Sigma(45)_{1...12} =$	1540.30	(45)
Distribution loss $0.15 \times (45)_m$														
	23.95	20.95	21.62	18.85	18.09	15.61	14.46	16.59	16.79	19.57	21.36	23.20	(46)	
Storage volume (litres) including any solar or WWHRS storage within same vessel												180.00	(47)	
Water storage loss:														
a) If manufacturer's declared loss factor is known (kWh/day)												1.85	(48)	
Temperature factor from Table 2b												0.60	(49)	
Energy lost from water storage (kWh/day) $(48) \times (49)$												1.11	(50)	
Enter (50) or (54) in (55)												1.11	(55)	
Water storage loss calculated for each month $(55) \times (41)_m$														
	34.41	31.08	34.41	33.30	34.41	33.30	34.41	34.41	33.30	34.41	33.30	34.41	(56)	
If the vessel contains dedicated solar storage or dedicated WWHRS $(56)_m \times [(47) - V_s] \div (47)$, else (56)														
	34.41	31.08	34.41	33.30	34.41	33.30	34.41	34.41	33.30	34.41	33.30	34.41	(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 $0.85 \times (45)m + (46)m + (57)m + (59)m + (61)m$

217.37	191.76	201.80	181.47	178.24	159.85	154.08	168.30	167.77	188.14	198.23	212.33	(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) $(62)m + (63)m$

217.37	191.76	201.80	181.47	178.24	159.85	154.08	168.30	167.77	188.14	198.23	212.33	
$\Sigma(64)1...12 =$											2219.35	(64)

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

99.24	88.11	94.06	86.43	86.23	79.24	78.19	82.92	81.87	89.52	92.00	97.56	(65)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

5. Internal gains

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

Metabolic gains (Table 5)

134.10	134.10	134.10	134.10	134.10	134.10	134.10	134.10	134.10	134.10	134.10	134.10	(66)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

22.04	19.57	15.92	12.05	9.01	7.61	8.22	10.68	14.34	18.20	21.25	22.65	(67)
-------	-------	-------	-------	------	------	------	-------	-------	-------	-------	-------	------

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

247.05	249.61	243.15	229.40	212.04	195.72	184.82	182.26	188.72	202.47	219.83	236.15	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

36.41	36.41	36.41	36.41	36.41	36.41	36.41	36.41	36.41	36.41	36.41	36.41	(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)

-107.28	-107.28	-107.28	-107.28	-107.28	-107.28	-107.28	-107.28	-107.28	-107.28	-107.28	-107.28	(71)
---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	------

Water heating gains (Table 5)

133.38	131.12	126.43	120.04	115.90	110.06	105.10	111.46	113.71	120.32	127.78	131.13	(72)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

465.70	463.54	448.73	424.72	400.17	376.62	361.37	367.62	380.00	404.23	432.09	453.16	(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

South $0.77 \times 7.41 \times 46.75 \times 0.9 \times 0.45 \times 0.80 = 86.43$ (78)

East $0.77 \times 10.65 \times 19.64 \times 0.9 \times 0.45 \times 0.80 = 52.18$ (76)

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

138.61	243.63	348.42	448.97	512.84	511.96	492.52	445.46	383.87	273.80	167.51	117.59	(83)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

604.31	707.17	797.14	873.69	913.01	888.58	853.89	813.09	763.87	678.03	599.60	570.75	(84)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

7. Mean internal temperature (heating season)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	21.00	(85)
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-------	------

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

0.94	0.90	0.84	0.72	0.58	0.42	0.30	0.33	0.52	0.76	0.91	0.95	(86)
------	------	------	------	------	------	------	------	------	------	------	------	------

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

19.92	20.17	20.47	20.76	20.92	20.98	21.00	20.99	20.96	20.75	20.30	19.88	(87)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

20.38	20.38	20.38	20.39	20.39	20.41	20.41	20.41	20.40	20.39	20.39	20.38	(88)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Utilisation factor for gains for rest of dwelling n2,m

0.94	0.89	0.82	0.70	0.54	0.38	0.26	0.29	0.48	0.74	0.89	0.95	(89)
------	------	------	------	------	------	------	------	------	------	------	------	------

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

18.91	19.27	19.69	20.10	20.30	20.39	20.40	20.41	20.36	20.09	19.47	18.86	(90)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Living area fraction

Living area ÷ (4) = 0.46 (91)

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

19.38	19.69	20.05	20.40	20.59	20.66	20.68	20.68	20.64	20.39	19.86	19.33	(92)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

19.38	19.69	20.05	20.40	20.59	20.66	20.68	20.68	20.64	20.39	19.86	19.33	(93)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

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

Utilisation factor for gains, ηm

0.92	0.88	0.81	0.70	0.55	0.40	0.28	0.31	0.49	0.74	0.88	0.93	(94)
------	------	------	------	------	------	------	------	------	------	------	------	------

Useful gains, ηmGm, W (94)m x (84)m

558.83	623.64	647.95	609.78	506.59	352.46	239.86	250.06	375.76	500.54	529.64	533.55	(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)]

942.23	920.26	839.86	697.85	536.74	358.40	241.01	251.71	389.80	591.51	777.15	929.84	(97)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

285.25	199.33	142.79	63.41	22.44	0.00	0.00	0.00	0.00	67.68	178.21	294.84	(98)
--------	--------	--------	-------	-------	------	------	------	------	-------	--------	--------	------

Σ(98)1...5, 10...12 = 1253.94 (98)

Space heating requirement kWh/m²/year

(98) ÷ (4) = 13.27 (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 heat pump

1.00 (303a)

Fraction of total space heat from community heat pump

(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

1253.94 (98)

Space heat from heat pump

(98) x (304a) x (305) x (306) = 1316.64 (307a)

Water heating

Annual water heating requirement

2219.35 (64)

Water heat from heat pump

(64) x (303a) x (305a) x (306) = 2330.32 (310a)

Electricity used for heat distribution

0.01 x [(307a)...(307e) + (310a)...(310e)] = 36.47 (313)

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

207.58 (330a)

mechanical ventilation fans - balanced, extract or positive input from outside

Total electricity for the above, kWh/year

207.58 (331)

Electricity for lighting (Appendix L)		389.19	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-259.09	(333)
Total delivered energy for all uses	$(307) + (309) + (310) + (312) + (315) + (331) + (332) \dots (337b) =$	3984.63	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from heat pump	1316.64	x	4.24	x 0.01 =	55.83	(340a)
Water heating from heat pump	2330.32	x	4.24	x 0.01 =	98.81	(342a)
Pumps and fans	207.58	x	13.19	x 0.01 =	27.38	(349)
Electricity for lighting	389.19	x	13.19	x 0.01 =	51.33	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-259.09	x	13.19	x 0.01 =	0.00	(352)
Total energy cost				$(340a) \dots (342e) + (345) \dots (354) =$	353.34	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.06	(357)
SAP value	85.16	
SAP rating (section 13)	85	(358)
SAP band	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	300.00					(367a)
CO ₂ emissions from heat pump $[(307a)+(310a)] \times 100 \div (367a) =$	1215.65	x	0.519	=	630.92	(367)
Electrical energy for community heat distribution	36.47	x	0.519	=	18.93	(372)
Total CO ₂ associated with community systems					649.85	(373)
Total CO ₂ associated with space and water heating					649.85	(376)
Pumps and fans	207.58	x	0.519	=	107.73	(378)
Electricity for lighting	389.19	x	0.519	=	201.99	(379)
Energy saving/generation technologies						
pv savings	-259.09	x	0.519	=	-134.47	(380)
Total CO ₂ , kg/year				$(376) \dots (382) =$	825.11	(383)
Dwelling CO ₂ emission rate				$(383) \div (4) =$	8.73	(384)
EI value					92.07	
EI rating (section 14)					92	(385)
EI band					A	

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	300.00					(367a)
Primary energy from heat pump $[(307a)+(310a)] \times 100 \div (367a) =$	1215.65	x	3.07	=	3732.05	(367)
Electrical energy for community heat distribution	36.47	x	3.07	=	111.96	(372)

Total primary energy associated with community systems					3844.01	(373)
Total primary energy associated with space and water heating					3844.01	(376)
Pumps and fans	207.58	x	3.07	=	637.27	(378)
Electricity for lighting	389.19	x	3.07	=	1194.80	(379)
Energy saving/generation technologies						
Electricity generated - PVs	-259.09	x	3.07	=	-795.39	(380)
Primary energy kWh/year					4880.69	(383)
Dwelling primary energy rate kWh/m2/year					51.67	(384)

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 AECOM Planner	Assessor number	101
Client	Default Client	Last modified	30/08/2018
Address	2.15 redYellow 42, London		

1. Overall dwelling dimensions

	Area (m ²)	Average storey height (m)	Volume (m ³)
Lowest occupied	82.75 (1a) x	2.62 (2a) =	216.81 (3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) = 82.75 (4)		
Dwelling volume		(3a) + (3b) + (3c) + (3d)...(3n) =	216.81 (5)

2. Ventilation rate

		m ³ 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	76.50 (23c)
--	--

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

0.28	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.25	0.25	0.26	0.27 (24a)
-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	---

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 (25)
-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	--

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			25.83	1.33	34.24		(27)						
External wall			28.59	0.18	5.15		(29a)						
Party wall			51.73	0.00	0.00		(32)						
Total area of external elements ΣA, m ²			54.42				(31)						
Fabric heat loss, W/K = Σ(A x U)					(26)...(30) + (32) =	39.39	(33)						
Heat capacity Cm = Σ(A x κ)					(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)						
Thermal mass parameter (TMP) in kJ/m ² K						100.00	(35)						
Thermal bridges: Σ(L x Ψ) calculated using Appendix K						8.16	(36)						
Total fabric heat loss					(33) + (36) =	47.55	(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)	20.04	19.81	19.58	18.44	18.21	17.07	17.07	16.84	17.53	18.21	18.67	19.13	(38)
Heat transfer coefficient, W/K (37)m + (38)m	67.59	67.36	67.13	65.99	65.77	64.63	64.63	64.40	65.08	65.77	66.22	66.68	
	Average = Σ(39)1...12/12 =											65.94	(39)
Heat loss parameter (HLP), W/m ² K (39)m ÷ (4)	0.82	0.81	0.81	0.80	0.79	0.78	0.78	0.78	0.79	0.79	0.80	0.81	
	Average = Σ(40)1...12/12 =											0.80	(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												2.51	(42)	
Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$												93.88	(43)	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage in litres per day for each month $V_{d,m} = \text{factor from Table 1c} \times (43)$	103.27	99.52	95.76	92.01	88.25	84.49	84.49	88.25	92.01	95.76	99.52	103.27		
												$\Sigma(44)1...12 =$	1126.60	(44)
Energy content of hot water used = $4.18 \times V_{d,m} \times n_m \times T_m / 3600$ kWh/month (see Tables 1b, 1c 1d)	153.15	133.94	138.22	120.50	115.63	99.78	92.46	106.10	107.36	125.12	136.58	148.32		
												$\Sigma(45)1...12 =$	1477.15	(45)
Distribution loss $0.15 \times (45)m$	22.97	20.09	20.73	18.08	17.34	14.97	13.87	15.91	16.10	18.77	20.49	22.25	(46)	
Storage volume (litres) including any solar or WWHRS storage within same vessel												180.00	(47)	
Water storage loss:														
a) If manufacturer's declared loss factor is known (kWh/day)												1.85	(48)	
Temperature factor from Table 2b												0.60	(49)	
Energy lost from water storage (kWh/day) $(48) \times (49)$												1.11	(50)	
Enter (50) or (54) in (55)												1.11	(55)	
Water storage loss calculated for each month $(55) \times (41)m$	34.41	31.08	34.41	33.30	34.41	33.30	34.41	34.41	33.30	34.41	33.30	34.41	(56)	
If the vessel contains dedicated solar storage or dedicated WWHRS $(56)m \times [(47) - V_s] \div (47)$, else (56)	34.41	31.08	34.41	33.30	34.41	33.30	34.41	34.41	33.30	34.41	33.30	34.41	(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 $0.85 \times (45)m + (46)m + (57)m + (59)m + (61)m$

210.82	186.04	195.89	176.31	173.30	155.59	150.13	163.77	163.17	182.79	192.39	205.99	(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) $(62)m + (63)m$

210.82	186.04	195.89	176.31	173.30	155.59	150.13	163.77	163.17	182.79	192.39	205.99	
$\Sigma(64)1...12 =$											2156.19	(64)

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

97.06	86.21	92.10	84.72	84.58	77.83	76.88	81.41	80.35	87.74	90.06	95.45	(65)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

5. Internal gains

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

Metabolic gains (Table 5)

125.65	125.65	125.65	125.65	125.65	125.65	125.65	125.65	125.65	125.65	125.65	125.65	(66)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

20.07	17.82	14.49	10.97	8.20	6.93	7.48	9.73	13.06	16.58	19.35	20.62	(67)
-------	-------	-------	-------	------	------	------	------	-------	-------	-------	-------	------

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

225.09	227.43	221.54	209.01	193.19	178.33	168.40	166.06	171.95	184.48	200.29	215.16	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

35.56	35.56	35.56	35.56	35.56	35.56	35.56	35.56	35.56	35.56	35.56	35.56	(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)

-100.52	-100.52	-100.52	-100.52	-100.52	-100.52	-100.52	-100.52	-100.52	-100.52	-100.52	-100.52	(71)
---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	------

Water heating gains (Table 5)

130.46	128.29	123.78	117.66	113.69	108.09	103.33	109.43	111.59	117.93	125.09	128.30	(72)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

436.31	434.23	420.52	398.34	375.78	354.04	339.91	345.91	357.29	379.68	405.42	424.78	(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

South $0.77 \times 17.97 \times 46.75 \times 0.9 \times 0.45 \times 0.80 = 209.60$ (78)

West $0.77 \times 7.86 \times 19.64 \times 0.9 \times 0.45 \times 0.80 = 38.51$ (80)

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

248.11	418.60	561.33	675.15	736.75	722.62	700.36	655.91	601.07	459.64	296.46	212.78	(83)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

684.42	852.84	981.85	1073.49	1112.53	1076.66	1040.27	1001.82	958.36	839.32	701.89	637.56	(84)
--------	--------	--------	---------	---------	---------	---------	---------	--------	--------	--------	--------	------

7. Mean internal temperature (heating season)

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

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec 21.00 (85)

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

0.91	0.85	0.76	0.65	0.51	0.37	0.27	0.29	0.45	0.69	0.86	0.93	(86)
------	------	------	------	------	------	------	------	------	------	------	------	------

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

19.77	20.12	20.45	20.74	20.90	20.97	20.99	20.99	20.95	20.73	20.22	19.70	(87)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

20.24	20.24	20.24	20.26	20.26	20.27	20.27	20.27	20.27	20.26	20.25	20.25	(88)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Utilisation factor for gains for rest of dwelling n2,m

0.90	0.83	0.74	0.62	0.48	0.33	0.23	0.25	0.41	0.65	0.84	0.92	(89)
------	------	------	------	------	------	------	------	------	------	------	------	------

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

18.60	19.09	19.55	19.94	20.15	20.25	20.27	20.27	20.22	19.94	19.25	18.51	(90)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Living area fraction

Living area ÷ (4) = 0.52 (91)

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

19.21	19.63	20.02	20.36	20.54	20.63	20.65	20.65	20.60	20.36	19.76	19.13	(92)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

19.21	19.63	20.02	20.36	20.54	20.63	20.65	20.65	20.60	20.36	19.76	19.13	(93)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

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

Utilisation factor for gains, ηm

0.89	0.82	0.74	0.62	0.49	0.35	0.25	0.27	0.43	0.66	0.83	0.90	(94)
------	------	------	------	------	------	------	------	------	------	------	------	------

Useful gains, ηmGm, W (94)m x (84)m

607.68	699.63	722.24	666.78	547.47	381.39	259.66	270.96	407.53	551.76	583.41	575.76	(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]

1007.89	992.07	907.78	756.28	581.52	389.56	261.53	273.44	423.21	641.65	838.26	995.72	(97)
---------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

297.76	196.52	138.04	64.44	25.33	0.00	0.00	0.00	0.00	66.88	183.49	312.45	
--------	--------	--------	-------	-------	------	------	------	------	-------	--------	--------	--

Σ(98)1...5, 10...12 = 1284.91 (98)

Space heating requirement kWh/m²/year

(98) ÷ (4) = 15.53 (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 heat pump

1.00 (303a)

Fraction of total space heat from community heat pump

(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

1284.91 (98)

Space heat from heat pump

(98) x (304a) x (305) x (306) = 1349.15 (307a)

Water heating

Annual water heating requirement

2156.19 (64)

Water heat from heat pump

(64) x (303a) x (305a) x (306) = 2264.00 (310a)

Electricity used for heat distribution

0.01 x [(307a)...(307e) + (310a)...(310e)] = 36.13 (313)

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

mechanical ventilation fans - balanced, extract or positive input from outside

181.85 (330a)

Total electricity for the above, kWh/year

181.85 (331)

Electricity for lighting (Appendix L)		354.39	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-259.09	(333)
Total delivered energy for all uses	$(307) + (309) + (310) + (312) + (315) + (331) + (332) \dots (337b) =$	3890.31	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from heat pump	1349.15	x	4.24	x 0.01 =	57.20	(340a)
Water heating from heat pump	2264.00	x	4.24	x 0.01 =	95.99	(342a)
Pumps and fans	181.85	x	13.19	x 0.01 =	23.99	(349)
Electricity for lighting	354.39	x	13.19	x 0.01 =	46.74	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-259.09	x	13.19	x 0.01 =	0.00	(352)
Total energy cost				$(340a) \dots (342e) + (345) \dots (354) =$	343.93	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.13	(357)
SAP value	84.23	
SAP rating (section 13)	84	(358)
SAP band	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	300.00					(367a)
CO ₂ emissions from heat pump $[(307a)+(310a)] \times 100 \div (367a) =$	1204.39	x	0.519	=	625.08	(367)
Electrical energy for community heat distribution	36.13	x	0.519	=	18.75	(372)
Total CO ₂ associated with community systems					643.83	(373)
Total CO ₂ associated with space and water heating					643.83	(376)
Pumps and fans	181.85	x	0.519	=	94.38	(378)
Electricity for lighting	354.39	x	0.519	=	183.93	(379)
Energy saving/generation technologies						
pv savings	-259.09	x	0.519	=	-134.47	(380)
Total CO ₂ , kg/year				$(376) \dots (382) =$	787.67	(383)
Dwelling CO ₂ emission rate				$(383) \div (4) =$	9.52	(384)
EI value					91.74	
EI rating (section 14)					92	(385)
EI band					A	

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	300.00					(367a)
Primary energy from heat pump $[(307a)+(310a)] \times 100 \div (367a) =$	1204.39	x	3.07	=	3697.46	(367)
Electrical energy for community heat distribution	36.13	x	3.07	=	110.92	(372)

Total primary energy associated with community systems					3808.39	(373)
Total primary energy associated with space and water heating					3808.39	(376)
Pumps and fans	181.85	x	3.07	=	558.26	(378)
Electricity for lighting	354.39	x	3.07	=	1087.98	(379)
Energy saving/generation technologies						
Electricity generated - PVs	-259.09	x	3.07	=	-795.39	(380)
Primary energy kWh/year					4659.24	(383)
Dwelling primary energy rate kWh/m2/year					56.30	(384)

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 AECOM Planner	Assessor number	101
Client	Default Client	Last modified	30/08/2018
Address	2.19 redYellow 42, London		

1. Overall dwelling dimensions

	Area (m ²)	Average storey height (m)	Volume (m ³)
Lowest occupied	53.10 (1a)	2.62 (2a)	139.12 (3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) = 53.10 (4)		
Dwelling volume	(3a) + (3b) + (3c) + (3d)...(3n) = 139.12 (5)		

2. Ventilation rate

		m ³ 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, q ₅₀ , 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
-----------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------

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
---	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------

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	76.50 (23c)
--	--

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

0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.23	0.24	0.25	0.25
-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------

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

0.27	0.26	0.26	0.25	0.24	0.23	0.23	0.23	0.23	0.23	0.24	0.25	0.25
-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------

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			10.65	1.33	14.12		(27)						
External wall			8.95	0.18	1.61		(29a)						
Party wall			63.88	0.00	0.00		(32)						
Total area of external elements ΣA, m ²			19.60				(31)						
Fabric heat loss, W/K = Σ(A x U)					(26)...(30) + (32) =	15.73	(33)						
Heat capacity Cm = Σ(A x κ)					(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)						
Thermal mass parameter (TMP) in kJ/m ² K						100.00	(35)						
Thermal bridges: Σ(L x Ψ) calculated using Appendix K						2.94	(36)						
Total fabric heat loss					(33) + (36) =	18.67	(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)	12.20	12.07	11.93	11.27	11.13	10.46	10.46	10.33	10.73	11.13	11.40	11.67	(38)
Heat transfer coefficient, W/K (37)m + (38)m	30.87	30.74	30.60	29.94	29.80	29.13	29.13	29.00	29.40	29.80	30.07	30.34	
	Average = Σ(39)1...12/12 =											29.90	(39)
Heat loss parameter (HLP), W/m ² K (39)m ÷ (4)	0.58	0.58	0.58	0.56	0.56	0.55	0.55	0.55	0.55	0.56	0.57	0.57	
	Average = Σ(40)1...12/12 =											0.56	(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												1.78	(42)	
Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$												76.51	(43)	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage in litres per day for each month $V_{d,m} = \text{factor from Table 1c} \times (43)$														
	84.16	81.10	78.04	74.98	71.92	68.86	68.86	71.92	74.98	78.04	81.10	84.16		
												$\Sigma(44)_{1...12} =$	918.13	(44)
Energy content of hot water used = $4.18 \times V_{d,m} \times n_m \times T_m / 3600$ kWh/month (see Tables 1b, 1c 1d)														
	124.81	109.16	112.64	98.20	94.23	81.31	75.35	86.46	87.50	101.97	111.31	120.87		
												$\Sigma(45)_{1...12} =$	1203.81	(45)
Distribution loss $0.15 \times (45)_m$														
	18.72	16.37	16.90	14.73	14.13	12.20	11.30	12.97	13.12	15.30	16.70	18.13	(46)	
Storage volume (litres) including any solar or WWHRs storage within same vessel												180.00	(47)	
Water storage loss:														
a) If manufacturer's declared loss factor is known (kWh/day)												1.85	(48)	
Temperature factor from Table 2b												0.60	(49)	
Energy lost from water storage (kWh/day) $(48) \times (49)$												1.11	(50)	
Enter (50) or (54) in (55)												1.11	(55)	
Water storage loss calculated for each month $(55) \times (41)_m$														
	34.41	31.08	34.41	33.30	34.41	33.30	34.41	34.41	33.30	34.41	33.30	34.41	(56)	
If the vessel contains dedicated solar storage or dedicated WWHRs $(56)_m \times [(47) - V_s] \div (47)$, else (56)														
	34.41	31.08	34.41	33.30	34.41	33.30	34.41	34.41	33.30	34.41	33.30	34.41	(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	0.00
------	------	------	------	------	------	------	------	------	------	------	------	------

 (61)

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

182.48	161.25	170.32	154.02	151.90	137.13	133.02	144.14	143.31	159.64	167.12	178.54
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (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

182.48	161.25	170.32	154.02	151.90	137.13	133.02	144.14	143.31	159.64	167.12	178.54
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

$$\Sigma(64)1...12 = 1882.86 \quad (64)$$

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

87.64	77.97	83.59	77.30	77.47	71.69	71.19	74.89	73.74	80.04	81.66	86.33
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (65)

5. Internal gains

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

Metabolic gains (Table 5)

89.08	89.08	89.08	89.08	89.08	89.08	89.08	89.08	89.08	89.08	89.08	89.08
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (66)

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

13.84	12.30	10.00	7.57	5.66	4.78	5.16	6.71	9.01	11.44	13.35	14.23
-------	-------	-------	------	------	------	------	------	------	-------	-------	-------

 (67)

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

155.28	156.89	152.83	144.18	133.27	123.02	116.17	114.55	118.61	127.26	138.17	148.43
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (68)

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

31.91	31.91	31.91	31.91	31.91	31.91	31.91	31.91	31.91	31.91	31.91	31.91
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (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)

-71.26	-71.26	-71.26	-71.26	-71.26	-71.26	-71.26	-71.26	-71.26	-71.26	-71.26	-71.26
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (71)

Water heating gains (Table 5)

117.79	116.02	112.35	107.36	104.13	99.56	95.69	100.65	102.42	107.58	113.42	116.03
--------	--------	--------	--------	--------	-------	-------	--------	--------	--------	--------	--------

 (72)

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

336.63	334.93	324.90	308.84	292.78	277.08	266.74	271.64	279.76	296.00	314.65	328.41
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (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

West

$$0.77 \times 10.65 \times 19.64 \times 0.9 \times 0.45 \times 0.80 = 52.18 \quad (80)$$

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

52.18	102.08	168.11	245.18	300.48	307.60	292.85	251.55	195.52	121.13	65.07	42.91
-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	-------

 (83)

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

388.82	437.01	493.02	554.03	593.26	584.68	559.58	523.19	475.29	417.13	379.72	371.32
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

 (84)

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

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

0.90	0.85	0.76	0.61	0.46	0.32	0.23	0.25	0.42	0.68	0.85	0.91
------	------	------	------	------	------	------	------	------	------	------	------

 (86)

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

20.31	20.49	20.72	20.90	20.98	21.00	21.00	21.00	20.99	20.88	20.59	20.28
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

 (87)

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

20.45	20.45	20.45	20.46	20.47	20.48	20.48	20.48	20.47	20.47	20.46	20.46	(88)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Utilisation factor for gains for rest of dwelling n2,m

0.89	0.84	0.75	0.59	0.43	0.29	0.20	0.23	0.39	0.65	0.83	0.90	(89)
------	------	------	------	------	------	------	------	------	------	------	------	------

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

19.52	19.77	20.09	20.35	20.44	20.47	20.48	20.48	20.46	20.32	19.93	19.49	(90)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Living area fraction

Living area ÷ (4) = 0.56 (91)

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

19.96	20.18	20.44	20.66	20.74	20.77	20.77	20.77	20.76	20.64	20.30	19.93	(92)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

19.96	20.18	20.44	20.66	20.74	20.77	20.77	20.77	20.76	20.64	20.30	19.93	(93)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

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

Utilisation factor for gains, η_m

0.88	0.84	0.75	0.60	0.45	0.31	0.22	0.24	0.41	0.66	0.83	0.90	(94)
------	------	------	------	------	------	------	------	------	------	------	------	------

Useful gains, $\eta_m G_m$, W (94)m x (84)m

343.66	365.14	367.67	331.83	264.44	178.99	121.41	126.60	193.28	274.70	314.37	332.48	(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, L_m , W [(39)m x [(93)m - (96)m]

483.54	469.58	426.68	352.07	269.45	179.71	121.53	126.79	195.74	299.16	397.06	477.32	(97)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

104.08	70.19	43.91	14.57	3.73	0.00	0.00	0.00	0.00	18.20	59.54	107.76	
--------	-------	-------	-------	------	------	------	------	------	-------	-------	--------	--

$\Sigma(98)1...5, 10...12 = 421.96$ (98)

Space heating requirement kWh/m²/year

(98) ÷ (4) = 7.95 (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 heat pump

1.00 (303a)

Fraction of total space heat from community heat pump

(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

421.96 (98)

Space heat from heat pump

(98) x (304a) x (305) x (306) = 443.06 (307a)

Water heating

Annual water heating requirement

1882.86 (64) (94)

Water heat from heat pump

(64) x (303a) x (305a) x (306) = 1977.00 (310a)

Electricity used for heat distribution

$0.01 \times [(307a)...(307e) + (310a)...(310e)] = 24.20$ (313)

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

mechanical ventilation fans - balanced, extract or positive input from outside

116.69 (330a)

Total electricity for the above, kWh/year

116.69 (331)

Electricity for lighting (Appendix L)

244.47 (332)

Energy saving/generation technologies

electricity generated by PV (Appendix M)

-259.09 (333)

Total delivered energy for all uses

(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) = 2522.14 (338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from heat pump	443.06	x	4.24	x 0.01 =	18.79	(340a)
Water heating from heat pump	1977.00	x	4.24	x 0.01 =	83.82	(342a)
Pumps and fans	116.69	x	13.19	x 0.01 =	15.39	(349)
Electricity for lighting	244.47	x	13.19	x 0.01 =	32.25	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-259.09	x	13.19	x 0.01 =	0.00	(352)
Total energy cost				(340a)...(342e) + (345)...(354) =	270.25	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.16	(357)
SAP value	83.86	
SAP rating (section 13)	84	(358)
SAP band	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	300.00					(367a)
CO ₂ emissions from heat pump [(307a)+(310a)] x 100 ÷ (367a) =	806.69	x	0.519	=	418.67	(367)
Electrical energy for community heat distribution	24.20	x	0.519	=	12.56	(372)
Total CO ₂ associated with community systems					431.23	(373)
Total CO ₂ associated with space and water heating					431.23	(376)
Pumps and fans	116.69	x	0.519	=	60.56	(378)
Electricity for lighting	244.47	x	0.519	=	126.88	(379)
Energy saving/generation technologies						
pv savings	-259.09	x	0.519	=	-134.47	(380)
Total CO ₂ , kg/year				(376)...(382) =	484.21	(383)
Dwelling CO ₂ emission rate				(383) ÷ (4) =	9.12	(384)
EI value					93.39	
EI rating (section 14)					93	(385)
EI band					A	

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	300.00					(367a)
Primary energy from heat pump [(307a)+(310a)] x 100 ÷ (367a) =	806.69	x	3.07	=	2476.53	(367)
Electrical energy for community heat distribution	24.20	x	3.07	=	74.30	(372)
Total primary energy associated with community systems					2550.83	(373)

Total primary energy associated with space and water heating					2550.83	(376)
Pumps and fans	116.69	x	3.07	=	358.23	(378)
Electricity for lighting	244.47	x	3.07	=	750.53	(379)
Energy saving/generation technologies						
Electricity generated - PVs	-259.09	x	3.07	=	-795.39	(380)
Primary energy kWh/year					2864.20	(383)
Dwelling primary energy rate kWh/m2/year					53.94	(384)

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 AECOM Planner	Assessor number	101
Client	Default Client	Last modified	30/08/2018
Address	4.1 redYellow 42, London		

1. Overall dwelling dimensions

	Area (m ²)	Average storey height (m)	Volume (m ³)
Lowest occupied	98.80 (1a) x	2.62 (2a) =	258.86 (3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) = 98.80 (4)		
Dwelling volume		(3a) + (3b) + (3c) + (3d)...(3n) =	258.86 (5)

2. Ventilation rate

		m ³ 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, q ₅₀ , 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	1 (19)
--	-------------------------------------

Shelter factor	1 - [0.075 x (19)] = 0.93 (20)
----------------	---

Infiltration rate incorporating shelter factor	(18) x (20) = 0.14 (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
-----------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------

Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.18	0.17	0.17	0.15	0.15	0.13	0.13	0.13	0.14	0.15	0.16	0.16
---	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------

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	76.50 (23c)
--	--

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]	0.29	0.29	0.29	0.27	0.27	0.25	0.25	0.25	0.26	0.27	0.27	0.28
--	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------

Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)	0.29	0.29	0.29	0.27	0.27	0.25	0.25	0.25	0.26	0.27	0.27	0.28
--	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------

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			26.79	1.33	35.52		(27)						
External wall			91.05	0.18	16.39		(29a)						
Party wall			40.39	0.00	0.00		(32)						
Total area of external elements ΣA, m ²			117.84				(31)						
Fabric heat loss, W/K = Σ(A x U)					(26)...(30) + (32) =	51.91	(33)						
Heat capacity Cm = Σ(A x κ)					(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)						
Thermal mass parameter (TMP) in kJ/m ² K						100.00	(35)						
Thermal bridges: Σ(L x Ψ) calculated using Appendix K						17.68	(36)						
Total fabric heat loss					(33) + (36) =	69.58	(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)	25.15	24.85	24.56	23.07	22.78	21.30	21.30	21.00	21.89	22.78	23.37	23.96	(38)
Heat transfer coefficient, W/K (37)m + (38)m	94.73	94.43	94.14	92.66	92.36	90.88	90.88	90.58	91.47	92.36	92.95	93.55	
	Average = Σ(39)1...12/12 =											92.58	(39)
Heat loss parameter (HLP), W/m ² K (39)m ÷ (4)	0.96	0.96	0.95	0.94	0.93	0.92	0.92	0.92	0.93	0.93	0.94	0.95	
	Average = Σ(40)1...12/12 =											0.94	(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												2.73	(42)	
Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$												98.99	(43)	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage in litres per day for each month $V_{d,m} = \text{factor from Table 1c} \times (43)$														
	108.89	104.93	100.97	97.01	93.05	89.09	89.09	93.05	97.01	100.97	104.93	108.89		
												$\Sigma(44)_{1...12} =$	1187.92	(44)
Energy content of hot water used = $4.18 \times V_{d,m} \times n_m \times T_m / 3600$ kWh/month (see Tables 1b, 1c 1d)														
	161.48	141.24	145.74	127.06	121.92	105.21	97.49	111.87	113.21	131.93	144.01	156.39		
												$\Sigma(45)_{1...12} =$	1557.55	(45)
Distribution loss $0.15 \times (45)_m$														
	24.22	21.19	21.86	19.06	18.29	15.78	14.62	16.78	16.98	19.79	21.60	23.46	(46)	
Storage volume (litres) including any solar or WWHRS storage within same vessel												180.00	(47)	
Water storage loss:														
a) If manufacturer's declared loss factor is known (kWh/day)												1.85	(48)	
Temperature factor from Table 2b												0.60	(49)	
Energy lost from water storage (kWh/day) $(48) \times (49)$												1.11	(50)	
Enter (50) or (54) in (55)												1.11	(55)	
Water storage loss calculated for each month $(55) \times (41)_m$														
	34.41	31.08	34.41	33.30	34.41	33.30	34.41	34.41	33.30	34.41	33.30	34.41	(56)	
If the vessel contains dedicated solar storage or dedicated WWHRS $(56)_m \times [(47) - V_s] \div (47)$, else (56)														
	34.41	31.08	34.41	33.30	34.41	33.30	34.41	34.41	33.30	34.41	33.30	34.41	(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 $0.85 \times (45)m + (46)m + (57)m + (59)m + (61)m$

219.16	193.33	203.41	182.87	179.59	161.02	155.16	169.54	169.02	189.60	199.83	214.06	(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

219.16	193.33	203.41	182.87	179.59	161.02	155.16	169.54	169.02	189.60	199.83	214.06	
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--

$$\Sigma(64)1...12 = 2236.59 \quad (64)$$

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

99.83	88.63	94.60	86.90	86.68	79.63	78.55	83.33	82.29	90.01	92.53	98.14	(65)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

5. Internal gains

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

Metabolic gains (Table 5)

136.41	136.41	136.41	136.41	136.41	136.41	136.41	136.41	136.41	136.41	136.41	136.41	(66)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

22.68	20.14	16.38	12.40	9.27	7.83	8.46	10.99	14.75	18.73	21.86	23.31	(67)
-------	-------	-------	-------	------	------	------	-------	-------	-------	-------	-------	------

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

254.37	257.01	250.36	236.20	218.32	201.52	190.30	187.66	194.31	208.47	226.35	243.15	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

36.64	36.64	36.64	36.64	36.64	36.64	36.64	36.64	36.64	36.64	36.64	36.64	(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)

-109.13	-109.13	-109.13	-109.13	-109.13	-109.13	-109.13	-109.13	-109.13	-109.13	-109.13	-109.13	(71)
---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	------

Water heating gains (Table 5)

134.18	131.90	127.15	120.69	116.50	110.60	105.58	112.01	114.29	120.97	128.52	131.90	(72)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

475.15	472.97	457.81	433.21	408.02	383.87	368.26	374.58	387.28	412.10	440.65	462.28	(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

North

$$0.77 \times 6.27 \times 10.63 \times 0.9 \times 0.45 \times 0.80 = 16.63 \quad (74)$$

West

$$0.77 \times 20.52 \times 19.64 \times 0.9 \times 0.45 \times 0.80 = 100.54 \quad (80)$$

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

117.18	228.47	377.93	559.17	695.83	717.78	681.06	577.35	441.67	271.22	145.89	96.55	(83)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	------

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

592.33	701.45	835.74	992.39	1103.85	1101.65	1049.32	951.94	828.95	683.33	586.54	558.83	(84)
--------	--------	--------	--------	---------	---------	---------	--------	--------	--------	--------	--------	------

7. Mean internal temperature (heating season)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	21.00	(85)
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-------	------

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

0.96	0.94	0.89	0.79	0.65	0.49	0.37	0.42	0.64	0.86	0.95	0.97	(86)
------	------	------	------	------	------	------	------	------	------	------	------	------

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

19.04	19.33	19.80	20.35	20.72	20.91	20.97	20.96	20.80	20.27	19.56	19.00	(87)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

20.12	20.12	20.12	20.14	20.14	20.15	20.15	20.15	20.15	20.14	20.13	20.13	(88)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Utilisation factor for gains for rest of dwelling n2,m

0.96	0.93	0.88	0.77	0.61	0.43	0.30	0.35	0.58	0.83	0.94	0.96	(89)
------	------	------	------	------	------	------	------	------	------	------	------	------

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

17.48	17.90	18.57	19.33	19.83	20.07	20.13	20.12	19.95	19.25	18.24	17.42	(90)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Living area fraction

Living area ÷ (4) = 0.43 (91)

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

18.15	18.52	19.10	19.77	20.21	20.44	20.50	20.49	20.32	19.69	18.81	18.10	(92)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

18.15	18.52	19.10	19.77	20.21	20.44	20.50	20.49	20.32	19.69	18.81	18.10	(93)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

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

Utilisation factor for gains, ηm

0.94	0.92	0.86	0.75	0.61	0.45	0.33	0.37	0.60	0.82	0.92	0.95	(94)
------	------	------	------	------	------	------	------	------	------	------	------	------

Useful gains, ηmGm, W (94)m x (84)m

559.33	642.27	718.05	748.18	675.25	498.28	344.99	356.74	494.73	560.29	539.34	531.61	(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]

1312.41	1286.03	1185.96	1007.19	786.33	530.38	353.99	370.08	568.82	839.56	1088.67	1300.30	(97)
---------	---------	---------	---------	--------	--------	--------	--------	--------	--------	---------	---------	------

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

560.29	432.61	348.13	186.49	82.64	0.00	0.00	0.00	0.00	207.77	395.52	571.90	
--------	--------	--------	--------	-------	------	------	------	------	--------	--------	--------	--

Σ(98)1...5, 10...12 = 2785.35 (98)

Space heating requirement kWh/m²/year

(98) ÷ (4) = 28.19 (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 heat pump

1.00 (303a)

Fraction of total space heat from community heat pump

(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

2785.35 (98)

Space heat from heat pump

(98) x (304a) x (305) x (306) = 2924.62 (307a)

Water heating

Annual water heating requirement

2236.59 (64)

Water heat from heat pump

(64) x (303a) x (305a) x (306) = 2348.42 (310a)

Electricity used for heat distribution

0.01 x [(307a)...(307e) + (310a)...(310e)] = 52.73 (313)

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

217.12 (330a)

mechanical ventilation fans - balanced, extract or positive input from outside

Total electricity for the above, kWh/year

217.12 (331)

Electricity for lighting (Appendix L)		400.49	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-259.09	(333)
Total delivered energy for all uses	$(307) + (309) + (310) + (312) + (315) + (331) + (332) \dots (337b) =$	5631.56	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from heat pump	2924.62	x	4.24	x 0.01 =	124.00	(340a)
Water heating from heat pump	2348.42	x	4.24	x 0.01 =	99.57	(342a)
Pumps and fans	217.12	x	13.19	x 0.01 =	28.64	(349)
Electricity for lighting	400.49	x	13.19	x 0.01 =	52.82	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-259.09	x	13.19	x 0.01 =	0.00	(352)
Total energy cost				$(340a) \dots (342e) + (345) \dots (354) =$	425.04	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.24	(357)
SAP value	82.68	
SAP rating (section 13)	83	(358)
SAP band	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	300.00					(367a)
CO ₂ emissions from heat pump $[(307a)+(310a)] \times 100 \div (367a) =$	1757.68	x	0.519	=	912.24	(367)
Electrical energy for community heat distribution	52.73	x	0.519	=	27.37	(372)
Total CO ₂ associated with community systems					939.60	(373)
Total CO ₂ associated with space and water heating					939.60	(376)
Pumps and fans	217.12	x	0.519	=	112.68	(378)
Electricity for lighting	400.49	x	0.519	=	207.86	(379)
Energy saving/generation technologies						
pv savings	-259.09	x	0.519	=	-134.47	(380)
Total CO ₂ , kg/year				$(376) \dots (382) =$	1125.68	(383)
Dwelling CO ₂ emission rate				$(383) \div (4) =$	11.39	(384)
EI value					89.51	
EI rating (section 14)					90	(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	300.00					(367a)
Primary energy from heat pump $[(307a)+(310a)] \times 100 \div (367a) =$	1757.68	x	3.07	=	5396.08	(367)
Electrical energy for community heat distribution	52.73	x	3.07	=	161.88	(372)

Total primary energy associated with community systems					5557.96	(373)
Total primary energy associated with space and water heating					5557.96	(376)
Pumps and fans	217.12	x	3.07	=	666.54	(378)
Electricity for lighting	400.49	x	3.07	=	1229.51	(379)
Energy saving/generation technologies						
Electricity generated - PVs	-259.09	x	3.07	=	-795.39	(380)
Primary energy kWh/year					6658.62	(383)
Dwelling primary energy rate kWh/m2/year					67.39	(384)

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 AECOM Planner	Assessor number	101
Client	Default Client	Last modified	30/08/2018
Address	4.1 redYellow 42, London		

1. Overall dwelling dimensions

	Area (m ²)	Average storey height (m)	Volume (m ³)
Lowest occupied	123.47 (1a) x	2.62 (2a) =	323.49 (3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) = 123.47 (4)		
Dwelling volume		(3a) + (3b) + (3c) + (3d)...(3n) =	323.49 (5)

2. Ventilation rate

			m ³ 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, q ₅₀ , 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	1 (19)
--	-------------------------------------

Shelter factor	1 - [0.075 x (19)] = 0.93 (20)
----------------	---

Infiltration rate incorporating shelter factor	(18) x (20) = 0.14 (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

	0.18	0.17	0.17	0.15	0.15	0.13	0.13	0.13	0.14	0.15	0.16	0.16 (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	76.50 (23c)
--	--

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

	0.29	0.29	0.29	0.27	0.27	0.25	0.25	0.25	0.26	0.27	0.27	0.28 (24a)
--	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	---

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

	0.29	0.29	0.29	0.27	0.27	0.25	0.25	0.25	0.26	0.27	0.27	0.28 (25)
--	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	--

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			37.21	1.33	49.33		(27)						
External wall			64.05	0.18	11.53		(29a)						
Party wall			52.32	0.00	0.00		(32)						
Total area of external elements ΣA, m ²			101.26				(31)						
Fabric heat loss, W/K = Σ(A x U)					(26)...(30) + (32) =	60.86	(33)						
Heat capacity Cm = Σ(A x κ)					(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)						
Thermal mass parameter (TMP) in kJ/m ² K						100.00	(35)						
Thermal bridges: Σ(L x Ψ) calculated using Appendix K						15.19	(36)						
Total fabric heat loss					(33) + (36) =	76.05	(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)	31.43	31.06	30.69	28.84	28.47	26.61	26.61	26.24	27.36	28.47	29.21	29.95	(38)
Heat transfer coefficient, W/K (37)m + (38)m	107.48	107.11	106.74	104.89	104.52	102.66	102.66	102.29	103.40	104.52	105.26	106.00	
	Average = Σ(39)1...12/12 =											104.79 (39)	
Heat loss parameter (HLP), W/m ² K (39)m ÷ (4)	0.87	0.87	0.86	0.85	0.85	0.83	0.83	0.83	0.84	0.85	0.85	0.86	
	Average = Σ(40)1...12/12 =											0.85 (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		2.88	(42)										
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		102.50	(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)	112.75	108.65	104.55	100.45	96.35	92.25	92.25	96.35	100.45	104.55	108.65	112.75	
	Σ(44)1...12 =											1230.00 (44)	
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	167.20	146.24	150.90	131.56	126.24	108.93	100.94	115.83	117.22	136.60	149.11	161.93	
	Σ(45)1...12 =											1612.72 (45)	
Distribution loss 0.15 x (45)m	25.08	21.94	22.64	19.73	18.94	16.34	15.14	17.37	17.58	20.49	22.37	24.29	(46)
Storage volume (litres) including any solar or WWHRs storage within same vessel												180.00 (47)	
Water storage loss:													
a) If manufacturer's declared loss factor is known (kWh/day)												1.85 (48)	
Temperature factor from Table 2b												0.60 (49)	
Energy lost from water storage (kWh/day) (48) x (49)												1.11 (50)	
Enter (50) or (54) in (55)												1.11 (55)	
Water storage loss calculated for each month (55) x (41)m	34.41	31.08	34.41	33.30	34.41	33.30	34.41	34.41	33.30	34.41	33.30	34.41	(56)
If the vessel contains dedicated solar storage or dedicated WWHRs (56)m x [(47) - Vs] ÷ (47), else (56)	34.41	31.08	34.41	33.30	34.41	33.30	34.41	34.41	33.30	34.41	33.30	34.41	(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 $0.85 \times (45)m + (46)m + (57)m + (59)m + (61)m$

224.88	198.33	208.58	187.37	183.91	164.75	158.62	173.51	173.03	194.28	204.93	219.60	(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

224.88	198.33	208.58	187.37	183.91	164.75	158.62	173.51	173.03	194.28	204.93	219.60	
$\Sigma(64)1...12 =$											2291.77	(64)

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

101.73	90.30	96.31	88.39	88.11	80.87	79.70	84.65	83.62	91.56	94.23	99.98	(65)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

5. Internal gains

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

Metabolic gains (Table 5)

143.79	143.79	143.79	143.79	143.79	143.79	143.79	143.79	143.79	143.79	143.79	143.79	(66)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

25.82	22.94	18.65	14.12	10.56	8.91	9.63	12.52	16.80	21.33	24.90	26.54	(67)
-------	-------	-------	-------	-------	------	------	-------	-------	-------	-------	-------	------

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

289.66	292.67	285.10	268.97	248.62	229.48	216.70	213.70	221.27	237.40	257.75	276.88	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

37.38	37.38	37.38	37.38	37.38	37.38	37.38	37.38	37.38	37.38	37.38	37.38	(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)

-115.03	-115.03	-115.03	-115.03	-115.03	-115.03	-115.03	-115.03	-115.03	-115.03	-115.03	-115.03	(71)
---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	------

Water heating gains (Table 5)

136.74	134.37	129.45	122.77	118.43	112.32	107.13	113.78	116.14	123.06	130.88	134.38	(72)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

518.36	516.11	499.34	472.00	443.74	416.85	399.60	406.13	420.35	447.93	479.66	503.94	(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 25.19 x 19.64 x 0.9 x 0.45 x 0.80 = 123.43 (76)

North 0.77 x 7.46 x 10.63 x 0.9 x 0.45 x 0.80 = 19.79 (74)

South 0.77 x 4.56 x 46.75 x 0.9 x 0.45 x 0.80 = 53.19 (78)

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

196.40	366.38	572.86	808.56	980.46	1002.17	954.52	824.58	655.64	425.47	241.36	163.96	(83)
--------	--------	--------	--------	--------	---------	--------	--------	--------	--------	--------	--------	------

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

714.77	882.49	1072.20	1280.56	1424.19	1419.03	1354.11	1230.71	1075.99	873.40	721.02	667.90	(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)

0.97	0.94	0.88	0.76	0.60	0.44	0.33	0.37	0.59	0.84	0.94	0.97	(86)
------	------	------	------	------	------	------	------	------	------	------	------	------

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

19.23	19.56	20.02	20.52	20.81	20.95	20.99	20.98	20.87	20.42	19.74	19.18	(87)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

20.19	20.20	20.20	20.21	20.21	20.23	20.23	20.23	20.22	20.21	20.21	20.20	(88)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Utilisation factor for gains for rest of dwelling n2,m

0.96	0.93	0.86	0.73	0.56	0.39	0.27	0.31	0.54	0.81	0.93	0.97	(89)
------	------	------	------	------	------	------	------	------	------	------	------	------

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

17.80	18.27	18.93	19.62	20.01	20.18	20.22	20.21	20.09	19.51	18.54	17.73	(90)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Living area fraction

Living area ÷ (4) = 0.54 (91)

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

18.57	18.97	19.52	20.10	20.44	20.60	20.63	20.63	20.52	20.00	19.19	18.51	(92)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

18.57	18.97	19.52	20.10	20.44	20.60	20.63	20.63	20.52	20.00	19.19	18.51	(93)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

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

Utilisation factor for gains, ηm

0.95	0.91	0.85	0.73	0.58	0.42	0.30	0.34	0.56	0.80	0.92	0.96	(94)
------	------	------	------	------	------	------	------	------	------	------	------	------

Useful gains, ηmGm, W (94)m x (84)m

678.15	805.72	907.54	931.11	819.55	591.34	407.60	422.71	601.46	702.29	664.13	638.89	(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]

1533.75	1506.64	1389.74	1175.09	913.87	615.58	413.91	432.33	663.36	982.96	1272.19	1516.89	(97)
---------	---------	---------	---------	--------	--------	--------	--------	--------	--------	---------	---------	------

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

636.56	471.01	358.75	175.66	70.17	0.00	0.00	0.00	0.00	208.81	437.80	653.23	
--------	--------	--------	--------	-------	------	------	------	------	--------	--------	--------	--

Σ(98)1...5, 10...12 = 3012.02 (98)

Space heating requirement kWh/m²/year

(98) ÷ (4) = 24.39 (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 heat pump

1.00 (303a)

Fraction of total space heat from community heat pump

(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

3012.02 (98)

Space heat from heat pump

(98) x (304a) x (305) x (306) = 3162.62 (307a)

Water heating

Annual water heating requirement

2291.77 (64)

Water heat from heat pump

(64) x (303a) x (305a) x (306) = 2406.36 (310a)

Electricity used for heat distribution

0.01 x [(307a)...(307e) + (310a)...(310e)] = 55.69 (313)

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

mechanical ventilation fans - balanced, extract or positive input from outside

271.33 (330a)

Total electricity for the above, kWh/year		271.33	(331)
Electricity for lighting (Appendix L)		456.06	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-259.09	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) =	6037.27	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from heat pump	3162.62	x	4.24	x 0.01 =	134.09	(340a)
Water heating from heat pump	2406.36	x	4.24	x 0.01 =	102.03	(342a)
Pumps and fans	271.33	x	13.19	x 0.01 =	35.79	(349)
Electricity for lighting	456.06	x	13.19	x 0.01 =	60.15	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-259.09	x	13.19	x 0.01 =	0.00	(352)
Total energy cost				(340a)...(342e) + (345)...(354) =	452.07	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.13	(357)
SAP value	84.28	
SAP rating (section 13)	84	(358)
SAP band	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	300.00					(367a)
CO ₂ emissions from heat pump [(307a)+(310a)] x 100 ÷ (367a) =	1856.32	x	0.519	=	963.43	(367)
Electrical energy for community heat distribution	55.69	x	0.519	=	28.90	(372)
Total CO ₂ associated with community systems					992.34	(373)
Total CO ₂ associated with space and water heating					992.34	(376)
Pumps and fans	271.33	x	0.519	=	140.82	(378)
Electricity for lighting	456.06	x	0.519	=	236.69	(379)
Energy saving/generation technologies						
pv savings	-259.09	x	0.519	=	-134.47	(380)
Total CO ₂ , kg/year				(376)...(382) =	1235.38	(383)
Dwelling CO ₂ emission rate				(383) ÷ (4) =	10.01	(384)
EI value					90.17	
EI rating (section 14)					90	(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	300.00					(367a)
Primary energy from heat pump [(307a)+(310a)] x 100 ÷ (367a) =	1856.32	x	3.07	=	5698.91	(367)

Electrical energy for community heat distribution	55.69	x	3.07	=	170.97	(372)
Total primary energy associated with community systems					5869.88	(373)
Total primary energy associated with space and water heating					5869.88	(376)
Pumps and fans	271.33	x	3.07	=	832.98	(378)
Electricity for lighting	456.06	x	3.07	=	1400.09	(379)
Energy saving/generation technologies						
Electricity generated - PVs	-259.09	x	3.07	=	-795.39	(380)
Primary energy kWh/year					7307.56	(383)
Dwelling primary energy rate kWh/m2/year					59.18	(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	Mr AECOM Planner	Assessor number	101
Client	Default Client	Last modified	30/08/2018
Address	5.3 redYellow 42, London		

1. Overall dwelling dimensions

	Area (m ²)	Average storey height (m)	Volume (m ³)
Lowest occupied	103.20 (1a) x	2.62 (2a) =	270.38 (3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) = 103.20 (4)		
Dwelling volume		(3a) + (3b) + (3c) + (3d)...(3n) =	270.38 (5)

2. Ventilation rate

		m ³ 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, q ₅₀ , 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	1 (19)
--	-------------------------------------

Shelter factor	1 - [0.075 x (19)] = 0.93 (20)
----------------	---

Infiltration rate incorporating shelter factor	(18) x (20) = 0.14 (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
-----------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------

Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.18	0.17	0.17	0.15	0.15	0.13	0.13	0.13	0.14	0.15	0.16	0.16
---	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------

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	76.50 (23c)
--	--

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

0.29	0.29	0.29	0.27	0.27	0.25	0.25	0.25	0.26	0.27	0.27	0.28
-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------

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

0.29	0.29	0.29	0.27	0.27	0.25	0.25	0.25	0.26	0.27	0.27	0.28
-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------

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			44.28	1.33	58.70		(27)						
External wall			35.72	0.18	6.43		(29a)						
Party wall			51.42	0.00	0.00		(32)						
Roof			103.20	0.12	12.38		(30)						
Total area of external elements ΣA, m ²			183.20				(31)						
Fabric heat loss, W/K = Σ(A x U)					(26)...(30) + (32) =	77.52	(33)						
Heat capacity Cm = Σ(A x κ)					(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)						
Thermal mass parameter (TMP) in kJ/m ² K						100.00	(35)						
Thermal bridges: Σ(L x Ψ) calculated using Appendix K						27.48	(36)						
Total fabric heat loss					(33) + (36) =	105.00	(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)	26.27	25.96	25.65	24.10	23.79	22.25	22.25	21.94	22.86	23.79	24.41	25.03	(38)
Heat transfer coefficient, W/K (37)m + (38)m	131.27	130.96	130.65	129.10	128.79	127.24	127.24	126.93	127.86	128.79	129.41	130.03	
	Average = Σ(39)1...12/12 =											129.02	(39)
Heat loss parameter (HLP), W/m ² K (39)m ÷ (4)	1.27	1.27	1.27	1.25	1.25	1.23	1.23	1.23	1.24	1.25	1.25	1.26	
	Average = Σ(40)1...12/12 =											1.25	(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

2.77

(42)

Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$

99.92

(43)

JanFebMarAprMayJunJulAugSepOctNovDec

Hot water usage in litres per day for each month $V_{d,m} = \text{factor from Table 1c} \times (43)$

109.91105.92101.9297.9293.9389.9389.9393.9397.92101.92105.92109.91

$\Sigma(44)1...12 =$

1199.06

(44)

Energy content of hot water used = $4.18 \times V_{d,m} \times n_m \times T_m / 3600$ kWh/month (see Tables 1b, 1c 1d)

163.00142.56147.11128.25123.06106.1998.40112.92114.27133.17145.36157.86

$\Sigma(45)1...12 =$

1572.16

(45)

Distribution loss $0.15 \times (45)m$

24.4521.3822.0719.2418.4615.9314.7616.9417.1419.9821.8023.68

(46)

Storage volume (litres) including any solar or WWHRs storage within same vessel

180.00

(47)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day)

1.85

(48)

Temperature factor from Table 2b

0.60

(49)

Energy lost from water storage (kWh/day) $(48) \times (49)$

1.11

(50)

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

1.11

(55)

Water storage loss calculated for each month $(55) \times (41)m$

34.4131.0834.4133.3034.4133.3034.4134.4133.3034.4133.3034.41

(56)

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

34.4131.0834.4133.3034.4133.3034.4134.4133.3034.4133.3034.41

(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
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

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
------	------	------	------	------	------	------	------	------	------	------	------

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

220.67	194.65	204.78	184.07	180.73	162.01	156.08	170.59	170.08	190.84	201.18	215.53
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

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
------	------	------	------	------	------	------	------	------	------	------	------

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

220.67	194.65	204.78	184.07	180.73	162.01	156.08	170.59	170.08	190.84	201.18	215.53
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

$$\Sigma(64)1...12 = 2251.21 \quad (64)$$

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

100.34	89.07	95.05	87.29	87.06	79.96	78.86	83.68	82.64	90.42	92.98	98.63
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

5. Internal gains

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

Metabolic gains (Table 5)

138.36	138.36	138.36	138.36	138.36	138.36	138.36	138.36	138.36	138.36	138.36	138.36
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

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

23.30	20.70	16.83	12.74	9.53	8.04	8.69	11.30	15.16	19.25	22.47	23.95
-------	-------	-------	-------	------	------	------	-------	-------	-------	-------	-------

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

261.40	264.11	257.28	242.72	224.36	207.09	195.56	192.85	199.68	214.23	232.60	249.87
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

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

36.84	36.84	36.84	36.84	36.84	36.84	36.84	36.84	36.84	36.84	36.84	36.84
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------

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
------	------	------	------	------	------	------	------	------	------	------	------

Losses e.g. evaporation (Table 5)

-110.69	-110.69	-110.69	-110.69	-110.69	-110.69	-110.69	-110.69	-110.69	-110.69	-110.69	-110.69
---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------

Water heating gains (Table 5)

134.86	132.55	127.76	121.24	117.01	111.05	105.99	112.48	114.78	121.53	129.14	132.56
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

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

484.07	481.87	466.38	441.22	415.40	390.70	374.75	381.13	394.13	419.52	448.72	470.89
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------

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 $0.77 \times 31.80 \times 19.64 \times 0.9 \times 0.45 \times 0.80 = 155.82 \quad (76)$

North $0.77 \times 10.14 \times 10.63 \times 0.9 \times 0.45 \times 0.80 = 26.90 \quad (74)$

South $0.77 \times 2.34 \times 46.75 \times 0.9 \times 0.45 \times 0.80 = 27.29 \quad (78)$

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

210.01	400.91	646.27	936.76	1153.29	1185.34	1126.38	962.22	748.32	471.08	259.82	174.14
--------	--------	--------	--------	---------	---------	---------	--------	--------	--------	--------	--------

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

694.08	882.78	1112.64	1377.98	1568.69	1576.03	1501.13	1343.35	1142.46	890.60	708.54	645.03
--------	--------	---------	---------	---------	---------	---------	---------	---------	--------	--------	--------

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

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

0.96	0.93	0.87	0.76	0.61	0.46	0.35	0.40	0.62	0.84	0.94	0.96
------	------	------	------	------	------	------	------	------	------	------	------

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

18.46	18.86	19.45	20.13	20.60	20.86	20.95	20.93	20.70	20.01	19.10	18.39	(87)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

19.86	19.87	19.87	19.88	19.88	19.89	19.89	19.90	19.89	19.88	19.88	19.87	(88)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Utilisation factor for gains for rest of dwelling n2,m

0.95	0.92	0.85	0.72	0.56	0.40	0.27	0.32	0.55	0.81	0.93	0.96	(89)
------	------	------	------	------	------	------	------	------	------	------	------	------

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

16.50	17.07	17.91	18.85	19.46	19.77	19.86	19.85	19.61	18.72	17.44	16.41	(90)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Living area fraction

Living area ÷ (4) = 0.47 (91)

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

17.43	17.92	18.64	19.46	20.00	20.29	20.38	20.36	20.13	19.33	18.23	17.35	(92)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

17.43	17.92	18.64	19.46	20.00	20.29	20.38	20.36	20.13	19.33	18.23	17.35	(93)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

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

Utilisation factor for gains, ηm

0.93	0.89	0.82	0.71	0.57	0.42	0.31	0.35	0.56	0.79	0.90	0.94	(94)
------	------	------	------	------	------	------	------	------	------	------	------	------

Useful gains, ηmGm, W (94)m x (84)m

647.69	788.75	916.56	976.57	890.98	664.13	461.46	475.10	645.11	703.96	640.64	607.60	(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]

1723.94	1704.51	1586.63	1362.73	1069.30	723.93	480.75	502.80	770.89	1124.39	1440.08	1709.95	(97)
---------	---------	---------	---------	---------	--------	--------	--------	--------	---------	---------	---------	------

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

800.73	615.39	498.53	278.04	132.67	0.00	0.00	0.00	0.00	312.80	575.59	820.15	
--------	--------	--------	--------	--------	------	------	------	------	--------	--------	--------	--

Σ(98)1...5, 10...12 = 4033.90 (98)

Space heating requirement kWh/m²/year

(98) ÷ (4) = 39.09 (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 heat pump

1.00 (303a)

Fraction of total space heat from community heat pump

(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

4033.90 (98)

Space heat from heat pump

(98) x (304a) x (305) x (306) = 4235.59 (307a)

Water heating

Annual water heating requirement

2251.21 (64)

Water heat from heat pump

(64) x (303a) x (305a) x (306) = 2363.77 (310a)

Electricity used for heat distribution

0.01 x [(307a)...(307e) + (310a)...(310e)] = 65.99 (313)

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

mechanical ventilation fans - balanced, extract or positive input from outside	226.78	(330a)
Total electricity for the above, kWh/year	226.78	(331)
Electricity for lighting (Appendix L)	411.56	(332)
Energy saving/generation technologies		
electricity generated by PV (Appendix M)	-259.09	(333)
Total delivered energy for all uses	(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) = 6978.61	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from heat pump	4235.59	x	4.24	x 0.01 =	179.59	(340a)
Water heating from heat pump	2363.77	x	4.24	x 0.01 =	100.22	(342a)
Pumps and fans	226.78	x	13.19	x 0.01 =	29.91	(349)
Electricity for lighting	411.56	x	13.19	x 0.01 =	54.28	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-259.09	x	13.19	x 0.01 =	0.00	(352)
Total energy cost				(340a)...(342e) + (345)...(354) =	484.01	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.37	(357)
SAP value	80.86	
SAP rating (section 13)	81	(358)
SAP band	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	300.00					(367a)
CO ₂ emissions from heat pump $[(307a)+(310a)] \times 100 \div (367a) =$	2199.79	x	0.519	=	1141.69	(367)
Electrical energy for community heat distribution	65.99	x	0.519	=	34.25	(372)
Total CO ₂ associated with community systems					1175.94	(373)
Total CO ₂ associated with space and water heating					1175.94	(376)
Pumps and fans	226.78	x	0.519	=	117.70	(378)
Electricity for lighting	411.56	x	0.519	=	213.60	(379)
Energy saving/generation technologies						
pv savings	-259.09	x	0.519	=	-134.47	(380)
Total CO ₂ , kg/year				(376)...(382) =	1372.77	(383)
Dwelling CO ₂ emission rate				(383) ÷ (4) =	13.30	(384)
EI value					87.59	
EI rating (section 14)					88	(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	300.00					(367a)
				$[(307a)+(310a)] \times 100 \div (367a) =$		

Primary energy from heat pump	2199.79	x	3.07	=	6753.34	(367)
Electrical energy for community heat distribution	65.99	x	3.07	=	202.60	(372)
Total primary energy associated with community systems					6955.95	(373)
Total primary energy associated with space and water heating					6955.95	(376)
Pumps and fans	226.78	x	3.07	=	696.23	(378)
Electricity for lighting	411.56	x	3.07	=	1263.47	(379)
Energy saving/generation technologies						
Electricity generated - PVs	-259.09	x	3.07	=	-795.39	(380)
Primary energy kWh/year					8120.25	(383)
Dwelling primary energy rate kWh/m2/year					78.68	(384)

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 AECOM Planner	Assessor number	101
Client	Default Client	Last modified	30/08/2018
Address	5.8 redYellow 42, London		

1. Overall dwelling dimensions

	Area (m ²)	Average storey height (m)	Volume (m ³)
Lowest occupied	121.16 (1a)	2.62 (2a)	317.44 (3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) = 121.16 (4)		
Dwelling volume	(3a) + (3b) + (3c) + (3d)...(3n) = 317.44 (5)		

2. Ventilation rate

		m ³ per hour
Number of chimneys	0	0 (6a)
Number of open flues	0	0 (6b)
Number of intermittent fans	0	0 (7a)
Number of passive vents	0	0 (7b)
Number of flueless gas fires	0	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, q ₅₀ , 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

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
-----------------------	------	------	------	------	------	------	------	------	------	------	------	------

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
---	------	------	------	------	------	------	------	------	------	------	------	------

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	76.50 (23c)
--	-------------

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

	0.28	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.25	0.25	0.26	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
--	------	------	------	------	------	------	------	------	------	------	------	------

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			57.02	1.33	75.59		(27)						
External wall			20.22	0.18	3.64		(29a)						
Party wall			75.31	0.00	0.00		(32)						
Roof			121.16	0.13	15.75		(30)						
Total area of external elements ΣA, m ²			198.40				(31)						
Fabric heat loss, W/K = Σ(A x U)					(26)...(30) + (32) =	94.99	(33)						
Heat capacity Cm = Σ(A x κ)					(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)						
Thermal mass parameter (TMP) in kJ/m ² K						100.00	(35)						
Thermal bridges: Σ(L x Ψ) calculated using Appendix K						29.76	(36)						
Total fabric heat loss					(33) + (36) =	124.75	(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)	29.34	29.00	28.67	27.00	26.67	25.00	25.00	24.66	25.66	26.67	27.33	28.00	(38)
Heat transfer coefficient, W/K (37)m + (38)m	154.08	153.75	153.42	151.75	151.41	149.74	149.74	149.41	150.41	151.41	152.08	152.75	
	Average = Σ(39)1...12/12 =											151.66	(39)
Heat loss parameter (HLP), W/m ² K (39)m ÷ (4)	1.27	1.27	1.27	1.25	1.25	1.24	1.24	1.23	1.24	1.25	1.26	1.26	
	Average = Σ(40)1...12/12 =											1.25	(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												2.87	(42)	
Annual average hot water usage in litres per day $V_{d,average} = (25 \times N) + 36$												102.31	(43)	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage in litres per day for each month $V_{d,m}$ = factor from Table 1c x (43)														
	112.54	108.45	104.35	100.26	96.17	92.08	92.08	96.17	100.26	104.35	108.45	112.54		
												$\Sigma(44)1...12 =$	1227.69	(44)
Energy content of hot water used = $4.18 \times V_{d,m} \times n_m \times T_m / 3600$ kWh/month (see Tables 1b, 1c 1d)														
	166.89	145.96	150.62	131.32	126.00	108.73	100.75	115.62	117.00	136.35	148.83	161.63		
												$\Sigma(45)1...12 =$	1609.70	(45)
Distribution loss $0.15 \times (45)m$														
	25.03	21.89	22.59	19.70	18.90	16.31	15.11	17.34	17.55	20.45	22.33	24.24	(46)	
Storage volume (litres) including any solar or WWHRS storage within same vessel												180.00	(47)	
Water storage loss:														
a) If manufacturer's declared loss factor is known (kWh/day)												1.85	(48)	
Temperature factor from Table 2b												0.60	(49)	
Energy lost from water storage (kWh/day) (48) x (49)												1.11	(50)	
Enter (50) or (54) in (55)												1.11	(55)	
Water storage loss calculated for each month (55) x (41)m														
	34.41	31.08	34.41	33.30	34.41	33.30	34.41	34.41	33.30	34.41	33.30	34.41	(56)	
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - V_s] ÷ (47), else (56)														
	34.41	31.08	34.41	33.30	34.41	33.30	34.41	34.41	33.30	34.41	33.30	34.41	(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 $0.85 \times (45)m + (46)m + (57)m + (59)m + (61)m$

224.56	198.06	208.29	187.13	183.67	164.54	158.43	173.29	172.81	194.02	204.65	219.30	(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) $(62)m + (63)m$

224.56	198.06	208.29	187.13	183.67	164.54	158.43	173.29	172.81	194.02	204.65	219.30	
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--

$$\Sigma(64)1...12 = 2288.74 \quad (64)$$

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

101.63	90.21	96.22	88.31	88.03	80.80	79.64	84.58	83.55	91.47	94.14	99.88	(65)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

5. Internal gains

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

Metabolic gains (Table 5)

143.38	143.38	143.38	143.38	143.38	143.38	143.38	143.38	143.38	143.38	143.38	143.38	(66)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

25.56	22.70	18.46	13.98	10.45	8.82	9.53	12.39	16.63	21.11	24.64	26.27	(67)
-------	-------	-------	-------	-------	------	------	-------	-------	-------	-------	-------	------

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

286.72	289.69	282.19	266.23	246.08	227.15	214.50	211.52	219.02	234.98	255.13	274.07	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

37.34	37.34	37.34	37.34	37.34	37.34	37.34	37.34	37.34	37.34	37.34	37.34	(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)

-114.71	-114.71	-114.71	-114.71	-114.71	-114.71	-114.71	-114.71	-114.71	-114.71	-114.71	-114.71	(71)
---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	------

Water heating gains (Table 5)

136.60	134.24	129.33	122.66	118.32	112.22	107.04	113.68	116.04	122.95	130.75	134.24	(72)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

514.89	512.64	496.00	468.88	440.87	414.21	397.08	403.61	417.71	445.06	476.53	500.60	(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

South $0.77 \times 46.00 \times 46.75 \times 0.9 \times 0.45 \times 0.80 = 536.53 \quad (78)$

West $0.77 \times 11.02 \times 19.64 \times 0.9 \times 0.45 \times 0.80 = 54.00 \quad (80)$

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

590.53	984.33	1293.26	1518.76	1629.19	1586.94	1542.57	1464.07	1371.56	1073.10	703.30	508.02	(83)
--------	--------	---------	---------	---------	---------	---------	---------	---------	---------	--------	--------	------

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

1105.42	1496.97	1789.26	1987.64	2070.06	2001.15	1939.66	1867.68	1789.27	1518.15	1179.83	1008.61	(84)
---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	------

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

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

0.92	0.86	0.78	0.68	0.57	0.44	0.32	0.35	0.51	0.73	0.88	0.94	(86)
------	------	------	------	------	------	------	------	------	------	------	------	------

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

18.80	19.32	19.83	20.32	20.67	20.88	20.96	20.95	20.81	20.33	19.47	18.70	(87)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

19.86	19.87	19.87	19.88	19.88	19.89	19.89	19.89	19.89	19.88	19.88	19.87	(88)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Utilisation factor for gains for rest of dwelling n2,m

0.91	0.84	0.76	0.65	0.52	0.37	0.25	0.27	0.44	0.68	0.86	0.93	(89)
------	------	------	------	------	------	------	------	------	------	------	------	------

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

16.99	17.71	18.43	19.09	19.53	19.79	19.87	19.86	19.72	19.12	17.94	16.84	(90)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Living area fraction

Living area ÷ (4) = 0.53 (91)

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

17.95	18.56	19.17	19.74	20.13	20.36	20.44	20.43	20.30	19.76	18.75	17.82	(92)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

17.95	18.56	19.17	19.74	20.13	20.36	20.44	20.43	20.30	19.76	18.75	17.82	(93)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

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

Utilisation factor for gains, ηm

0.89	0.82	0.74	0.64	0.53	0.40	0.29	0.31	0.47	0.68	0.84	0.91	(94)
------	------	------	------	------	------	------	------	------	------	------	------	------

Useful gains, ηmGm, W (94)m x (84)m

984.23	1226.01	1324.06	1276.95	1095.49	799.64	555.65	578.23	833.96	1031.95	989.41	913.97	(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)]

2102.78	2100.28	1943.74	1644.74	1276.55	863.01	575.36	602.82	931.88	1386.27	1771.74	2080.59	(97)
---------	---------	---------	---------	---------	--------	--------	--------	--------	---------	---------	---------	------

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

832.20	587.51	461.04	264.81	134.70	0.00	0.00	0.00	0.00	263.62	563.28	867.97	
--------	--------	--------	--------	--------	------	------	------	------	--------	--------	--------	--

Σ(98)1...5, 10...12 = 3975.12 (98)

Space heating requirement kWh/m²/year

(98) ÷ (4) = 32.81 (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 heat pump

1.00 (303a)

Fraction of total space heat from community heat pump

(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

3975.12 (98)

Space heat from heat pump

(98) x (304a) x (305) x (306) = 4173.88 (307a)

Water heating

Annual water heating requirement

2288.74 (64)

Water heat from heat pump

(64) x (303a) x (305a) x (306) = 2403.18 (310a)

Electricity used for heat distribution

0.01 x [(307a)...(307e) + (310a)...(310e)] = 65.77 (313)

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

mechanical ventilation fans - balanced, extract or positive input from outside

266.25 (330a)

Total electricity for the above, kWh/year		266.25	(331)
Electricity for lighting (Appendix L)		451.41	(332)
Energy saving/generation technologies			
electricity generated by PV (Appendix M)		-259.09	(333)
Total delivered energy for all uses	$(307) + (309) + (310) + (312) + (315) + (331) + (332) \dots (337b) =$	7035.64	(338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from heat pump	4173.88	x	4.24	x 0.01 =	176.97	(340a)
Water heating from heat pump	2403.18	x	4.24	x 0.01 =	101.89	(342a)
Pumps and fans	266.25	x	13.19	x 0.01 =	35.12	(349)
Electricity for lighting	451.41	x	13.19	x 0.01 =	59.54	(350)
Additional standing charges					120.00	(351)
Energy saving/generation technologies						
pv savings	-259.09	x	13.19	x 0.01 =	0.00	(352)
Total energy cost				$(340a) \dots (342e) + (345) \dots (354) =$	493.53	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.25	(357)
SAP value	82.60	
SAP rating (section 13)	83	(358)
SAP band	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	300.00					(367a)
CO ₂ emissions from heat pump $[(307a)+(310a)] \times 100 \div (367a) =$	2192.35	x	0.519	=	1137.83	(367)
Electrical energy for community heat distribution	65.77	x	0.519	=	34.13	(372)
Total CO ₂ associated with community systems					1171.97	(373)
Total CO ₂ associated with space and water heating					1171.97	(376)
Pumps and fans	266.25	x	0.519	=	138.18	(378)
Electricity for lighting	451.41	x	0.519	=	234.28	(379)
Energy saving/generation technologies						
pv savings	-259.09	x	0.519	=	-134.47	(380)
Total CO ₂ , kg/year				$(376) \dots (382) =$	1409.97	(383)
Dwelling CO ₂ emission rate				$(383) \div (4) =$	11.64	(384)
EI value					88.63	
EI rating (section 14)					89	(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	300.00					(367a)
Primary energy from heat pump $[(307a)+(310a)] \times 100 \div (367a) =$	2192.35	x	3.07	=	6730.52	(367)

Electrical energy for community heat distribution	65.77	x	3.07	=	201.92	(372)
Total primary energy associated with community systems					6932.44	(373)
Total primary energy associated with space and water heating					6932.44	(376)
Pumps and fans	266.25	x	3.07	=	817.39	(378)
Electricity for lighting	451.41	x	3.07	=	1385.84	(379)
Energy saving/generation technologies						
Electricity generated - PVs	-259.09	x	3.07	=	-795.39	(380)
Primary energy kWh/year					8340.28	(383)
Dwelling primary energy rate kWh/m2/year					68.84	(384)

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 AECOM Planner	Assessor number	101
Client	Default Client	Last modified	30/08/2018
Address	2.2 redYellow 42, London		

1. Overall dwelling dimensions

	Area (m ²)	Average storey height (m)	Volume (m ³)
Lowest occupied	104.56 (1a)	2.62 (2a)	273.95 (3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) = 104.56 (4)		
Dwelling volume		(3a) + (3b) + (3c) + (3d)...(3n) = 273.95 (5)	

2. Ventilation rate

		m ³ 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, q ₅₀ , 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	76.50 (23c)
--	--

a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]	0.28	0.28	0.27	0.26	0.25	0.24	0.24	0.24	0.25	0.25	0.26	0.27 (24a)
--	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	---

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 (25)
--	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	--

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			24.90	1.33	= 33.01		(27)						
External wall			31.55	0.18	= 5.68		(29a)						
Party wall			62.13	0.00	= 0.00		(32)						
Total area of external elements ΣA, m ²			56.45				(31)						
Fabric heat loss, W/K = Σ(A x U)					(26)...(30) + (32) =	38.69	(33)						
Heat capacity Cm = Σ(A x κ)					(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)						
Thermal mass parameter (TMP) in kJ/m ² K						100.00	(35)						
Thermal bridges: Σ(L x Ψ) calculated using Appendix K						8.47	(36)						
Total fabric heat loss					(33) + (36) =	47.16	(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)	25.32	25.03	24.74	23.30	23.01	21.57	21.57	21.28	22.15	23.01	23.59	24.17	(38)
Heat transfer coefficient, W/K (37)m + (38)m	72.48	72.19	71.90	70.46	70.17	68.73	68.73	68.44	69.31	70.17	70.75	71.32	
	Average = Σ(39)1...12/12 =											70.39	(39)
Heat loss parameter (HLP), W/m ² K (39)m ÷ (4)	0.69	0.69	0.69	0.67	0.67	0.66	0.66	0.65	0.66	0.67	0.68	0.68	
	Average = Σ(40)1...12/12 =											0.67	(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												2.78	(42)	
Annual average hot water usage in litres per day $V_d, average = (25 \times N) + 36$												100.18	(43)	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hot water usage in litres per day for each month $V_d, m = \text{factor from Table 1c} \times (43)$	110.19	106.19	102.18	98.17	94.17	90.16	90.16	94.17	98.17	102.18	106.19	110.19		
												$\Sigma(44)1...12 =$	1202.11	(44)
Energy content of hot water used = $4.18 \times V_d, m \times n_m \times T_m / 3600$ kWh/month (see Tables 1b, 1c 1d)	163.41	142.92	147.48	128.58	123.37	106.46	98.65	113.21	114.56	133.51	145.73	158.26		
												$\Sigma(45)1...12 =$	1576.15	(45)
Distribution loss $0.15 \times (45)m$	24.51	21.44	22.12	19.29	18.51	15.97	14.80	16.98	17.18	20.03	21.86	23.74	(46)	
Storage volume (litres) including any solar or WWHRS storage within same vessel												180.00	(47)	
Water storage loss:														
a) If manufacturer's declared loss factor is known (kWh/day)												1.85	(48)	
Temperature factor from Table 2b												0.60	(49)	
Energy lost from water storage (kWh/day) $(48) \times (49)$												1.11	(50)	
Enter (50) or (54) in (55)												1.11	(55)	
Water storage loss calculated for each month $(55) \times (41)m$	34.41	31.08	34.41	33.30	34.41	33.30	34.41	34.41	33.30	34.41	33.30	34.41	(56)	
If the vessel contains dedicated solar storage or dedicated WWHRS $(56)m \times [(47) - V_s] \div (47)$, else (56)	34.41	31.08	34.41	33.30	34.41	33.30	34.41	34.41	33.30	34.41	33.30	34.41	(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 $0.85 \times (45)m + (46)m + (57)m + (59)m + (61)m$

221.09	195.01	205.16	184.39	181.05	162.28	156.33	170.88	170.37	191.18	201.55	215.93	(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) $(62)m + (63)m$

221.09	195.01	205.16	184.39	181.05	162.28	156.33	170.88	170.37	191.18	201.55	215.93	
$\Sigma(64)1...12 =$											2255.20	(64)

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

100.47	89.19	95.18	87.40	87.16	80.05	78.94	83.78	82.74	90.53	93.11	98.76	(65)
--------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

5. Internal gains

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

Metabolic gains (Table 5)

138.90	138.90	138.90	138.90	138.90	138.90	138.90	138.90	138.90	138.90	138.90	138.90	(66)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

23.49	20.86	16.97	12.85	9.60	8.11	8.76	11.39	15.28	19.40	22.65	24.14	(67)
-------	-------	-------	-------	------	------	------	-------	-------	-------	-------	-------	------

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

263.50	266.23	259.34	244.67	226.15	208.75	197.13	194.39	201.28	215.95	234.47	251.87	(68)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

36.89	36.89	36.89	36.89	36.89	36.89	36.89	36.89	36.89	36.89	36.89	36.89	(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)

-111.12	-111.12	-111.12	-111.12	-111.12	-111.12	-111.12	-111.12	-111.12	-111.12	-111.12	-111.12	(71)
---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	---------	------

Water heating gains (Table 5)

135.04	132.73	127.92	121.39	117.15	111.18	106.10	112.61	114.92	121.68	129.31	132.74	(72)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

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

486.70	484.49	468.90	443.58	417.58	392.71	376.66	383.05	396.15	421.70	451.10	473.42	(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
---------------------------	------------------------	--------------------------------	-----------------------------------	------------------------------------	------------

West $0.77 \times 11.76 \times 19.64 \times 0.9 \times 0.45 \times 0.80 = 57.62$ (80)

North $0.77 \times 13.14 \times 10.63 \times 0.9 \times 0.45 \times 0.80 = 34.86$ (74)

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

92.48	179.34	298.83	452.56	576.73	601.86	568.17	471.99	352.00	213.05	114.85	76.45	(83)
-------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	-------	------

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

579.18	663.83	767.73	896.14	994.31	994.57	944.83	855.04	748.15	634.75	565.95	549.87	(84)
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	------

7. Mean internal temperature (heating season)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	21.00	(85)
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-------	------

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

0.96	0.94	0.89	0.77	0.60	0.43	0.32	0.36	0.59	0.84	0.94	0.97	(86)
------	------	------	------	------	------	------	------	------	------	------	------	------

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

19.68	19.91	20.27	20.67	20.89	20.98	20.99	20.99	20.93	20.60	20.08	19.64	(87)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

20.35	20.35	20.35	20.36	20.37	20.38	20.38	20.38	20.37	20.37	20.36	20.36	(88)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Utilisation factor for gains for rest of dwelling n2,m

0.96	0.93	0.88	0.75	0.57	0.39	0.27	0.32	0.55	0.82	0.93	0.97	(89)
------	------	------	------	------	------	------	------	------	------	------	------	------

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

18.54	18.88	19.39	19.95	20.24	20.36	20.37	20.37	20.30	19.87	19.14	18.50	(90)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

Living area fraction

Living area ÷ (4) = 0.47 (91)

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

19.07	19.36	19.80	20.28	20.55	20.65	20.66	20.66	20.59	20.21	19.58	19.03	(92)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

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

19.07	19.36	19.80	20.28	20.55	20.65	20.66	20.66	20.59	20.21	19.58	19.03	(93)
-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	------

8. Space heating requirement

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

Utilisation factor for gains, ηm

0.95	0.92	0.86	0.74	0.58	0.41	0.29	0.34	0.56	0.81	0.92	0.96	(94)
------	------	------	------	------	------	------	------	------	------	------	------	------

Useful gains, ηmGm, W (94)m x (84)m

549.65	611.94	663.12	666.36	576.33	406.81	277.46	288.58	421.38	516.13	522.02	525.54	(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]

1070.61	1043.70	956.14	802.09	620.72	415.59	279.34	291.73	449.93	674.39	882.69	1058.06	(97)
---------	---------	--------	--------	--------	--------	--------	--------	--------	--------	--------	---------	------

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

387.60	290.15	218.01	97.73	33.02	0.00	0.00	0.00	0.00	117.74	259.68	396.20	
--------	--------	--------	-------	-------	------	------	------	------	--------	--------	--------	--

Σ(98)1...5, 10...12 = 1800.13 (98)

Space heating requirement kWh/m²/year

(98) ÷ (4) = 17.22 (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

1800.13 (98)

Space heat from boilers

(98) x (304a) x (305) x (306) = 1890.14 (307a)

Water heating

Annual water heating requirement

2255.20 (64)

Water heat from boilers

(64) x (303a) x (305a) x (306) = 2367.96 (310a)

Electricity used for heat distribution

0.01 x [(307a)...(307e) + (310a)...(310e)] = 42.58 (313)

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

229.77 (330a)

mechanical ventilation fans - balanced, extract or positive input from outside

Total electricity for the above, kWh/year

229.77 (331)

Electricity for lighting (Appendix L)

414.86 (332)

Total delivered energy for all uses

(307) + (309) + (310) + (312) + (315) + (331) + (332)...(337b) = 4902.72 (338)

10b. Fuel costs - community heating scheme

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating from boilers	1890.14	x	4.24	x 0.01 =	80.14	(340a)
Water heating from boilers	2367.96	x	4.24	x 0.01 =	100.40	(342a)
Pumps and fans	229.77	x	13.19	x 0.01 =	30.31	(349)
Electricity for lighting	414.86	x	13.19	x 0.01 =	54.72	(350)
Additional standing charges					120.00	(351)
Total energy cost				(340a)...(342e) + (345)...(354) =	385.57	(355)

11b. SAP rating - community heating scheme

Energy cost deflator (Table 12)	0.42	(356)
Energy cost factor (ECF)	1.08	(357)
SAP value	84.90	
SAP rating (section 13)	85	(358)
SAP band	B	

12b. CO₂ emissions - community heating scheme

	Energy kWh/year		Emission factor		Emissions (kg/year)	
Emissions from other sources (space heating)						
Efficiency of boilers	89.50					(367a)
CO ₂ emissions from boilers	4757.65	x	0.216	=	1027.65	(367)
Electrical energy for community heat distribution	42.58	x	0.519	=	22.10	(372)
Total CO ₂ associated with community systems					1049.75	(373)
Total CO ₂ associated with space and water heating					1049.75	(376)
Pumps and fans	229.77	x	0.519	=	119.25	(378)
Electricity for lighting	414.86	x	0.519	=	215.31	(379)
Total CO ₂ , kg/year				(376)..(382) =	1384.31	(383)
Dwelling CO ₂ emission rate				(383) ÷ (4) =	13.24	(384)
EI value					87.60	
EI rating (section 14)					88	(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	89.50					(367a)
Primary energy from boilers	4757.65	x	1.22	=	5804.33	(367)
Electrical energy for community heat distribution	42.58	x	3.07	=	130.72	(372)
Total primary energy associated with community systems					5935.05	(373)
Total primary energy associated with space and water heating					5935.05	(376)
Pumps and fans	229.77	x	3.07	=	705.40	(378)
Electricity for lighting	414.86	x	3.07	=	1273.61	(379)
Primary energy kWh/year					7914.06	(383)
Dwelling primary energy rate kWh/m ² /year					75.69	(384)

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	Mr AECOM Planner	Assessor number	101
Client	Default Client	Last modified	30/08/2018
Address	2.2 redYellow 42, London		

1. Overall dwelling dimensions

	Area (m ²)	Average storey height (m)	Volume (m ³)
Lowest occupied	104.56 (1a)	2.62 (2a)	273.95 (3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) = 104.56 (4)		
Dwelling volume		(3a) + (3b) + (3c) + (3d)...(3n) =	273.95 (5)

2. Ventilation rate

		m ³ per hour
Number of chimneys	0 x 40 =	0 (6a)
Number of open flues	0 x 20 =	0 (6b)
Number of intermittent fans	4 x 10 =	40 (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) = 40 ÷ (5) = 0.15 (8)

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

Air permeability value, q ₅₀ , 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)	0.40 (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) = 0.34 (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
-----------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------

Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.43	0.42	0.41	0.37	0.36	0.32	0.32	0.31	0.34	0.36	0.38	0.40
---	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------

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)
--	--

d) natural ventilation or whole house positive input ventilation from loft

0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58
-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------

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

0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58
-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------	-----------------------------------

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			24.90	1.33	33.01		(27)						
External wall			31.55	0.18	5.68		(29a)						
Party wall			62.13	0.00	0.00		(32)						
Total area of external elements ΣA, m ²			56.45				(31)						
Fabric heat loss, W/K = Σ(A x U)					(26)...(30) + (32) =	38.69	(33)						
Heat capacity Cm = Σ(A x κ)					(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)						
Thermal mass parameter (TMP) in kJ/m ² K						250.00	(35)						
Thermal bridges: Σ(L x Ψ) calculated using Appendix K						2.82	(36)						
Total fabric heat loss					(33) + (36) =	41.51	(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)	53.53	53.20	52.89	51.40	51.12	49.82	49.82	49.58	50.32	51.12	51.68	52.27	(38)
Heat transfer coefficient, W/K (37)m + (38)m	95.04	94.72	94.40	92.91	92.63	91.34	91.34	91.10	91.84	92.63	93.20	93.79	
	Average = Σ(39)1...12/12 =											92.91	(39)
Heat loss parameter (HLP), W/m ² K (39)m ÷ (4)	0.91	0.91	0.90	0.89	0.89	0.87	0.87	0.87	0.88	0.89	0.89	0.90	
	Average = Σ(40)1...12/12 =											0.89	(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												2.78	(42)	
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36												100.18	(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)														
	110.19	106.19	102.18	98.17	94.17	90.16	90.16	94.17	98.17	102.18	106.19	110.19		
												Σ(44)1...12 =	1202.11	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)														
	163.41	142.92	147.48	128.58	123.37	106.46	98.65	113.21	114.56	133.51	145.73	158.26		
												Σ(45)1...12 =	1576.15	(45)
Distribution loss 0.15 x (45)m														
	24.51	21.44	22.12	19.29	18.51	15.97	14.80	16.98	17.18	20.03	21.86	23.74	(46)	
Storage volume (litres) including any solar or WWHRs storage within same vessel												180.00	(47)	
Water storage loss:														
a) If manufacturer's declared loss factor is known (kWh/day)												1.55	(48)	
Temperature factor from Table 2b												0.54	(49)	
Energy lost from water storage (kWh/day) (48) x (49)												0.84	(50)	
Enter (50) or (54) in (55)												0.84	(55)	
Water storage loss calculated for each month (55) x (41)m														
	25.98	23.47	25.98	25.14	25.98	25.14	25.98	25.98	25.14	25.98	25.14	25.98	(56)	
If the vessel contains dedicated solar storage or dedicated WWHRs (56)m x [(47) - Vs] ÷ (47), else (56)														
	25.98	23.47	25.98	25.14	25.98	25.14	25.98	25.98	25.14	25.98	25.14	25.98	(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)	