TER Worksheet
Design - Draft

SRS Partnership

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 Stuart Searle	Assessor number	3519
Client	Avis Appleton & Associates	Last modified	14/09/2016
Address	PF1 Liffords Place, London, SW13		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		68.90	(1a) x	2.50	(2a) =	172.25	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	68.90	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	172.25	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		2	x 10 =	20	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	20	÷ (5) =	0.12	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	5.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.37	(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) = 0.31	(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	0.40	0.39	0.38	0.34	0.33	0.30	0.30	0.29	0.31	0.33	0.35	0.37	(22b)

Calculate effective air change rate for the applicable case:

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

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

	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(24d)

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

	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Door			2.10	x	1.00	=	2.10			(26)
Window			15.12	x	1.33	=	20.05			(27)
Exposed floor			68.90	x	0.13	=	8.96			(28b
External wall			77.72	x	0.18	=	13.99			(29a)
Total area of external elements ∑A, m²			163.84							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	45.09 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		15.31 (36)
Total fabric heat loss	(33) + (36) =	60.40 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
32.90	32.72	32.55	31.75	31.60	30.91	30.91	30.78	31.17	31.60	31.90	32.22	(38)

Heat transfer coefficient, W/K (37)m + (38)m

93.30	93.12	92.95	92.15	92.00	91.31	91.31	91.18	91.58	92.00	92.31	92.62	

Average = ∑(39)1...12/12 = 92.15 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

1.35	1.35	1.35	1.34	1.34	1.33	1.33	1.32	1.33	1.34	1.34	1.34	

Average = ∑(40)1...12/12 = 1.34 (40)

Number of days in month (Table 1a)

31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N		2.22 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		86.90 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
95.59	92.12	88.64	85.17	81.69	78.21	78.21	81.69	85.17	88.64	92.12	95.59	

∑(44)1...12 = 1042.85 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

141.76	123.99	127.94	111.54	107.03	92.36	85.58	98.21	99.38	115.82	126.43	137.29	

∑(45)1...12 = 1367.34 (45)

Distribution loss 0.15 x (45)m

21.26	18.60	19.19	16.73	16.05	13.85	12.84	14.73	14.91	17.37	18.96	20.59	(46)

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

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)

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

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)

Primary circuit loss for each month from Table 3

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)

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

48.71	42.40	45.17	42.00	41.63	38.57	39.86	41.63	42.00	45.17	45.43	48.71	(61)

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

190.48	166.39	173.12	153.54	148.66	130.93	125.44	139.84	141.38	160.99	171.85	186.00	(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

190.48	166.39	173.12	153.54	148.66	130.93	125.44	139.84	141.38	160.99	171.85	186.00	

∑(64)1...12 = 1888.62 (64)

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

59.32	51.83	53.83	47.59	45.99	40.35	38.42	43.06	43.54	49.80	53.39	57.83	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	110.96	110.96	110.96	110.96	110.96	110.96	110.96	110.96	110.96	110.96	110.96	110.96	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	17.37	15.42	12.54	9.50	7.10	5.99	6.48	8.42	11.30	14.35	16.74	17.85	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	194.72	196.74	191.65	180.81	167.12	154.26	145.67	143.65	148.74	159.58	173.26	186.12	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.10	34.10	34.10	34.10	34.10	34.10	34.10	34.10	34.10	34.10	34.10	34.10	(69)
Pump and fan gains (Table 5a)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (Table 5)	-88.77	-88.77	-88.77	-88.77	-88.77	-88.77	-88.77	-88.77	-88.77	-88.77	-88.77	-88.77	(71)
Water heating gains (Table 5)	79.72	77.12	72.36	66.10	61.82	56.04	51.64	57.88	60.48	66.94	74.16	77.73	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	351.09	348.57	335.83	315.68	295.33	275.59	263.07	269.23	279.81	300.15	323.45	340.99	(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	
SouthWest	0.77	x	4.62	x	36.79	x 0.9 x	0.63	x	0.70	=	51.95	(79)
SouthEast	0.77	x	2.31	x	36.79	x 0.9 x	0.63	x	0.70	=	25.98	(77)
NorthEast	0.77	x	8.19	x	11.28	x 0.9 x	0.63	x	0.70	=	28.24	(75)

Solar gains in watts ∑(74)m...(82)m

106.17	190.22	285.19	395.12	480.69	493.98	469.27	402.87	322.85	216.95	128.87	89.75	(83)

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

457.26	538.79	621.02	710.81	776.02	769.57	732.35	672.10	602.66	517.11	452.32	430.74	(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)	1.00	0.99	0.98	0.95	0.85	0.69	0.53	0.59	0.84	0.97	0.99	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.55	19.73	20.03	20.42	20.75	20.93	20.98	20.97	20.83	20.40	19.90	19.52	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	19.80	19.80	19.80	19.81	19.81	19.82	19.82	19.82	19.82	19.81	19.81	19.81	(88)
Utilisation factor for gains for rest of dwelling n2,m	1.00	0.99	0.98	0.93	0.80	0.59	0.40	0.46	0.76	0.95	0.99	1.00	(89)

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

17.89	18.16	18.59	19.14	19.57	19.78	19.82	19.81	19.69	19.13	18.41	17.85

(90)

Living area fraction — Living area ÷ (4) = 0.49 (91)

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

18.71	18.93	19.30	19.77	20.15	20.34	20.39	20.38	20.25	19.75	19.14	18.67

(92)

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

18.71	18.93	19.30	19.77	20.15	20.34	20.39	20.38	20.25	19.75	19.14	18.67

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.99	0.99	0.97	0.93	0.82	0.64	0.46	0.52	0.79	0.95	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	454.68	532.46	603.86	658.02	634.64	490.57	339.67	352.35	475.43	492.83	447.41	428.85	(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]	1344.26	1306.69	1189.55	1001.66	777.41	524.54	346.06	363.19	563.17	842.21	1111.79	1340.14	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	661.85	520.28	435.75	247.42	106.22	0.00	0.00	0.00	0.00	259.94	478.35	678.00	

∑(98)1...5, 10...12 = 3387.81 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 49.17 (99)

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

Space heating

Fraction of space heat from secondary/supplementary system (table 11) — 0.00 (201)

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

Fraction of space heat from main system 2 — 0.00 (202)

Fraction of total space heat from main system 1 — (202) x [1- (203)] = 1.00 (204)

Fraction of total space heat from main system 2 — (202) x (203) = 0.00 (205)

Efficiency of main system 1 (%) — 93.40 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	708.62	557.05	466.54	264.90	113.73	0.00	0.00	0.00	0.00	278.31	512.15	725.91	

∑(211)1...5, 10...12 = 3627.21 (211)

Water heating

Efficiency of water heater

87.93	87.73	87.28	86.25	84.22	80.30	80.30	80.30	80.30	86.25	87.49	88.02

(217)

Water heating fuel, kWh/month

216.63	189.67	198.35	178.03	176.51	163.05	156.22	174.14	176.07	186.65	196.42	211.33

∑(219a)1...12 = 2223.07 (219)

Annual totals

Space heating fuel - main system 1 — 3627.21

Water heating fuel — 2223.07

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

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

boiler flue fan — 45.00 (230e)

Total electricity for the above, kWh/year — 75.00 (231)

Electricity for lighting (Appendix L)		306.70	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	6231.97	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	3627.21	x	3.48	x 0.01 =	126.23	(240)
Water heating	2223.07	x	3.48	x 0.01 =	77.36	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	306.70	x	13.19	x 0.01 =	40.45	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		373.94	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.38	(257)
SAP value	80.76	
SAP rating (section 13)	81	(258)
SAP band	B	

12a. CO_2 emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	3627.21	x	0.216	=	783.48	(261)
Water heating	2223.07	x	0.216	=	480.18	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1263.66	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	306.70	x	0.519	=	159.18	(268)
Total CO_2, kg/year			(265)...(271) =		1461.76	(272)
Dwelling CO_2 emission rate			(272) ÷ (4) =		21.22	(273)
EI value					82.80	
EI rating (section 14)					83	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	3627.21	x	1.22	=	4425.19	(261)
Water heating	2223.07	x	1.22	=	2712.14	(264)
Space and water heating			(261) + (262) + (263) + (264) =		7137.33	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	306.70	x	3.07	=	941.56	(268)
Primary energy kWh/year					8309.15	(272)
Dwelling primary energy rate kWh/m2/year					120.60	(273)

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Assessor name	Mr Stuart Searle	Assessor number	3519
Client	Avis Appleton & Associates	Last modified	14/09/2016
Address	PF2 Liffords Place, London, SW13		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		68.90	(1a) x	2.50	(2a) =	172.25	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	68.90	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	172.25	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		2	x 10 =	20	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	20	÷ (5) =	0.12	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	5.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.37	(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) = 0.31	(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	0.40	0.39	0.38	0.34	0.33	0.30	0.30	0.29	0.31	0.33	0.35	0.37	(22b)

Calculate effective air change rate for the applicable case:

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

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

	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(24d)

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

	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Door			2.10	x	1.00	=	2.10			(26)
Window			15.12	x	1.33	=	20.05			(27)
Exposed floor			68.90	x	0.13	=	8.96			(28b
External wall			57.97	x	0.18	=	10.43			(29a)
Party wall			19.75	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			144.09							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	41.54 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		13.34 (36)
Total fabric heat loss	(33) + (36) =	54.88 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
32.90	32.72	32.55	31.75	31.60	30.91	30.91	30.78	31.17	31.60	31.90	32.22	(38)

Heat transfer coefficient, W/K (37)m + (38)m

87.78	87.60	87.43	86.63	86.48	85.79	85.79	85.66	86.05	86.48	86.78	87.10	

Average = ∑(39)1...12/12 = 86.63 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

1.27	1.27	1.27	1.26	1.26	1.25	1.25	1.24	1.25	1.26	1.26	1.26	

Average = ∑(40)1...12/12 = 1.26 (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	2.22 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	86.90 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
95.59	92.12	88.64	85.17	81.69	78.21	78.21	81.69	85.17	88.64	92.12	95.59	

∑(44)1...12 = 1042.85 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

141.76	123.99	127.94	111.54	107.03	92.36	85.58	98.21	99.38	115.82	126.43	137.29	

∑(45)1...12 = 1367.34 (45)

Distribution loss 0.15 x (45)m

21.26	18.60	19.19	16.73	16.05	13.85	12.84	14.73	14.91	17.37	18.96	20.59	(46)

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

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)

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

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)

Primary circuit loss for each month from Table 3

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)

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

48.71	42.40	45.17	42.00	41.63	38.57	39.86	41.63	42.00	45.17	45.43	48.71	(61)

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

190.48	166.39	173.12	153.54	148.66	130.93	125.44	139.84	141.38	160.99	171.85	186.00	(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

	190.48	166.39	173.12	153.54	148.66	130.93	125.44	139.84	141.38	160.99	171.85	186.00

∑(64)1...12 = 1888.62 (64)

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

	59.32	51.83	53.83	47.59	45.99	40.35	38.42	43.06	43.54	49.80	53.39	57.83 (65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	110.96	110.96	110.96	110.96	110.96	110.96	110.96	110.96	110.96	110.96	110.96	110.96	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	17.37	15.42	12.54	9.50	7.10	5.99	6.48	8.42	11.30	14.35	16.74	17.85	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	194.72	196.74	191.65	180.81	167.12	154.26	145.67	143.65	148.74	159.58	173.26	186.12	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.10	34.10	34.10	34.10	34.10	34.10	34.10	34.10	34.10	34.10	34.10	34.10	(69)
Pump and fan gains (Table 5a)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (Table 5)	-88.77	-88.77	-88.77	-88.77	-88.77	-88.77	-88.77	-88.77	-88.77	-88.77	-88.77	-88.77	(71)
Water heating gains (Table 5)	79.72	77.12	72.36	66.10	61.82	56.04	51.64	57.88	60.48	66.94	74.16	77.73	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	351.09	348.57	335.83	315.68	295.33	275.59	263.07	269.23	279.81	300.15	323.45	340.99	(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	
SouthWest	0.77	x	4.62	x	36.79	x 0.9 x	0.63	x	0.70	=	51.95	(79)
NorthWest	0.77	x	2.31	x	11.28	x 0.9 x	0.63	x	0.70	=	7.97	(81)
NorthEast	0.77	x	8.19	x	11.28	x 0.9 x	0.63	x	0.70	=	28.24	(75)

Solar gains in watts ∑(74)m...(82)m

	88.16	162.19	253.86	368.09	461.16	479.32	453.17	380.45	292.90	187.87	107.78	74.03 (83)

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

	439.25	510.76	589.69	683.77	756.49	754.91	716.24	649.68	572.70	488.02	431.23	415.01 (84)

7. Mean internal temperature (heating season)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	1.00	0.99	0.98	0.95	0.85	0.67	0.51	0.58	0.84	0.97	0.99	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.63	19.80	20.08	20.47	20.78	20.95	20.99	20.98	20.85	20.43	19.96	19.60	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	19.86	19.86	19.87	19.87	19.88	19.88	19.88	19.89	19.88	19.88	19.87	19.87	(88)

Utilisation factor for gains for rest of dwelling n2,m

1.00	0.99	0.98	0.93	0.80	0.58	0.39	0.45	0.76	0.96	0.99	1.00	(89)

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

18.05	18.29	18.71	19.26	19.67	19.85	19.88	19.88	19.76	19.22	18.54	18.01	(90)

Living area fraction — Living area ÷ (4) = 0.49 (91)

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

18.83	19.03	19.39	19.85	20.22	20.39	20.43	20.42	20.30	19.82	19.24	18.79	(92)

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

18.83	19.03	19.39	19.85	20.22	20.39	20.43	20.42	20.30	19.82	19.24	18.79	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	1.00	0.99	0.98	0.93	0.81	0.62	0.45	0.52	0.79	0.96	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	437.18	505.80	575.46	634.97	615.06	470.74	323.62	336.02	454.77	467.82	427.30	413.50	(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]	1275.11	1238.04	1126.60	948.75	736.59	496.67	328.14	344.30	533.22	797.14	1053.53	1270.94	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	623.42	492.07	410.05	225.92	90.42	0.00	0.00	0.00	0.00	245.02	450.89	637.94	

∑(98)1...5, 10...12 = 3175.72 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 46.09 (99)

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

Space heating

Fraction of space heat from secondary/supplementary system (table 11) — 0.00 (201)

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

Fraction of space heat from main system 2 — 0.00 (202)

Fraction of total space heat from main system 1 — (202) x [1- (203)] = 1.00 (204)

Fraction of total space heat from main system 2 — (202) x (203) = 0.00 (205)

Efficiency of main system 1 (%) — 93.40 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	667.47	526.84	439.03	241.88	96.81	0.00	0.00	0.00	0.00	262.33	482.75	683.02	

∑(211)1...5, 10...12 = 3400.13 (211)

Water heating

Efficiency of water heater

87.82	87.62	87.15	86.02	83.84	80.30	80.30	80.30	80.30	86.11	87.37	87.90	(217)

Water heating fuel, kWh/month

216.91	189.91	198.65	178.49	177.31	163.05	156.22	174.14	176.07	186.97	196.70	211.60	

∑(219a)1...12 = 2226.01 (219)

Annual totals

Space heating fuel - main system 1 — 3400.13

Water heating fuel — 2226.01

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

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

boiler flue fan — 45.00 (230e)

Total electricity for the above, kWh/year		75.00	(231)
Electricity for lighting (Appendix L)		306.70	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	6007.84	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	3400.13	x	3.48	x 0.01 =	118.32	(240)
Water heating	2226.01	x	3.48	x 0.01 =	77.47	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	306.70	x	13.19	x 0.01 =	40.45	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		366.14	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.35	(257)
SAP value	81.17	
SAP rating (section 13)	81	(258)
SAP band	B	

12a. CO_2 emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	3400.13	x	0.216	=	734.43	(261)
Water heating	2226.01	x	0.216	=	480.82	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1215.25	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	306.70	x	0.519	=	159.18	(268)
Total CO_2, kg/year				(265)...(271) =	1413.35	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	20.51	(273)
EI value					83.37	
EI rating (section 14)					83	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	3400.13	x	1.22	=	4148.15	(261)
Water heating	2226.01	x	1.22	=	2715.74	(264)
Space and water heating			(261) + (262) + (263) + (264) =		6863.89	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	306.70	x	3.07	=	941.56	(268)
Primary energy kWh/year					8035.71	(272)
Dwelling primary energy rate kWh/m2/year					116.63	(273)

TER Worksheet
Design - Draft

SRS Partnership

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 Stuart Searle	Assessor number	3519
Client	Avis Appleton & Associates	Last modified	14/09/2016
Address	PF3 Liffords Place, London, SW13		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		42.60	(1a) x	2.50	(2a) =	106.50	(3a)
+1		42.60	(1b) x	3.00	(2b) =	127.80	(3b)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	85.20	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	234.30	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	3	x 10 =	30	(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) =	30	÷ (5) =	0.13 (8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	5.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.38	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.32	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.41	0.40	0.39	0.35	0.35	0.31	0.31	0.30	0.32	0.35	0.36	0.38	(22b)

Calculate effective air change rate for the applicable case:

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

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

	0.58	0.58	0.58	0.56	0.56	0.55	0.55	0.54	0.55	0.56	0.57	0.57	(24d)

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

0.58	0.58	0.58	0.56	0.56	0.55	0.55	0.54	0.55	0.56	0.57	0.57

(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Door			2.10	x	1.00	=	2.10			(26)
Window			14.86	x	1.33	=	19.70			(27)
Exposed floor			42.60	x	0.13	=	5.54			(28b
External wall			104.59	x	0.18	=	18.83			(29a)
Party wall			43.45	x	0.00	=	0.00			(32)
Roof			7.92	x	0.13	=	1.03			(30)
Total area of external elements ∑A, m²			172.07							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	47.19 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		13.60 (36)
Total fabric heat loss	(33) + (36) =	60.80 (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)													
	45.15	44.90	44.65	43.49	43.27	42.26	42.26	42.08	42.65	43.27	43.71	44.17	(38)
Heat transfer coefficient, W/K (37)m + (38)m													
	105.94	105.69	105.45	104.29	104.07	103.06	103.06	102.87	103.45	104.07	104.51	104.97	
Average = ∑(39)1...12/12 =												104.28	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)													
	1.24	1.24	1.24	1.22	1.22	1.21	1.21	1.21	1.21	1.22	1.23	1.23	
Average = ∑(40)1...12/12 =												1.22	(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	2.55 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	94.86 (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)													
	104.35	100.55	96.76	92.96	89.17	85.38	85.38	89.17	92.96	96.76	100.55	104.35	
∑(44)1...12 =												1138.34	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)													
	154.74	135.34	139.66	121.76	116.83	100.82	93.42	107.20	108.48	126.42	138.00	149.86	
∑(45)1...12 =												1492.54	(45)
Distribution loss 0.15 x (45)m													
	23.21	20.30	20.95	18.26	17.52	15.12	14.01	16.08	16.27	18.96	20.70	22.48	(46)
Water storage loss calculated for each month (55) x (41)m													
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)													
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)
Primary circuit loss for each month from Table 3													
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)
Combi loss for each month from Table 3a, 3b or 3c													
	50.96	46.03	49.31	45.85	45.44	42.10	43.51	45.44	45.85	49.31	49.32	50.96	(61)

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

205.70	181.37	188.97	167.60	162.27	142.92	136.93	152.64	154.33	175.73	187.32	200.82	(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

205.70	181.37	188.97	167.60	162.27	142.92	136.93	152.64	154.33	175.73	187.32	200.82	

∑(64)1...12 = 2056.59 (64)

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

64.19	56.51	58.76	51.95	50.21	44.05	41.94	47.00	47.53	54.36	58.21	62.57	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	127.71	127.71	127.71	127.71	127.71	127.71	127.71	127.71	127.71	127.71	127.71	127.71	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	21.05	18.70	15.20	11.51	8.60	7.26	7.85	10.20	13.69	17.39	20.29	21.63	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	229.96	232.35	226.34	213.54	197.38	182.19	172.04	169.65	175.67	188.47	204.63	219.82	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.77	35.77	35.77	35.77	35.77	35.77	35.77	35.77	35.77	35.77	35.77	35.77	(69)
Pump and fan gains (Table 5a)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (Table 5)	-102.17	-102.17	-102.17	-102.17	-102.17	-102.17	-102.17	-102.17	-102.17	-102.17	-102.17	-102.17	(71)
Water heating gains (Table 5)	86.28	84.09	78.98	72.15	67.48	61.18	56.37	63.18	66.02	73.07	80.85	84.10	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	401.61	399.45	384.84	361.51	337.77	314.94	300.57	307.35	319.69	343.24	370.09	389.86	(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	
SouthEast	0.77	x	10.02	x	36.79	x 0.9 x	0.63	x	0.70	=	112.67	(77)
SouthWest	0.77	x	4.84	x	36.79	x 0.9 x	0.63	x	0.70	=	54.42	(79)

Solar gains in watts ∑(74)m...(82)m

167.10	284.63	389.44	482.53	540.48	536.57	517.31	474.08	421.68	314.57	200.14	143.00	(83)

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

568.70	684.07	774.28	844.04	878.25	851.51	817.88	781.43	741.37	657.81	570.23	532.86	(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)	1.00	0.99	0.98	0.95	0.86	0.71	0.54	0.58	0.81	0.96	0.99	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.70	19.89	20.16	20.50	20.77	20.94	20.99	20.98	20.88	20.51	20.04	19.66	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	19.89	19.89	19.89	19.90	19.90	19.91	19.91	19.91	19.91	19.90	19.90	19.89	(88)

Utilisation factor for gains for rest of dwelling n2,m

1.00	0.99	0.97	0.93	0.82	0.61	0.41	0.46	0.73	0.94	0.99	1.00

(89)

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

18.16	18.45	18.84	19.32	19.68	19.87	19.91	19.91	19.81	19.35	18.67	18.12

(90)

Living area fraction — Living area ÷ (4) = 0.42 (91)

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

18.81	19.06	19.40	19.82	20.14	20.32	20.36	20.36	20.26	19.84	19.25	18.77

(92)

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

18.81	19.06	19.40	19.82	20.14	20.32	20.36	20.36	20.26	19.84	19.25	18.77

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.99	0.99	0.97	0.92	0.83	0.65	0.47	0.51	0.76	0.94	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	565.42	674.82	750.27	780.61	726.78	554.90	382.23	398.86	563.65	619.89	563.28	530.56	(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]	1537.37	1496.25	1360.41	1138.44	878.76	589.80	387.87	407.42	637.66	961.59	1269.36	1529.46	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	723.13	552.00	453.94	257.64	113.07	0.00	0.00	0.00	0.00	254.23	508.38	743.19	

∑(98)1...5, 10...12 = 3605.57 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 42.32 (99)

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

Space heating

Fraction of space heat from secondary/supplementary system (table 11) — 0.00 (201)

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

Fraction of space heat from main system 2 — 0.00 (202)

Fraction of total space heat from main system 1 — (202) x [1- (203)] = 1.00 (204)

Fraction of total space heat from main system 2 — (202) x (203) = 0.00 (205)

Efficiency of main system 1 (%) — 93.40 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	774.23	591.01	486.02	275.84	121.06	0.00	0.00	0.00	0.00	272.19	544.30	795.70	

∑(211)1...5, 10...12 = 3860.36 (211)

Water heating

Efficiency of water heater

87.95	87.67	87.18	86.13	84.16	80.30	80.30	80.30	80.30	85.98	87.44	88.04

(217)

Water heating fuel, kWh/month

233.89	206.87	216.76	194.59	192.81	177.98	170.52	190.09	192.19	204.39	214.23	228.09

∑(219a)1...12 = 2422.40 (219)

Annual totals

Space heating fuel - main system 1 — 3860.36

Water heating fuel — 2422.40

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

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

boiler flue fan	45.00			(230e)
Total electricity for the above, kWh/year			75.00	(231)
Electricity for lighting (Appendix L)			371.74	(232)
Total delivered energy for all uses		(211)...(221) + (231) + (232)...(237b) =	6729.49	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	3860.36	x	3.48	x 0.01 =	134.34	(240)
Water heating	2422.40	x	3.48	x 0.01 =	84.30	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	371.74	x	13.19	x 0.01 =	49.03	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		397.56	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.28	(257)
SAP value	82.11	
SAP rating (section 13)	82	(258)
SAP band	B	

12a. CO_2 emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	3860.36	x	0.216	=	833.84	(261)
Water heating	2422.40	x	0.216	=	523.24	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1357.07	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	371.74	x	0.519	=	192.93	(268)
Total CO_2, kg/year				(265)...(271) =	1588.93	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	18.65	(273)
EI value					83.65	
EI rating (section 14)					84	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	3860.36	x	1.22	=	4709.64	(261)
Water heating	2422.40	x	1.22	=	2955.32	(264)
Space and water heating			(261) + (262) + (263) + (264) =		7664.96	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	371.74	x	3.07	=	1141.23	(268)
Primary energy kWh/year					9036.44	(272)
Dwelling primary energy rate kWh/m2/year					106.06	(273)

TER Worksheet
Design - Draft

SRS Partnership

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 Stuart Searle	Assessor number	3519
Client	Avis Appleton & Associates	Last modified	14/09/2016
Address	PF4 Liffords Place, London, SW13		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		102.40	(1a) x	2.50	(2a) =	256.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	102.40	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	256.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		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) =	0.16	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	5.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.41	(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) = 0.35	(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	0.44	0.43	0.42	0.38	0.37	0.33	0.33	0.32	0.35	0.37	0.39	0.41	(22b)

Calculate effective air change rate for the applicable case:

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.60	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.58	0.58	(24d)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.60	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.58	0.58	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Door			2.10	x	1.00	=	2.10			(26)
Window			18.32	x	1.33	=	24.29			(27)
Exposed floor			102.40	x	0.13	=	13.31			(28b
External wall			89.58	x	0.18	=	16.12			(29a)
Total area of external elements ∑A, m²			212.40							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	55.82 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		15.62 (36)
Total fabric heat loss	(33) + (36) =	71.44 (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)	50.43	50.11	49.80	48.33	48.06	46.79	46.79	46.55	47.28	48.06	48.61	49.19	(38)
Heat transfer coefficient, W/K (37)m + (38)m	121.87	121.55	121.24	119.78	119.50	118.23	118.23	117.99	118.72	119.50	120.06	120.64	

Average = ∑(39)1...12/12 = 119.77 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.19	1.19	1.18	1.17	1.17	1.15	1.15	1.15	1.16	1.17	1.17	1.18	

Average = ∑(40)1...12/12 = 1.17 (40)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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	2.76 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	99.77 (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)	109.74	105.75	101.76	97.77	93.78	89.79	89.79	93.78	97.77	101.76	105.75	109.74	

∑(44)1...12 = 1197.19 (44)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	162.74	142.34	146.88	128.05	122.87	106.03	98.25	112.74	114.09	132.96	145.14	157.61	

∑(45)1...12 = 1569.70 (45)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Distribution loss 0.15 x (45)m	24.41	21.35	22.03	19.21	18.43	15.90	14.74	16.91	17.11	19.94	21.77	23.64	(46)
Water storage loss calculated for each month (55) x (41)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)
Primary circuit loss for each month from Table 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)
Combi loss for each month from Table 3a, 3b or 3c	50.96	46.03	50.96	48.22	47.79	44.28	45.76	47.79	48.22	50.96	49.32	50.96	(61)
Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m	213.70	188.36	197.84	176.27	170.66	150.31	144.01	160.53	162.31	183.92	194.45	208.57	(62)

Solar DHW input calculated using Appendix G or Appendix H

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

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

213.70	188.36	197.84	176.27	170.66	150.31	144.01	160.53	162.31	183.92	194.45	208.57	

∑(64)1...12 = 2150.93 (64)

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

66.85	58.83	61.58	54.63	52.80	46.32	44.11	49.43	49.99	56.95	60.59	65.14	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	138.03	138.03	138.03	138.03	138.03	138.03	138.03	138.03	138.03	138.03	138.03	138.03	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	23.71	21.06	17.13	12.97	9.69	8.18	8.84	11.49	15.43	19.59	22.86	24.37	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	260.15	262.85	256.05	241.56	223.28	206.10	194.62	191.92	198.73	213.21	231.49	248.67	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.80	36.80	36.80	36.80	36.80	36.80	36.80	36.80	36.80	36.80	36.80	36.80	(69)
Pump and fan gains (Table 5a)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (Table 5)	-110.43	-110.43	-110.43	-110.43	-110.43	-110.43	-110.43	-110.43	-110.43	-110.43	-110.43	-110.43	(71)
Water heating gains (Table 5)	89.86	87.55	82.76	75.88	70.97	64.34	59.28	66.44	69.43	76.54	84.15	87.56	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	441.13	438.87	423.35	397.82	371.36	346.03	330.16	337.27	350.99	376.75	405.91	428.01	(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	
NorthWest	0.77	x	8.64	x	11.28	x 0.9 x	0.63	x	0.70	=	29.79	(81)
SouthEast	0.77	x	9.68	x	36.79	x 0.9 x	0.63	x	0.70	=	108.85	(77)

Solar gains in watts ∑(74)m...(82)m

138.64	246.05	362.95	493.77	593.27	606.67	577.53	500.59	407.82	279.03	167.86	117.48	(83)

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

579.77	684.92	786.29	891.58	964.63	952.70	907.69	837.86	758.81	655.78	573.77	545.49	(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)	1.00	1.00	0.99	0.96	0.89	0.73	0.56	0.62	0.86	0.98	1.00	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.67	19.84	20.11	20.46	20.76	20.94	20.99	20.98	20.85	20.45	20.00	19.65	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	19.93	19.93	19.93	19.94	19.95	19.96	19.96	19.96	19.95	19.95	19.94	19.94	(88)
Utilisation factor for gains for rest of dwelling n2,m	1.00	0.99	0.99	0.95	0.84	0.63	0.43	0.49	0.79	0.97	1.00	1.00	(89)

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

18.16	18.40	18.79	19.31	19.71	19.92	19.95	19.95	19.83	19.30	18.64	18.13	(90)

Living area fraction — Living area ÷ (4) = 0.41 (91)

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

18.77	18.99	19.33	19.78	20.14	20.33	20.37	20.37	20.24	19.77	19.19	18.75	(92)

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

18.77	18.99	19.33	19.78	20.14	20.33	20.37	20.37	20.24	19.77	19.19	18.75	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	1.00	0.99	0.98	0.95	0.85	0.67	0.48	0.55	0.82	0.97	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	578.08	680.29	772.39	843.63	820.35	636.92	439.45	456.66	619.38	634.21	570.25	544.31	(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]	1764.04	1712.12	1555.09	1302.58	1008.66	677.69	445.99	468.13	729.39	1095.70	1451.93	1754.71	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	882.35	693.39	582.33	330.45	140.10	0.00	0.00	0.00	0.00	343.35	634.81	900.54	

∑(98)1...5, 10...12 = 4507.33 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 44.02 (99)

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

Space heating

Fraction of space heat from secondary/supplementary system (table 11) — 0.00 (201)

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

Fraction of space heat from main system 2 — 0.00 (202)

Fraction of total space heat from main system 1 — (202) x [1- (203)] = 1.00 (204)

Fraction of total space heat from main system 2 — (202) x (203) = 0.00 (205)

Efficiency of main system 1 (%) — 93.40 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	944.70	742.39	623.48	353.80	150.00	0.00	0.00	0.00	0.00	367.61	679.67	964.17	

∑(211)1...5, 10...12 = 4825.83 (211)

Water heating

Efficiency of water heater

88.24	88.03	87.61	86.61	84.56	80.30	80.30	80.30	80.30	86.60	87.81	88.31	(217)

Water heating fuel, kWh/month

242.19	213.97	225.83	203.52	201.82	187.18	179.33	199.92	202.12	212.38	221.45	236.17	

∑(219a)1...12 = 2525.88 (219)

Annual totals

Space heating fuel - main system 1 — 4825.83

Water heating fuel — 2525.88

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

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

boiler flue fan — 45.00 (230e)

Total electricity for the above, kWh/year — 75.00 (231)

Electricity for lighting (Appendix L) — 418.75 (232)

Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	7845.46	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	4825.83	x	3.48	x 0.01 =	167.94	(240)
Water heating	2525.88	x	3.48	x 0.01 =	87.90	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	418.75	x	13.19	x 0.01 =	55.23	(250)
Additional standing charges					120.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	440.96	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.26	(257)
SAP value	82.47	
SAP rating (section 13)	82	(258)
SAP band	B	

12a. CO_2 emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	4825.83	x	0.216	=	1042.38	(261)
Water heating	2525.88	x	0.216	=	545.59	(264)
Space and water heating				(261) + (262) + (263) + (264) =	1587.97	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	418.75	x	0.519	=	217.33	(268)
Total CO_2, kg/year				(265)...(271) =	1844.22	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	18.01	(273)
EI value					83.23	
EI rating (section 14)					83	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	4825.83	x	1.22	=	5887.51	(261)
Water heating	2525.88	x	1.22	=	3081.58	(264)
Space and water heating				(261) + (262) + (263) + (264) =	8969.09	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	418.75	x	3.07	=	1285.55	(268)
Primary energy kWh/year					10484.89	(272)
Dwelling primary energy rate kWh/m2/year					102.39	(273)

TER Worksheet
Design - Draft

SRS Partnership

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 Stuart Searle	Assessor number	3519
Client	Avis Appleton & Associates	Last modified	14/09/2016
Address	PF5 Liffords Place, London, SW13		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		79.10	(1a) x	2.50	(2a) =	197.75	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	79.10	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	197.75	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		3	x 10 =	30	(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) =	30	÷ (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, q50, expressed in cubic metres per hour per square metre of envelope area	5.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.40	(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	(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	0.44	0.43	0.42	0.38	0.37	0.32	0.32	0.32	0.34	0.37	0.38	0.40	(22b)

Calculate effective air change rate for the applicable case:

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

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	(24d)

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	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Door			2.10	x	1.00	=	2.10			(26)
Window			12.10	x	1.33	=	16.04			(27)
Exposed floor			79.10	x	0.13	=	10.28			(28b
External wall			88.80	x	0.18	=	15.98			(29a)
Total area of external elements ∑A, m²			182.10							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	44.41 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		16.60 (36)
Total fabric heat loss	(33) + (36) =	61.01 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
38.81	38.57	38.34	37.23	37.02	36.06	36.06	35.88	36.43	37.02	37.44	37.88	(38)

Heat transfer coefficient, W/K (37)m + (38)m

99.82	99.58	99.34	98.24	98.03	97.07	97.07	96.89	97.44	98.03	98.45	98.89	

Average = ∑(39)1...12/12 = 98.24 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

1.26	1.26	1.26	1.24	1.24	1.23	1.23	1.22	1.23	1.24	1.24	1.25	

Average = ∑(40)1...12/12 = 1.24 (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	2.45 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	92.28 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
101.51	97.82	94.13	90.44	86.75	83.05	83.05	86.75	90.44	94.13	97.82	101.51	

∑(44)1...12 = 1107.39 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

150.54	131.66	135.86	118.45	113.65	98.07	90.88	104.29	105.53	122.99	134.25	145.79	

∑(45)1...12 = 1451.96 (45)

Distribution loss 0.15 x (45)m

22.58	19.75	20.38	17.77	17.05	14.71	13.63	15.64	15.83	18.45	20.14	21.87	(46)

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

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)

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

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)

Primary circuit loss for each month from Table 3

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)

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

50.96	45.02	47.97	44.60	44.20	40.96	42.32	44.20	44.60	47.97	48.24	50.96	(61)

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

201.50	176.68	183.83	163.05	157.86	139.03	133.20	148.49	150.13	170.95	182.49	196.75	(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

201.50	176.68	183.83	163.05	157.86	139.03	133.20	148.49	150.13	170.95	182.49	196.75	

∑(64)1...12 = 2003.96 (64)

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

62.79	55.03	57.17	50.53	48.84	42.85	40.80	45.73	46.24	52.88	56.70	61.21	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	122.28	122.28	122.28	122.28	122.28	122.28	122.28	122.28	122.28	122.28	122.28	122.28	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	20.42	18.14	14.75	11.17	8.35	7.05	7.61	9.90	13.28	16.87	19.69	20.99	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	217.55	219.81	214.12	202.01	186.72	172.35	162.75	160.50	166.18	178.29	193.58	207.95	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.23	35.23	35.23	35.23	35.23	35.23	35.23	35.23	35.23	35.23	35.23	35.23	(69)
Pump and fan gains (Table 5a)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (Table 5)	-97.82	-97.82	-97.82	-97.82	-97.82	-97.82	-97.82	-97.82	-97.82	-97.82	-97.82	-97.82	(71)
Water heating gains (Table 5)	84.40	81.89	76.84	70.19	65.65	59.51	54.84	61.46	64.22	71.08	78.75	82.28	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	385.05	382.52	368.39	346.04	323.40	301.59	287.89	294.54	306.37	328.93	354.70	373.90	(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	
SouthWest	0.77	x	4.84	x	36.79	x 0.9 x	0.63	x	0.70	=	54.42	(79)
NorthWest	0.77	x	4.84	x	11.28	x 0.9 x	0.63	x	0.70	=	16.69	(81)
SouthEast	0.77	x	2.42	x	36.79	x 0.9 x	0.63	x	0.70	=	27.21	(77)

Solar gains in watts ∑(74)m...(82)m

98.33	173.03	251.47	336.26	399.17	406.19	387.49	339.04	280.60	195.20	118.78	83.49	(83)

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

483.38	555.55	619.86	682.31	722.57	707.79	675.38	633.58	586.97	524.13	473.48	457.39	(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)	1.00	1.00	0.99	0.97	0.91	0.77	0.60	0.66	0.88	0.98	1.00	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.62	19.78	20.04	20.38	20.70	20.91	20.98	20.97	20.82	20.41	19.95	19.60	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	19.87	19.87	19.88	19.89	19.89	19.90	19.90	19.90	19.89	19.89	19.88	19.88	(88)
Utilisation factor for gains for rest of dwelling n2,m	1.00	0.99	0.98	0.95	0.87	0.68	0.47	0.52	0.81	0.97	0.99	1.00	(89)

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

18.04	18.27	18.65	19.15	19.59	19.84	19.89	19.89	19.74	19.20	18.54	18.01

(90)

Living area fraction — Living area ÷ (4) = 0.44 (91)

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

18.73	18.93	19.25	19.69	20.07	20.30	20.36	20.36	20.21	19.73	19.15	18.70

(92)

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

18.73	18.93	19.25	19.69	20.07	20.30	20.36	20.36	20.21	19.73	19.15	18.70

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	1.00	0.99	0.98	0.95	0.87	0.71	0.53	0.58	0.83	0.97	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	481.41	551.04	608.56	649.38	631.36	504.41	356.20	368.91	488.45	506.03	469.74	455.94	(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]	1440.56	1396.96	1267.09	1060.03	820.70	553.71	365.41	383.44	595.38	894.64	1186.79	1434.09	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	713.61	568.46	489.95	295.67	140.87	0.00	0.00	0.00	0.00	289.12	516.27	727.74	

∑(98)1...5, 10...12 = 3741.69 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 47.30 (99)

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

Space heating

Fraction of space heat from secondary/supplementary system (table 11) — 0.00 (201)

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

Fraction of space heat from main system 2 — 0.00 (202)

Fraction of total space heat from main system 1 — (202) x [1- (203)] = 1.00 (204)

Fraction of total space heat from main system 2 — (202) x (203) = 0.00 (205)

Efficiency of main system 1 (%) — 93.40 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	764.03	608.63	524.57	316.56	150.82	0.00	0.00	0.00	0.00	309.55	552.76	779.16	

∑(211)1...5, 10...12 = 4006.09 (211)

Water heating

Efficiency of water heater

87.96	87.78	87.40	86.53	84.77	80.30	80.30	80.30	80.30	86.36	87.52	88.04

(217)

Water heating fuel, kWh/month

229.07	201.28	210.33	188.42	186.23	173.14	165.88	184.92	186.96	197.95	208.50	223.46

∑(219a)1...12 = 2356.14 (219)

Annual totals

Space heating fuel - main system 1 — 4006.09

Water heating fuel — 2356.14

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

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

boiler flue fan — 45.00 (230e)

Total electricity for the above, kWh/year — 75.00 (231)

Electricity for lighting (Appendix L)		360.60	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	6797.83	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	4006.09	x	3.48	x 0.01 =	139.41	(240)
Water heating	2356.14	x	3.48	x 0.01 =	81.99	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	360.60	x	13.19	x 0.01 =	47.56	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		398.86	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.35	(257)
SAP value	81.17	
SAP rating (section 13)	81	(258)
SAP band	B	

12a. CO_2 emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	4006.09	x	0.216	=	865.31	(261)
Water heating	2356.14	x	0.216	=	508.93	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1374.24	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	360.60	x	0.519	=	187.15	(268)
Total CO_2, kg/year				(265)...(271) =	1600.32	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	20.23	(273)
EI value					82.72	
EI rating (section 14)					83	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	4006.09	x	1.22	=	4887.43	(261)
Water heating	2356.14	x	1.22	=	2874.49	(264)
Space and water heating			(261) + (262) + (263) + (264) =		7761.92	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	360.60	x	3.07	=	1107.04	(268)
Primary energy kWh/year					9099.20	(272)
Dwelling primary energy rate kWh/m2/year					115.03	(273)

TER Worksheet
Design - Draft

SRS Partnership

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 Stuart Searle	Assessor number	3519
Client	Avis Appleton & Associates	Last modified	14/09/2016
Address	PS1 Liffords Place, London, SW13		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		68.90	(1a) x	2.50	(2a) =	172.25	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	68.90	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	172.25	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		2	x 10 =	20	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	20	÷ (5) =	0.12	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	5.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.37	(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) = 0.31	(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	0.40	0.39	0.38	0.34	0.33	0.30	0.30	0.29	0.31	0.33	0.35	0.37	(22b)

Calculate effective air change rate for the applicable case:

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

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

	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(24d)

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

	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Door			2.10	x	1.00	=	2.10			(26)
Window			15.12	x	1.33	=	20.05			(27)
External wall			77.72	x	0.18	=	13.99			(29a)
Roof			9.20	x	0.13	=	1.20			(30)
Total area of external elements ∑A, m²			104.14							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	37.33 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		13.06 (36)
Total fabric heat loss	(33) + (36) =	50.40 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
32.90	32.72	32.55	31.75	31.60	30.91	30.91	30.78	31.17	31.60	31.90	32.22	(38)

Heat transfer coefficient, W/K (37)m + (38)m

83.29	83.12	82.95	82.15	82.00	81.30	81.30	81.17	81.57	82.00	82.30	82.62	

Average = ∑(39)1...12/12 = 82.15 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

1.21	1.21	1.20	1.19	1.19	1.18	1.18	1.18	1.18	1.19	1.19	1.20	

Average = ∑(40)1...12/12 = 1.19 (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		2.22 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36		86.90 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
95.59	92.12	88.64	85.17	81.69	78.21	78.21	81.69	85.17	88.64	92.12	95.59	

∑(44)1...12 = 1042.85 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

141.76	123.99	127.94	111.54	107.03	92.36	85.58	98.21	99.38	115.82	126.43	137.29	

∑(45)1...12 = 1367.34 (45)

Distribution loss 0.15 x (45)m

21.26	18.60	19.19	16.73	16.05	13.85	12.84	14.73	14.91	17.37	18.96	20.59	(46)

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

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)

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

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)

Primary circuit loss for each month from Table 3

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)

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

48.71	42.40	45.17	42.00	41.63	38.57	39.86	41.63	42.00	45.17	45.43	48.71	(61)

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

190.48	166.39	173.12	153.54	148.66	130.93	125.44	139.84	141.38	160.99	171.85	186.00	(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

190.48	166.39	173.12	153.54	148.66	130.93	125.44	139.84	141.38	160.99	171.85	186.00	

∑(64)1...12 = 1888.62 (64)

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

59.32	51.83	53.83	47.59	45.99	40.35	38.42	43.06	43.54	49.80	53.39	57.83	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	110.96	110.96	110.96	110.96	110.96	110.96	110.96	110.96	110.96	110.96	110.96	110.96	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	17.37	15.42	12.54	9.50	7.10	5.99	6.48	8.42	11.30	14.35	16.74	17.85	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	194.72	196.74	191.65	180.81	167.12	154.26	145.67	143.65	148.74	159.58	173.26	186.12	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.10	34.10	34.10	34.10	34.10	34.10	34.10	34.10	34.10	34.10	34.10	34.10	(69)
Pump and fan gains (Table 5a)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (Table 5)	-88.77	-88.77	-88.77	-88.77	-88.77	-88.77	-88.77	-88.77	-88.77	-88.77	-88.77	-88.77	(71)
Water heating gains (Table 5)	79.72	77.12	72.36	66.10	61.82	56.04	51.64	57.88	60.48	66.94	74.16	77.73	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	351.09	348.57	335.83	315.68	295.33	275.59	263.07	269.23	279.81	300.15	323.45	340.99	(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	
SouthWest	0.77	x	4.62	x	36.79	x 0.9 x	0.63	x	0.70	=	51.95	(79)
SouthEast	0.77	x	2.31	x	36.79	x 0.9 x	0.63	x	0.70	=	25.98	(77)
NorthEast	0.77	x	8.19	x	11.28	x 0.9 x	0.63	x	0.70	=	28.24	(75)

Solar gains in watts ∑(74)m...(82)m

106.17	190.22	285.19	395.12	480.69	493.98	469.27	402.87	322.85	216.95	128.87	89.75	(83)

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

457.26	538.79	621.02	710.81	776.02	769.57	732.35	672.10	602.66	517.11	452.32	430.74	(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)	1.00	0.99	0.98	0.94	0.82	0.64	0.48	0.54	0.80	0.96	0.99	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.74	19.92	20.20	20.56	20.83	20.96	20.99	20.99	20.89	20.52	20.06	19.71	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	19.91	19.91	19.92	19.93	19.93	19.94	19.94	19.94	19.93	19.93	19.92	19.92	(88)
Utilisation factor for gains for rest of dwelling n2,m	1.00	0.99	0.97	0.91	0.77	0.55	0.37	0.42	0.72	0.95	0.99	1.00	(89)

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

18.24	18.50	18.91	19.42	19.77	19.91	19.93	19.93	19.85	19.38	18.72	18.20

(90)

Living area fraction — Living area ÷ (4) = 0.49 (91)

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

18.98	19.20	19.54	19.98	20.29	20.43	20.45	20.45	20.36	19.94	19.38	18.94

(92)

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

18.98	19.20	19.54	19.98	20.29	20.43	20.45	20.45	20.36	19.94	19.38	18.94

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.99	0.99	0.97	0.91	0.79	0.59	0.42	0.48	0.76	0.95	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	454.78	532.31	602.34	650.02	611.36	456.21	310.62	323.84	455.40	489.82	447.32	428.95	(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]	1222.65	1188.43	1081.98	909.97	704.61	473.95	313.38	328.86	510.83	766.06	1010.69	1217.84	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	571.30	440.91	356.86	187.16	69.38	0.00	0.00	0.00	0.00	205.52	405.62	586.93	

∑(98)1...5, 10...12 = 2823.68 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 40.98 (99)

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

Space heating

Fraction of space heat from secondary/supplementary system (table 11) — 0.00 (201)

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

Fraction of space heat from main system 2 — 0.00 (202)

Fraction of total space heat from main system 1 — (202) x [1- (203)] = 1.00 (204)

Fraction of total space heat from main system 2 — (202) x (203) = 0.00 (205)

Efficiency of main system 1 (%) — 93.40 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	611.67	472.06	382.07	200.38	74.28	0.00	0.00	0.00	0.00	220.04	434.29	628.41	

∑(211)1...5, 10...12 = 3023.21 (211)

Water heating

Efficiency of water heater	87.64	87.39	86.83	85.55	83.26	80.30	80.30	80.30	80.30	85.67	87.14	87.74	(217)
Water heating fuel, kWh/month	217.33	190.40	199.37	179.48	178.55	163.05	156.22	174.14	176.07	187.93	197.22	211.99	

∑(219a)1...12 = 2231.73 (219)

Annual totals

Space heating fuel - main system 1 — 3023.21

Water heating fuel — 2231.73

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

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

boiler flue fan — 45.00 (230e)

Total electricity for the above, kWh/year — 75.00 (231)

Electricity for lighting (Appendix L)		306.70	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	5636.64	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	3023.21	x	3.48	x 0.01 =	105.21	(240)
Water heating	2231.73	x	3.48	x 0.01 =	77.66	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	306.70	x	13.19	x 0.01 =	40.45	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		353.22	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.30	(257)
SAP value	81.83	
SAP rating (section 13)	82	(258)
SAP band	B	

12a. CO_2 emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	3023.21	x	0.216	=	653.01	(261)
Water heating	2231.73	x	0.216	=	482.05	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1135.07	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	306.70	x	0.519	=	159.18	(268)
Total CO_2, kg/year			(265)...(271) =		1333.17	(272)
Dwelling CO_2 emission rate			(272) ÷ (4) =		19.35	(273)
EI value					84.32	
EI rating (section 14)					84	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	3023.21	x	1.22	=	3688.31	(261)
Water heating	2231.73	x	1.22	=	2722.72	(264)
Space and water heating			(261) + (262) + (263) + (264) =		6411.03	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	306.70	x	3.07	=	941.56	(268)
Primary energy kWh/year					7582.84	(272)
Dwelling primary energy rate kWh/m2/year					110.06	(273)

TER Worksheet
Design - Draft

SRS Partnership

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 Stuart Searle	Assessor number	3519
Client	Avis Appleton & Associates	Last modified	14/09/2016
Address	PS2 Liffords Place, London, SW13		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		68.90	(1a) x	2.50	(2a) =	172.25	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	68.90	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	172.25	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		2	x 10 =	20	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	20	÷ (5) =	0.12	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	5.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.37	(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) = 0.31	(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	0.40	0.39	0.38	0.34	0.33	0.30	0.30	0.29	0.31	0.33	0.35	0.37	(22b)

Calculate effective air change rate for the applicable case:

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

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

	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(24d)

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

	0.58	0.58	0.57	0.56	0.56	0.54	0.54	0.54	0.55	0.56	0.56	0.57	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Door			2.10	x	1.00	=	2.10			(26)
Window			15.12	x	1.33	=	20.05			(27)
External wall			57.97	x	0.18	=	10.43			(29a)
Party wall			19.75	x	0.00	=	0.00			(32)
Roof			9.20	x	0.13	=	1.20			(30)
Total area of external elements ∑A, m²			84.39							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	33.78 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		11.81 (36)
Total fabric heat loss	(33) + (36) =	45.58 (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)	32.90	32.72	32.55	31.75	31.60	30.91	30.91	30.78	31.17	31.60	31.90	32.22	(38)
Heat transfer coefficient, W/K (37)m + (38)m	78.48	78.31	78.14	77.34	77.19	76.49	76.49	76.36	76.76	77.19	77.49	77.81	

Average = ∑(39)1...12/12 = 77.33 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.14	1.14	1.13	1.12	1.12	1.11	1.11	1.11	1.11	1.12	1.12	1.13	
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)

Average = ∑(40)1...12/12 = 1.12 (40)

4. Water heating energy requirement

Assumed occupancy, N	2.22 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	86.90 (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)	95.59	92.12	88.64	85.17	81.69	78.21	78.21	81.69	85.17	88.64	92.12	95.59	

∑(44)1...12 = 1042.85 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	141.76	123.99	127.94	111.54	107.03	92.36	85.58	98.21	99.38	115.82	126.43	137.29	

∑(45)1...12 = 1367.34 (45)

Distribution loss 0.15 x (45)m	21.26	18.60	19.19	16.73	16.05	13.85	12.84	14.73	14.91	17.37	18.96	20.59	(46)
Water storage loss calculated for each month (55) x (41)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)
Primary circuit loss for each month from Table 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)
Combi loss for each month from Table 3a, 3b or 3c	48.71	42.40	45.17	42.00	41.63	38.57	39.86	41.63	42.00	45.17	45.43	48.71	(61)
Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m	190.48	166.39	173.12	153.54	148.66	130.93	125.44	139.84	141.38	160.99	171.85	186.00	(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

190.48	166.39	173.12	153.54	148.66	130.93	125.44	139.84	141.38	160.99	171.85	186.00	

∑(64)1...12 = 1888.62 (64)

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

59.32	51.83	53.83	47.59	45.99	40.35	38.42	43.06	43.54	49.80	53.39	57.83	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	110.96	110.96	110.96	110.96	110.96	110.96	110.96	110.96	110.96	110.96	110.96	110.96	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	17.37	15.42	12.54	9.50	7.10	5.99	6.48	8.42	11.30	14.35	16.74	17.85	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	194.72	196.74	191.65	180.81	167.12	154.26	145.67	143.65	148.74	159.58	173.26	186.12	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.10	34.10	34.10	34.10	34.10	34.10	34.10	34.10	34.10	34.10	34.10	34.10	(69)
Pump and fan gains (Table 5a)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (Table 5)	-88.77	-88.77	-88.77	-88.77	-88.77	-88.77	-88.77	-88.77	-88.77	-88.77	-88.77	-88.77	(71)
Water heating gains (Table 5)	79.72	77.12	72.36	66.10	61.82	56.04	51.64	57.88	60.48	66.94	74.16	77.73	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	351.09	348.57	335.83	315.68	295.33	275.59	263.07	269.23	279.81	300.15	323.45	340.99	(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	
SouthWest	0.77	x	4.62	x	36.79	x 0.9 x	0.63	x	0.70	=	51.95	(79)
NorthWest	0.77	x	2.31	x	11.28	x 0.9 x	0.63	x	0.70	=	7.97	(81)
NorthEast	0.77	x	8.19	x	11.28	x 0.9 x	0.63	x	0.70	=	28.24	(75)

Solar gains in watts ∑(74)m...(82)m

88.16	162.19	253.86	368.09	461.16	479.32	453.17	380.45	292.90	187.87	107.78	74.03	(83)

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

439.25	510.76	589.69	683.77	756.49	754.91	716.24	649.68	572.70	488.02	431.23	415.01	(84)

7. Mean internal temperature (heating season)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	1.00	0.99	0.98	0.94	0.81	0.62	0.46	0.53	0.80	0.97	0.99	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.81	19.97	20.24	20.60	20.86	20.97	21.00	20.99	20.90	20.55	20.11	19.78	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	19.97	19.97	19.97	19.98	19.98	19.99	19.99	19.99	19.99	19.98	19.98	19.98	(88)

Utilisation factor for gains for rest of dwelling n2,m

1.00	0.99	0.98	0.92	0.76	0.54	0.36	0.42	0.73	0.95	0.99	1.00	(89)

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

18.38	18.62	19.02	19.52	19.85	19.98	19.99	19.99	19.92	19.46	18.84	18.35	(90)

Living area fraction — Living area ÷ (4) = 0.49 (91)

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

19.09	19.29	19.62	20.05	20.35	20.47	20.48	20.48	20.40	20.00	19.46	19.05	(92)

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

19.09	19.29	19.62	20.05	20.35	20.47	20.48	20.48	20.40	20.00	19.46	19.05	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	1.00	0.99	0.97	0.92	0.78	0.58	0.41	0.47	0.76	0.95	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	437.25	505.67	574.08	626.89	590.46	435.83	295.30	308.08	435.04	465.11	427.21	413.57	(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]	1160.33	1126.53	1025.19	862.17	667.60	448.71	297.15	311.74	483.74	725.31	958.11	1155.48	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	537.97	417.22	335.63	169.40	57.39	0.00	0.00	0.00	0.00	193.58	382.24	551.98	

∑(98)1...5, 10...12 = 2645.41 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 38.39 (99)

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

Space heating

Fraction of space heat from secondary/supplementary system (table 11) — 0.00 (201)

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

Fraction of space heat from main system 2 — 0.00 (202)

Fraction of total space heat from main system 1 — (202) x [1- (203)] = 1.00 (204)

Fraction of total space heat from main system 2 — (202) x (203) = 0.00 (205)

Efficiency of main system 1 (%) — 93.40 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	575.99	446.70	359.34	181.37	61.44	0.00	0.00	0.00	0.00	207.26	409.25	590.98	

∑(211)1...5, 10...12 = 2832.35 (211)

Water heating

Efficiency of water heater

87.52	87.27	86.69	85.30	82.88	80.30	80.30	80.30	80.30	85.52	87.01	87.62	(217)

Water heating fuel, kWh/month

217.64	190.66	199.70	180.01	179.37	163.05	156.22	174.14	176.07	188.26	197.52	212.28	

∑(219a)1...12 = 2234.90 (219)

Annual totals

Space heating fuel - main system 1 — 2832.35

Water heating fuel — 2234.90

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

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

boiler flue fan — 45.00 (230e)

Total electricity for the above, kWh/year		75.00	(231)
Electricity for lighting (Appendix L)		306.70	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	5448.94	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2832.35	x	3.48	x 0.01 =	98.57	(240)
Water heating	2234.90	x	3.48	x 0.01 =	77.77	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	306.70	x	13.19	x 0.01 =	40.45	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		346.69	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.28	(257)
SAP value	82.17	
SAP rating (section 13)	82	(258)
SAP band	B	

12a. CO_2 emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	2832.35	x	0.216	=	611.79	(261)
Water heating	2234.90	x	0.216	=	482.74	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1094.53	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	306.70	x	0.519	=	159.18	(268)
Total CO_2, kg/year				(265)...(271) =	1292.63	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	18.76	(273)
EI value					84.79	
EI rating (section 14)					85	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	2832.35	x	1.22	=	3455.46	(261)
Water heating	2234.90	x	1.22	=	2726.58	(264)
Space and water heating			(261) + (262) + (263) + (264) =		6182.04	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	306.70	x	3.07	=	941.56	(268)
Primary energy kWh/year					7353.85	(272)
Dwelling primary energy rate kWh/m2/year					106.73	(273)

TER Worksheet
Design - Draft

SRS Partnership

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 Stuart Searle	Assessor number	3519
Client	Avis Appleton & Associates	Last modified	14/09/2016
Address	PS3 Liffords Place, London, SW13		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		102.40	(1a) x	2.50	(2a) =	256.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	102.40	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	256.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		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) =	0.16	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	5.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.41	(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) = 0.35	(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	0.44	0.43	0.42	0.38	0.37	0.33	0.33	0.32	0.35	0.37	0.39	0.41	(22b)

Calculate effective air change rate for the applicable case:

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.60	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.58	0.58	(24d)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.60	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.58	0.58	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Door			2.10	x	1.00	=	2.10			(26)
Window			18.32	x	1.33	=	24.29			(27)
External wall			89.58	x	0.18	=	16.12			(29a)
Total area of external elements ∑A, m²			110.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	42.51 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		8.34 (36)
Total fabric heat loss	(33) + (36) =	50.85 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
50.43	50.11	49.80	48.33	48.06	46.79	46.79	46.55	47.28	48.06	48.61	49.19	(38)

Heat transfer coefficient, W/K (37)m + (38)m

101.28	100.96	100.65	99.19	98.91	97.64	97.64	97.40	98.13	98.91	99.47	100.05	

Average = ∑(39)1...12/12 = 99.19 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

0.99	0.99	0.98	0.97	0.97	0.95	0.95	0.95	0.96	0.97	0.97	0.98	

Average = ∑(40)1...12/12 = 0.97 (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	2.76 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	99.77 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
109.74	105.75	101.76	97.77	93.78	89.79	89.79	93.78	97.77	101.76	105.75	109.74	

∑(44)1...12 = 1197.19 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

162.74	142.34	146.88	128.05	122.87	106.03	98.25	112.74	114.09	132.96	145.14	157.61	

∑(45)1...12 = 1569.70 (45)

Distribution loss 0.15 x (45)m

24.41	21.35	22.03	19.21	18.43	15.90	14.74	16.91	17.11	19.94	21.77	23.64	(46)

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

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)

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

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)

Primary circuit loss for each month from Table 3

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)

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

50.96	46.03	50.96	48.22	47.79	44.28	45.76	47.79	48.22	50.96	49.32	50.96	(61)

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

213.70	188.36	197.84	176.27	170.66	150.31	144.01	160.53	162.31	183.92	194.45	208.57	(62)

Solar DHW input calculated using Appendix G or Appendix H

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

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

213.70	188.36	197.84	176.27	170.66	150.31	144.01	160.53	162.31	183.92	194.45	208.57

∑(64)1...12 = 2150.93 (64)

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

66.85	58.83	61.58	54.63	52.80	46.32	44.11	49.43	49.99	56.95	60.59	65.14

(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	138.03	138.03	138.03	138.03	138.03	138.03	138.03	138.03	138.03	138.03	138.03	138.03	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	23.71	21.06	17.13	12.97	9.69	8.18	8.84	11.49	15.43	19.59	22.86	24.37	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	260.15	262.85	256.05	241.56	223.28	206.10	194.62	191.92	198.73	213.21	231.49	248.67	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.80	36.80	36.80	36.80	36.80	36.80	36.80	36.80	36.80	36.80	36.80	36.80	(69)
Pump and fan gains (Table 5a)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (Table 5)	-110.43	-110.43	-110.43	-110.43	-110.43	-110.43	-110.43	-110.43	-110.43	-110.43	-110.43	-110.43	(71)
Water heating gains (Table 5)	89.86	87.55	82.76	75.88	70.97	64.34	59.28	66.44	69.43	76.54	84.15	87.56	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	441.13	438.87	423.35	397.82	371.36	346.03	330.16	337.27	350.99	376.75	405.91	428.01	(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	
NorthWest	0.77	x	8.64	x	11.28	x 0.9 x	0.63	x	0.70	=	29.79	(81)
SouthEast	0.77	x	9.68	x	36.79	x 0.9 x	0.63	x	0.70	=	108.85	(77)

Solar gains in watts ∑(74)m...(82)m

138.64	246.05	362.95	493.77	593.27	606.67	577.53	500.59	407.82	279.03	167.86	117.48

(83)

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

579.77	684.92	786.29	891.58	964.63	952.70	907.69	837.86	758.81	655.78	573.77	545.49

(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)	1.00	1.00	0.99	0.95	0.83	0.64	0.47	0.53	0.80	0.97	1.00	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.95	20.11	20.35	20.66	20.89	20.98	21.00	20.99	20.93	20.63	20.23	19.92	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	20.09	20.10	20.10	20.11	20.11	20.12	20.12	20.12	20.12	20.11	20.11	20.10	(88)
Utilisation factor for gains for rest of dwelling n2,m	1.00	0.99	0.98	0.93	0.78	0.56	0.38	0.43	0.73	0.96	0.99	1.00	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)	18.68	18.91	19.27	19.72	20.01	20.11	20.12	20.12	20.07	19.68	19.10	18.65	(90)

Living area fraction — Living area ÷ (4) = 0.41 (91)

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

19.20	19.40	19.71	20.10	20.36	20.46	20.48	20.48	20.42	20.06	19.56	19.17 (92)

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

19.20	19.40	19.71	20.10	20.36	20.46	20.48	20.48	20.42	20.06	19.56	19.17 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	1.00	0.99	0.98	0.93	0.80	0.59	0.42	0.47	0.76	0.96	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	578.20	680.07	769.81	827.86	769.76	560.64	377.24	394.45	573.41	628.35	570.12	544.44	(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]	1508.63	1463.87	1329.66	1110.91	857.01	572.59	378.56	397.08	620.09	936.16	1239.54	1497.57	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	692.23	526.71	416.53	203.80	64.91	0.00	0.00	0.00	0.00	229.01	481.98	709.13	

∑(98)1...5, 10...12 = 3324.31 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 32.46 (99)

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

Space heating

Fraction of space heat from secondary/supplementary system (table 11) — 0.00 (201)

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

Fraction of space heat from main system 2 — 0.00 (202)

Fraction of total space heat from main system 1 — (202) x [1- (203)] = 1.00 (204)

Fraction of total space heat from main system 2 — (202) x (203) = 0.00 (205)

Efficiency of main system 1 (%) — 93.40 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	741.15	563.93	445.96	218.20	69.50	0.00	0.00	0.00	0.00	245.19	516.04	759.24	

∑(211)1...5, 10...12 = 3559.22 (211)

Water heating

Efficiency of water heater

87.80	87.50	86.88	85.42	82.85	80.30	80.30	80.30	80.30	85.60	87.25	87.89 (217)

Water heating fuel, kWh/month

243.41	215.27	227.71	206.36	205.98	187.18	179.33	199.92	202.12	214.85	222.88	237.31

∑(219a)1...12 = 2542.34 (219)

Annual totals

Space heating fuel - main system 1 — 3559.22

Water heating fuel — 2542.34

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

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

boiler flue fan — 45.00 (230e)

Total electricity for the above, kWh/year — 75.00 (231)

Electricity for lighting (Appendix L) — 418.75 (232)

Total delivered energy for all uses — (211)...(221) + (231) + (232)...(237b) = 6595.30 (238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	3559.22	x	3.48	x 0.01 =	123.86	(240)
Water heating	2542.34	x	3.48	x 0.01 =	88.47	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	418.75	x	13.19	x 0.01 =	55.23	(250)
Additional standing charges					120.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	397.46	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.13	(257)
SAP value	84.20	
SAP rating (section 13)	84	(258)
SAP band	B	

12a. CO_2 emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	3559.22	x	0.216	=	768.79	(261)
Water heating	2542.34	x	0.216	=	549.14	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1317.94	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	418.75	x	0.519	=	217.33	(268)
Total CO_2, kg/year				(265)...(271) =	1574.19	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	15.37	(273)
EI value					85.69	
EI rating (section 14)					86	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	3559.22	x	1.22	=	4342.25	(261)
Water heating	2542.34	x	1.22	=	3101.65	(264)
Space and water heating			(261) + (262) + (263) + (264) =		7443.90	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	418.75	x	3.07	=	1285.55	(268)
Primary energy kWh/year					8959.70	(272)
Dwelling primary energy rate kWh/m2/year					87.50	(273)

TER Worksheet
Design - Draft

SRS Partnership

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 Stuart Searle	Assessor number	3519
Client	Avis Appleton & Associates	Last modified	14/09/2016
Address	PS4 Liffords Place, London, SW13		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		79.10	(1a) x	2.50	(2a) =	197.75	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	79.10	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	197.75	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		3	x 10 =	30	(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) =	30	÷ (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, q50, expressed in cubic metres per hour per square metre of envelope area	5.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.40	(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	(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	0.44	0.43	0.42	0.38	0.37	0.32	0.32	0.32	0.34	0.37	0.38	0.40	(22b)

Calculate effective air change rate for the applicable case:

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

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	(24d)

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	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Door			2.10	x	1.00	=	2.10			(26)
Window			12.10	x	1.33	=	16.04			(27)
External wall			88.80	x	0.18	=	15.98			(29a)
Total area of external elements ∑A, m²			103.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	34.13 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		7.92 (36)
Total fabric heat loss	(33) + (36) =	42.05 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
38.81	38.57	38.34	37.23	37.02	36.06	36.06	35.88	36.43	37.02	37.44	37.88	(38)

Heat transfer coefficient, W/K (37)m + (38)m

80.86	80.62	80.39	79.28	79.07	78.11	78.11	77.93	78.48	79.07	79.49	79.93	

Average = ∑(39)1...12/12 = 79.28 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

1.02	1.02	1.02	1.00	1.00	0.99	0.99	0.99	0.99	1.00	1.00	1.01	

Average = ∑(40)1...12/12 = 1.00 (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	2.45 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	92.28 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
101.51	97.82	94.13	90.44	86.75	83.05	83.05	86.75	90.44	94.13	97.82	101.51	

∑(44)1...12 = 1107.39 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

150.54	131.66	135.86	118.45	113.65	98.07	90.88	104.29	105.53	122.99	134.25	145.79	

∑(45)1...12 = 1451.96 (45)

Distribution loss 0.15 x (45)m

22.58	19.75	20.38	17.77	17.05	14.71	13.63	15.64	15.83	18.45	20.14	21.87	(46)

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

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)

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

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)

Primary circuit loss for each month from Table 3

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)

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

50.96	45.02	47.97	44.60	44.20	40.96	42.32	44.20	44.60	47.97	48.24	50.96	(61)

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

201.50	176.68	183.83	163.05	157.86	139.03	133.20	148.49	150.13	170.95	182.49	196.75	(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

201.50	176.68	183.83	163.05	157.86	139.03	133.20	148.49	150.13	170.95	182.49	196.75

∑(64)1...12 = 2003.96 (64)

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

62.79	55.03	57.17	50.53	48.84	42.85	40.80	45.73	46.24	52.88	56.70	61.21

(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	122.28	122.28	122.28	122.28	122.28	122.28	122.28	122.28	122.28	122.28	122.28	122.28	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	20.42	18.14	14.75	11.17	8.35	7.05	7.61	9.90	13.28	16.87	19.69	20.99	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	217.55	219.81	214.12	202.01	186.72	172.35	162.75	160.50	166.18	178.29	193.58	207.95	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.23	35.23	35.23	35.23	35.23	35.23	35.23	35.23	35.23	35.23	35.23	35.23	(69)
Pump and fan gains (Table 5a)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (Table 5)	-97.82	-97.82	-97.82	-97.82	-97.82	-97.82	-97.82	-97.82	-97.82	-97.82	-97.82	-97.82	(71)
Water heating gains (Table 5)	84.40	81.89	76.84	70.19	65.65	59.51	54.84	61.46	64.22	71.08	78.75	82.28	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	385.05	382.52	368.39	346.04	323.40	301.59	287.89	294.54	306.37	328.93	354.70	373.90	(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	
SouthWest	0.77	x	4.84	x	36.79	x 0.9 x	0.63	x	0.70	=	54.42	(79)
NorthWest	0.77	x	4.84	x	11.28	x 0.9 x	0.63	x	0.70	=	16.69	(81)
SouthEast	0.77	x	2.42	x	36.79	x 0.9 x	0.63	x	0.70	=	27.21	(77)

Solar gains in watts ∑(74)m...(82)m

98.33	173.03	251.47	336.26	399.17	406.19	387.49	339.04	280.60	195.20	118.78	83.49

(83)

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

483.38	555.55	619.86	682.31	722.57	707.79	675.38	633.58	586.97	524.13	473.48	457.39

(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)	1.00	0.99	0.99	0.95	0.86	0.67	0.50	0.56	0.81	0.97	1.00	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.94	20.09	20.33	20.62	20.86	20.97	21.00	20.99	20.92	20.62	20.23	19.92	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	20.06	20.07	20.07	20.08	20.08	20.09	20.09	20.10	20.09	20.08	20.08	20.07	(88)
Utilisation factor for gains for rest of dwelling n2,m	1.00	0.99	0.98	0.94	0.81	0.59	0.40	0.45	0.74	0.96	0.99	1.00	(89)

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

18.65	18.87	19.21	19.64	19.95	20.08	20.09	20.09	20.03	19.64	19.08	18.62	(90)

Living area fraction — Living area ÷ (4) = 0.44 (91)

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

19.22	19.40	19.70	20.07	20.34	20.47	20.49	20.48	20.42	20.07	19.58	19.19	(92)

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

19.22	19.40	19.70	20.07	20.34	20.47	20.49	20.48	20.42	20.07	19.58	19.19	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	1.00	0.99	0.98	0.94	0.82	0.63	0.45	0.50	0.77	0.96	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	481.53	550.80	606.44	638.25	595.82	443.84	301.77	315.19	452.02	500.80	469.53	456.08	(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]	1206.18	1169.38	1060.77	885.36	683.45	458.26	303.55	318.35	495.85	748.44	991.91	1198.14	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	539.14	415.69	338.02	177.92	65.20	0.00	0.00	0.00	0.00	184.24	376.11	552.09	

∑(98)1...5, 10...12 = 2648.42 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 33.48 (99)

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

Space heating

Fraction of space heat from secondary/supplementary system (table 11) — 0.00 (201)

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

Fraction of space heat from main system 2 — 0.00 (202)

Fraction of total space heat from main system 1 — (202) x [1- (203)] = 1.00 (204)

Fraction of total space heat from main system 2 — (202) x (203) = 0.00 (205)

Efficiency of main system 1 (%) — 93.40 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	577.24	445.06	361.91	190.49	69.81	0.00	0.00	0.00	0.00	197.26	402.69	591.11	

∑(211)1...5, 10...12 = 2835.57 (211)

Water heating

Efficiency of water heater

87.41	87.13	86.56	85.27	83.01	80.30	80.30	80.30	80.30	85.24	86.83	87.51	(217)

Water heating fuel, kWh/month

230.52	202.78	212.36	191.21	190.17	173.14	165.88	184.92	186.96	200.56	210.16	224.83	

∑(219a)1...12 = 2373.49 (219)

Annual totals

Space heating fuel - main system 1 — 2835.57

Water heating fuel — 2373.49

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

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

boiler flue fan — 45.00 (230e)

Total electricity for the above, kWh/year — 75.00 (231)

Electricity for lighting (Appendix L) — 360.60 (232)

Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	5644.66	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2835.57	x	3.48	x 0.01 =	98.68	(240)
Water heating	2373.49	x	3.48	x 0.01 =	82.60	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	360.60	x	13.19	x 0.01 =	47.56	(250)
Additional standing charges					120.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	358.73	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.21	(257)
SAP value	83.06	
SAP rating (section 13)	83	(258)
SAP band	B	

12a. CO_2 emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	2835.57	x	0.216	=	612.48	(261)
Water heating	2373.49	x	0.216	=	512.67	(264)
Space and water heating				(261) + (262) + (263) + (264) =	1125.16	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	360.60	x	0.519	=	187.15	(268)
Total CO_2, kg/year				(265)...(271) =	1351.23	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	17.08	(273)
EI value					85.41	
EI rating (section 14)					85	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	2835.57	x	1.22	=	3459.40	(261)
Water heating	2373.49	x	1.22	=	2895.66	(264)
Space and water heating				(261) + (262) + (263) + (264) =	6355.06	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	360.60	x	3.07	=	1107.04	(268)
Primary energy kWh/year					7692.34	(272)
Dwelling primary energy rate kWh/m2/year					97.25	(273)

TER Worksheet
Design - Draft

SRS Partnership

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 Stuart Searle	Assessor number	3519
Client	Avis Appleton & Associates	Last modified	14/09/2016
Address	PT1 Liffords Place, London, SW13		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		52.40	(1a) x	2.50	(2a) =	131.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	52.40	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	131.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		2	x 10 =	20	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	20	÷ (5) =	0.15	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	5.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.40	(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	(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	0.44	0.43	0.42	0.38	0.37	0.33	0.33	0.32	0.34	0.37	0.39	0.40	(22b)

Calculate effective air change rate for the applicable case:

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.60	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)
Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)	0.60	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Door			2.10	x	1.00	=	2.10			(26)
Window			10.99	x	1.33	=	14.57			(27)
External wall			69.86	x	0.18	=	12.57			(29a)
Roof			57.64	x	0.13	=	7.49			(30)
Total area of external elements ∑A, m²			140.59							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	36.74 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		20.54 (36)
Total fabric heat loss	(33) + (36) =	57.27 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
25.73	25.57	25.41	24.68	24.54	23.90	23.90	23.78	24.15	24.54	24.82	25.11	(38)

Heat transfer coefficient, W/K (37)m + (38)m

83.01	82.85	82.69	81.95	81.82	81.17	81.17	81.06	81.42	81.82	82.09	82.39	

Average = ∑(39)1...12/12 = 81.95 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

1.58	1.58	1.58	1.56	1.56	1.55	1.55	1.55	1.55	1.56	1.57	1.57	

Average = ∑(40)1...12/12 = 1.56 (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	1.76 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	76.02 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
83.62	80.58	77.54	74.50	71.46	68.42	68.42	71.46	74.50	77.54	80.58	83.62	

∑(44)1...12 = 912.25 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

124.01	108.46	111.92	97.58	93.63	80.79	74.87	85.91	86.94	101.32	110.59	120.10	

∑(45)1...12 = 1196.10 (45)

Distribution loss 0.15 x (45)m

18.60	16.27	16.79	14.64	14.04	12.12	11.23	12.89	13.04	15.20	16.59	18.01	(46)

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

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)

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

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)

Primary circuit loss for each month from Table 3

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)

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

42.61	37.09	39.51	36.74	36.41	33.74	34.87	36.41	36.74	39.51	39.74	42.61	(61)

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

166.62	145.55	151.44	134.32	130.04	114.53	109.73	122.32	123.68	140.83	150.33	162.71	(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

166.62	145.55	151.44	134.32	130.04	114.53	109.73	122.32	123.68	140.83	150.33	162.71	

∑(64)1...12 = 1652.10 (64)

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

51.89	45.34	47.09	41.63	40.23	35.30	33.61	37.67	38.09	43.57	46.71	50.59	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	88.04	88.04	88.04	88.04	88.04	88.04	88.04	88.04	88.04	88.04	88.04	88.04	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	13.72	12.19	9.91	7.50	5.61	4.73	5.12	6.65	8.93	11.33	13.23	14.10	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	153.46	155.06	151.04	142.50	131.72	121.58	114.81	113.22	117.23	125.77	136.56	146.69	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.80	31.80	31.80	31.80	31.80	31.80	31.80	31.80	31.80	31.80	31.80	31.80	(69)
Pump and fan gains (Table 5a)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (Table 5)	-70.43	-70.43	-70.43	-70.43	-70.43	-70.43	-70.43	-70.43	-70.43	-70.43	-70.43	-70.43	(71)
Water heating gains (Table 5)	69.74	67.46	63.30	57.82	54.08	49.03	45.17	50.63	52.90	58.56	64.87	67.99	(72)

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

289.34	287.12	276.66	260.23	243.82	227.75	217.51	222.91	231.47	248.07	267.07	281.20	(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	
SouthWest	0.77	x	5.37	x	36.79	x 0.9 x	0.63	x	0.70	=	60.38	(79)
NorthEast	0.77	x	5.62	x	11.28	x 0.9 x	0.63	x	0.70	=	19.38	(75)

Solar gains in watts ∑(74)m...(82)m

79.76	142.30	211.80	291.09	352.20	361.16	343.41	296.06	238.98	161.88	96.71	67.50	(83)

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

369.10	429.42	488.46	551.32	596.02	588.92	560.92	518.97	470.46	409.96	363.78	348.70	(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)	1.00	0.99	0.98	0.95	0.88	0.75	0.59	0.65	0.86	0.97	0.99	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.31	19.49	19.80	20.22	20.61	20.87	20.96	20.94	20.74	20.24	19.70	19.27	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	19.63	19.63	19.63	19.64	19.64	19.65	19.65	19.65	19.65	19.64	19.64	19.63	(88)
Utilisation factor for gains for rest of dwelling n2,m	0.99	0.99	0.98	0.94	0.83	0.64	0.43	0.49	0.78	0.95	0.99	1.00	(89)

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

17.42	17.69	18.15	18.75	19.27	19.56	19.64	19.63	19.44	18.79	18.00	17.38	(90)

Living area fraction — Living area ÷ (4) = 0.46 (91)

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

18.29	18.52	18.91	19.43	19.89	20.17	20.25	20.24	20.04	19.46	18.79	18.26	(92)

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

18.29	18.52	18.91	19.43	19.89	20.17	20.25	20.24	20.04	19.46	18.79	18.26	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.99	0.99	0.97	0.93	0.84	0.68	0.51	0.57	0.81	0.95	0.99	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	366.28	423.39	474.31	513.46	502.02	401.98	284.74	293.47	381.17	390.22	358.86	346.55	(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]	1161.56	1128.59	1026.34	863.01	669.72	451.82	296.15	310.95	483.81	725.08	959.50	1157.96	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	591.69	473.89	410.72	251.68	124.77	0.00	0.00	0.00	0.00	249.13	432.46	603.69	

∑(98)1...5, 10...12 = 3138.02 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 59.89 (99)

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

Space heating

Fraction of space heat from secondary/supplementary system (table 11) — 0.00 (201)

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

Fraction of space heat from main system 2 — 0.00 (202)

Fraction of total space heat from main system 1 — (202) x [1- (203)] = 1.00 (204)

Fraction of total space heat from main system 2 — (202) x (203) = 0.00 (205)

Efficiency of main system 1 (%) — 93.40 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	633.50	507.38	439.74	269.46	133.59	0.00	0.00	0.00	0.00	266.74	463.02	646.35	

∑(211)1...5, 10...12 = 3359.77 (211)

Water heating

Efficiency of water heater

87.97	87.80	87.44	86.61	84.95	80.30	80.30	80.30	80.30	86.47	87.56	88.05	(217)

Water heating fuel, kWh/month

189.41	165.76	173.19	155.08	153.08	142.63	136.65	152.33	154.02	162.86	171.69	184.80	

∑(219a)1...12 = 1941.52 (219)

Annual totals

Space heating fuel - main system 1 — 3359.77

Water heating fuel — 1941.52

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

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

boiler flue fan — 45.00 (230e)

Total electricity for the above, kWh/year — 75.00 (231)

Electricity for lighting (Appendix L) — 242.30 (232)

Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	5618.59 (238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	3359.77	x	3.48	x 0.01 =	116.92	(240)
Water heating	1941.52	x	3.48	x 0.01 =	67.56	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	242.30	x	13.19	x 0.01 =	31.96	(250)
Additional standing charges					120.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	346.34	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.49	(257)
SAP value	79.17	
SAP rating (section 13)	79	(258)
SAP band	C	

12a. CO_2 emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	3359.77	x	0.216	=	725.71	(261)
Water heating	1941.52	x	0.216	=	419.37	(264)
Space and water heating				(261) + (262) + (263) + (264) =	1145.08	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	242.30	x	0.519	=	125.75	(268)
Total CO_2, kg/year				(265)...(271) =	1309.76	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	25.00	(273)
EI value					81.98	
EI rating (section 14)					82	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	3359.77	x	1.22	=	4098.91	(261)
Water heating	1941.52	x	1.22	=	2368.65	(264)
Space and water heating				(261) + (262) + (263) + (264) =	6467.57	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	242.30	x	3.07	=	743.87	(268)
Primary energy kWh/year					7441.68	(272)
Dwelling primary energy rate kWh/m2/year					142.02	(273)

TER Worksheet
Design - Draft

SRS Partnership

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 Stuart Searle	Assessor number	3519
Client	Avis Appleton & Associates	Last modified	14/09/2016
Address	PT2 Liffords Place, London, SW13		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		52.40	(1a) x	2.50	(2a) =	131.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	52.40	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	131.00	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		2	x 10 =	20	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	20	÷ (5) =	0.15	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	5.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.40	(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	(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	0.44	0.43	0.42	0.38	0.37	0.33	0.33	0.32	0.34	0.37	0.39	0.40	(22b)

Calculate effective air change rate for the applicable case:

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.60	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.60	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Door			2.10	x	1.00	=	2.10			(26)
Window			10.99	x	1.33	=	14.57			(27)
External wall			56.11	x	0.18	=	10.10			(29a)
Party wall			13.75	x	0.00	=	0.00			(32)
Roof			57.64	x	0.13	=	7.49			(30)
Total area of external elements ∑A, m²			126.84							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	34.26 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		16.92 (36)
Total fabric heat loss	(33) + (36) =	51.18 (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)	25.73	25.57	25.41	24.68	24.54	23.90	23.90	23.78	24.15	24.54	24.82	25.11	(38)
Heat transfer coefficient, W/K (37)m + (38)m	76.92	76.76	76.60	75.86	75.73	75.08	75.08	74.97	75.33	75.73	76.00	76.30	

Average = ∑(39)1...12/12 = 75.86 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.47	1.46	1.46	1.45	1.45	1.43	1.43	1.43	1.44	1.45	1.45	1.46	

Average = ∑(40)1...12/12 = 1.45 (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	1.76 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	76.02 (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)	83.62	80.58	77.54	74.50	71.46	68.42	68.42	71.46	74.50	77.54	80.58	83.62	

∑(44)1...12 = 912.25 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	124.01	108.46	111.92	97.58	93.63	80.79	74.87	85.91	86.94	101.32	110.59	120.10	

∑(45)1...12 = 1196.10 (45)

Distribution loss 0.15 x (45)m	18.60	16.27	16.79	14.64	14.04	12.12	11.23	12.89	13.04	15.20	16.59	18.01	(46)
Water storage loss calculated for each month (55) x (41)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)
Primary circuit loss for each month from Table 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)
Combi loss for each month from Table 3a, 3b or 3c	42.61	37.09	39.51	36.74	36.41	33.74	34.87	36.41	36.74	39.51	39.74	42.61	(61)
Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m	166.62	145.55	151.44	134.32	130.04	114.53	109.73	122.32	123.68	140.83	150.33	162.71	(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

166.62	145.55	151.44	134.32	130.04	114.53	109.73	122.32	123.68	140.83	150.33	162.71	

∑(64)1...12 = 1652.10 (64)

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

51.89	45.34	47.09	41.63	40.23	35.30	33.61	37.67	38.09	43.57	46.71	50.59	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	88.04	88.04	88.04	88.04	88.04	88.04	88.04	88.04	88.04	88.04	88.04	88.04	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	13.72	12.19	9.91	7.50	5.61	4.73	5.12	6.65	8.93	11.33	13.23	14.10	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	153.46	155.06	151.04	142.50	131.72	121.58	114.81	113.22	117.23	125.77	136.56	146.69	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	31.80	31.80	31.80	31.80	31.80	31.80	31.80	31.80	31.80	31.80	31.80	31.80	(69)
Pump and fan gains (Table 5a)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (Table 5)	-70.43	-70.43	-70.43	-70.43	-70.43	-70.43	-70.43	-70.43	-70.43	-70.43	-70.43	-70.43	(71)
Water heating gains (Table 5)	69.74	67.46	63.30	57.82	54.08	49.03	45.17	50.63	52.90	58.56	64.87	67.99	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	289.34	287.12	276.66	260.23	243.82	227.75	217.51	222.91	231.47	248.07	267.07	281.20	(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	
SouthWest	0.77	x	5.37	x	36.79	x 0.9 x	0.63	x	0.70	=	60.38	(79)
NorthEast	0.77	x	5.62	x	11.28	x 0.9 x	0.63	x	0.70	=	19.38	(75)

Solar gains in watts ∑(74)m...(82)m

79.76	142.30	211.80	291.09	352.20	361.16	343.41	296.06	238.98	161.88	96.71	67.50	(83)

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

369.10	429.42	488.46	551.32	596.02	588.92	560.92	518.97	470.46	409.96	363.78	348.70	(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)	1.00	0.99	0.98	0.95	0.87	0.72	0.56	0.62	0.85	0.97	0.99	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.45	19.63	19.93	20.33	20.68	20.90	20.97	20.96	20.79	20.34	19.82	19.41	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	19.71	19.71	19.72	19.73	19.73	19.74	19.74	19.74	19.73	19.73	19.72	19.72	(88)
Utilisation factor for gains for rest of dwelling n2,m	0.99	0.99	0.97	0.93	0.82	0.61	0.41	0.47	0.76	0.95	0.99	1.00	(89)

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

17.68	17.95	18.38	18.96	19.43	19.68	19.73	19.72	19.57	18.98	18.23	17.64 (90)

Living area fraction — Living area ÷ (4) = 0.46 (91)

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

18.50	18.72	19.10	19.59	20.01	20.24	20.30	20.30	20.14	19.61	18.96	18.46 (92)

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

18.50	18.72	19.10	19.59	20.01	20.24	20.30	20.30	20.14	19.61	18.96	18.46 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.99	0.99	0.97	0.93	0.83	0.66	0.48	0.54	0.79	0.95	0.99	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	366.39	423.43	473.90	510.97	494.06	387.74	270.72	280.27	373.76	389.24	358.91	346.66	(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]	1091.93	1060.93	964.97	811.06	628.99	423.66	278.12	292.03	454.74	681.93	901.77	1087.90	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	539.80	428.40	365.36	216.06	100.39	0.00	0.00	0.00	0.00	217.76	390.86	551.49	

∑(98)1...5, 10...12 = 2810.13 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 53.63 (99)

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

Space heating

Fraction of space heat from secondary/supplementary system (table 11) — 0.00 (201)

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

Fraction of space heat from main system 2 — 0.00 (202)

Fraction of total space heat from main system 1 — (202) x [1- (203)] = 1.00 (204)

Fraction of total space heat from main system 2 — (202) x (203) = 0.00 (205)

Efficiency of main system 1 (%) — 93.40 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	577.95	458.67	391.18	231.33	107.48	0.00	0.00	0.00	0.00	233.15	418.48	590.46	

∑(211)1...5, 10...12 = 3008.70 (211)

Water heating

Efficiency of water heater

87.80	87.61	87.19	86.24	84.41	80.30	80.30	80.30	80.30	86.14	87.35	87.88 (217)

Water heating fuel, kWh/month

189.79	166.14	173.69	155.74	154.06	142.63	136.65	152.33	154.02	163.48	172.11	185.15

∑(219a)1...12 = 1945.79 (219)

Annual totals

Space heating fuel - main system 1 — 3008.70

Water heating fuel — 1945.79

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

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

boiler flue fan — 45.00 (230e)

Total electricity for the above, kWh/year — 75.00 (231)

Electricity for lighting (Appendix L)		242.30	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	5271.79	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	3008.70	x	3.48	x 0.01 =	104.70	(240)
Water heating	1945.79	x	3.48	x 0.01 =	67.71	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	242.30	x	13.19	x 0.01 =	31.96	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		334.27	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.44	(257)
SAP value	79.89	
SAP rating (section 13)	80	(258)
SAP band	C	

12a. CO_2 emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	3008.70	x	0.216	=	649.88	(261)
Water heating	1945.79	x	0.216	=	420.29	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1070.17	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	242.30	x	0.519	=	125.75	(268)
Total CO_2, kg/year			(265)...(271) =		1234.85	(272)
Dwelling CO_2 emission rate			(272) ÷ (4) =		23.57	(273)
EI value					83.01	
EI rating (section 14)					83	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	3008.70	x	1.22	=	3670.62	(261)
Water heating	1945.79	x	1.22	=	2373.86	(264)
Space and water heating			(261) + (262) + (263) + (264) =		6044.48	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	242.30	x	3.07	=	743.87	(268)
Primary energy kWh/year					7018.60	(272)
Dwelling primary energy rate kWh/m2/year					133.94	(273)

TER Worksheet
Design - Draft

SRS Partnership

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 Stuart Searle	Assessor number	3519
Client	Avis Appleton & Associates	Last modified	14/09/2016
Address	PT3 Liffords Place, London, SW13		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		37.00	(1a) x	2.50	(2a) =	92.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	37.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	92.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		2	x 10 =	20	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	20	÷ (5) =	0.22	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	5.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.47	(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) = 0.40	(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	0.51	0.50	0.49	0.44	0.43	0.38	0.38	0.37	0.40	0.43	0.45	0.47	(22b)

Calculate effective air change rate for the applicable case:

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.63	0.62	0.62	0.60	0.59	0.57	0.57	0.57	0.58	0.59	0.60	0.61	(24d)
Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)	0.63	0.62	0.62	0.60	0.59	0.57	0.57	0.57	0.58	0.59	0.60	0.61	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Door			2.10	x	1.00	=	2.10			(26)
Window			6.22	x	1.33	=	8.25			(27)
External wall			40.93	x	0.18	=	7.37			(29a)
Party wall			13.75	x	0.00	=	0.00			(32)
Roof			40.70	x	0.13	=	5.29			(30)
Total area of external elements ∑A, m²			89.95							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	23.00 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		9.70 (36)
Total fabric heat loss	(33) + (36) =	32.70 (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)	19.16	19.01	18.86	18.16	18.03	17.43	17.43	17.31	17.66	18.03	18.30	18.57	(38)
Heat transfer coefficient, W/K (37)m + (38)m	51.86	51.71	51.56	50.87	50.74	50.13	50.13	50.02	50.36	50.74	51.00	51.28	

Average = ∑(39)1...12/12 = 50.87 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.40	1.40	1.39	1.37	1.37	1.35	1.35	1.35	1.36	1.37	1.38	1.39	

Average = ∑(40)1...12/12 = 1.37 (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	1.33 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	65.77 (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)	72.34	69.71	67.08	64.45	61.82	59.19	59.19	61.82	64.45	67.08	69.71	72.34	

∑(44)1...12 = 789.19 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	107.28	93.83	96.82	84.41	81.00	69.89	64.77	74.32	75.21	87.65	95.67	103.90	

∑(45)1...12 = 1034.75 (45)

Distribution loss 0.15 x (45)m	16.09	14.07	14.52	12.66	12.15	10.48	9.71	11.15	11.28	13.15	14.35	15.58	(46)
Water storage loss calculated for each month (55) x (41)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)
Primary circuit loss for each month from Table 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)
Combi loss for each month from Table 3a, 3b or 3c	36.86	32.09	34.18	31.78	31.50	29.19	30.16	31.50	31.78	34.18	34.38	36.86	(61)
Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m	144.15	125.92	131.01	116.20	112.50	99.08	94.93	105.82	106.99	121.83	130.05	140.76	(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

	144.15	125.92	131.01	116.20	112.50	99.08	94.93	105.82	106.99	121.83	130.05	140.76

∑(64)1...12 = 1429.24 (64)

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

	44.89	39.22	40.74	36.01	34.81	30.54	29.08	32.59	32.95	37.69	40.41	43.76 (65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	66.45	66.45	66.45	66.45	66.45	66.45	66.45	66.45	66.45	66.45	66.45	66.45	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	10.51	9.33	7.59	5.75	4.30	3.63	3.92	5.09	6.84	8.68	10.13	10.80	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	114.07	115.25	112.27	105.92	97.90	90.37	85.34	84.15	87.14	93.49	101.50	109.04	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	29.65	29.65	29.65	29.65	29.65	29.65	29.65	29.65	29.65	29.65	29.65	29.65	(69)
Pump and fan gains (Table 5a)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (Table 5)	-53.16	-53.16	-53.16	-53.16	-53.16	-53.16	-53.16	-53.16	-53.16	-53.16	-53.16	-53.16	(71)
Water heating gains (Table 5)	60.33	58.36	54.76	50.02	46.78	42.41	39.08	43.80	45.77	50.66	56.12	58.82	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	230.85	228.89	220.56	207.62	194.92	182.35	174.27	178.98	185.68	198.76	213.69	224.59	(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	
SouthWest	0.77	x	4.84	x	36.79	x 0.9 x	0.63	x	0.70	=	54.42	(79)
SouthEast	0.77	x	1.38	x	36.79	x 0.9 x	0.63	x	0.70	=	15.52	(77)

Solar gains in watts ∑(74)m...(82)m

	69.94	119.14	163.01	201.98	226.23	224.59	216.53	198.44	176.50	131.67	83.77	59.86 (83)

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

	300.79	348.02	383.56	409.60	421.15	406.94	390.80	377.42	362.18	330.43	297.47	284.45 (84)

7. Mean internal temperature (heating season)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.99	0.99	0.97	0.94	0.86	0.71	0.54	0.58	0.80	0.95	0.99	0.99	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.62	19.81	20.09	20.43	20.73	20.92	20.98	20.97	20.86	20.48	19.99	19.59	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	19.76	19.77	19.77	19.78	19.79	19.80	19.80	19.80	19.79	19.79	19.78	19.77	(88)
Utilisation factor for gains for rest of dwelling n2,m	0.99	0.98	0.96	0.91	0.80	0.61	0.41	0.44	0.71	0.92	0.98	0.99	(89)

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

17.97	18.25	18.65	19.14	19.53	19.75	19.79	19.79	19.69	19.21	18.51	17.93

(90)

Living area fraction — Living area ÷ (4) = 0.53 (91)

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

18.84	19.07	19.41	19.82	20.16	20.36	20.42	20.41	20.30	19.88	19.29	18.81

(92)

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

18.84	19.07	19.41	19.82	20.16	20.36	20.42	20.41	20.30	19.88	19.29	18.81

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.99	0.98	0.96	0.91	0.82	0.66	0.48	0.52	0.75	0.93	0.98	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	297.30	340.51	367.71	374.30	346.06	267.09	187.14	194.82	271.69	305.83	291.10	281.80	(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]	754.17	732.82	665.52	555.61	429.30	288.99	191.40	200.77	312.42	470.72	621.73	749.04	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	339.91	263.63	221.58	130.54	61.93	0.00	0.00	0.00	0.00	122.68	238.05	347.63	

∑(98)1...5, 10...12 = 1725.94 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 46.65 (99)

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

Space heating

Fraction of space heat from secondary/supplementary system (table 11) — 0.00 (201)

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

Fraction of space heat from main system 2 — 0.00 (202)

Fraction of total space heat from main system 1 — (202) x [1- (203)] = 1.00 (204)

Fraction of total space heat from main system 2 — (202) x (203) = 0.00 (205)

Efficiency of main system 1 (%) — 93.40 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	363.93	282.26	237.23	139.76	66.30	0.00	0.00	0.00	0.00	131.35	254.87	372.19	

∑(211)1...5, 10...12 = 1847.90 (211)

Water heating

Efficiency of water heater	87.14	86.87	86.36	85.34	83.62	80.30	80.30	80.30	80.30	85.07	86.55	87.24	(217)
Water heating fuel, kWh/month	165.43	144.95	151.69	136.15	134.54	123.39	118.22	131.79	133.24	143.22	150.26	161.35	

∑(219a)1...12 = 1694.22 (219)

Annual totals

Space heating fuel - main system 1 — 1847.90

Water heating fuel — 1694.22

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

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

boiler flue fan — 45.00 (230e)

Total electricity for the above, kWh/year — 75.00 (231)

Electricity for lighting (Appendix L)		185.61	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	3802.73	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	1847.90	x	3.48	x 0.01 =	64.31	(240)
Water heating	1694.22	x	3.48	x 0.01 =	58.96	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	185.61	x	13.19	x 0.01 =	24.48	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		277.64	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.42	(257)
SAP value	80.16	
SAP rating (section 13)	80	(258)
SAP band	C	

12a. CO_2 emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	1847.90	x	0.216	=	399.15	(261)
Water heating	1694.22	x	0.216	=	365.95	(264)
Space and water heating			(261) + (262) + (263) + (264) =		765.10	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	185.61	x	0.519	=	96.33	(268)
Total CO_2, kg/year			(265)...(271) =		900.35	(272)
Dwelling CO_2 emission rate			(272) ÷ (4) =		24.33	(273)
EI value					85.29	
EI rating (section 14)					85	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	1847.90	x	1.22	=	2254.44	(261)
Water heating	1694.22	x	1.22	=	2066.95	(264)
Space and water heating			(261) + (262) + (263) + (264) =		4321.39	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	185.61	x	3.07	=	569.81	(268)
Primary energy kWh/year					5121.45	(272)
Dwelling primary energy rate kWh/m2/year					138.42	(273)

TER Worksheet
Design - Draft

SRS Partnership

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 Stuart Searle	Assessor number	3519
Client	Avis Appleton & Associates	Last modified	14/09/2016
Address	PT4 Liffords Place, London, SW13		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		45.80	(1a) x	2.50	(2a) =	114.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	45.80	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	114.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		2	x 10 =	20	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	20	÷ (5) =	0.17	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	5.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.42	(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) = 0.36	(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	0.46	0.45	0.44	0.40	0.39	0.34	0.34	0.33	0.36	0.39	0.41	0.42	(22b)

Calculate effective air change rate for the applicable case:

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.61	0.60	0.60	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.58	0.59	(24d)
Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)	0.61	0.60	0.60	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.58	0.59	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Door			2.10	x	1.00	=	2.10			(26)
Window			8.32	x	1.33	=	11.03			(27)
External wall			43.83	x	0.18	=	7.89			(29a)
Party wall			17.75	x	0.00	=	0.00			(32)
Roof			50.38	x	0.13	=	6.55			(30)
Total area of external elements ∑A, m²			104.63							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	27.57 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		11.64 (36)
Total fabric heat loss	(33) + (36) =	39.21 (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)	22.89	22.74	22.59	21.87	21.74	21.11	21.11	21.00	21.35	21.74	22.01	22.29	(38)
Heat transfer coefficient, W/K (37)m + (38)m	62.10	61.95	61.80	61.08	60.95	60.32	60.32	60.21	60.56	60.95	61.22	61.50	

Average = ∑(39)1...12/12 = 61.08 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.36	1.35	1.35	1.33	1.33	1.32	1.32	1.31	1.32	1.33	1.34	1.34	

Average = ∑(40)1...12/12 = 1.33 (40)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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	1.57 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	71.43 (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)	78.57	75.72	72.86	70.00	67.14	64.29	64.29	67.14	70.00	72.86	75.72	78.57	

∑(44)1...12 = 857.16 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	116.52	101.91	105.16	91.68	87.97	75.91	70.34	80.72	81.69	95.20	103.92	112.85	

∑(45)1...12 = 1123.87 (45)

Distribution loss 0.15 x (45)m	17.48	15.29	15.77	13.75	13.20	11.39	10.55	12.11	12.25	14.28	15.59	16.93	(46)
Water storage loss calculated for each month (55) x (41)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)
Primary circuit loss for each month from Table 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)
Combi loss for each month from Table 3a, 3b or 3c	40.04	34.85	37.13	34.52	34.22	31.70	32.76	34.22	34.52	37.13	37.34	40.04	(61)
Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m	156.56	136.76	142.29	126.20	122.19	107.62	103.10	114.94	116.21	132.33	141.25	152.89	(62)

Solar DHW input calculated using Appendix G or Appendix H

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

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

156.56	136.76	142.29	126.20	122.19	107.62	103.10	114.94	116.21	132.33	141.25	152.89	

∑(64)1...12 = 1552.34 (64)

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

48.75	42.60	44.25	39.12	37.80	33.17	31.58	35.39	35.79	40.94	43.89	47.53	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	78.38	78.38	78.38	78.38	78.38	78.38	78.38	78.38	78.38	78.38	78.38	78.38	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	12.40	11.01	8.95	6.78	5.07	4.28	4.62	6.01	8.07	10.24	11.95	12.74	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	136.35	137.76	134.19	126.60	117.02	108.02	102.00	100.59	104.15	111.74	121.32	130.33	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	30.84	30.84	30.84	30.84	30.84	30.84	30.84	30.84	30.84	30.84	30.84	30.84	(69)
Pump and fan gains (Table 5a)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (Table 5)	-62.70	-62.70	-62.70	-62.70	-62.70	-62.70	-62.70	-62.70	-62.70	-62.70	-62.70	-62.70	(71)
Water heating gains (Table 5)	65.53	63.39	59.47	54.33	50.81	46.07	42.45	47.57	49.71	55.02	60.95	63.89	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	263.78	261.67	252.14	237.22	222.42	207.88	198.58	203.68	211.44	226.52	243.74	256.47	(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	
NorthWest	0.77	x	4.52	x	11.28	x 0.9 x	0.63	x	0.70	=	15.59	(81)
SouthEast	0.77	x	3.80	x	36.79	x 0.9 x	0.63	x	0.70	=	42.73	(77)

Solar gains in watts ∑(74)m...(82)m

58.32	104.51	156.75	217.27	264.39	271.74	258.13	221.56	177.48	119.21	70.79	49.30	(83)

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

322.10	366.18	408.88	454.49	486.81	479.61	456.72	425.24	388.92	345.73	314.54	305.77	(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)	1.00	0.99	0.98	0.95	0.87	0.72	0.56	0.62	0.85	0.97	0.99	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.58	19.75	20.02	20.39	20.72	20.92	20.98	20.97	20.82	20.41	19.93	19.56	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	19.80	19.80	19.80	19.81	19.82	19.83	19.83	19.83	19.82	19.82	19.81	19.81	(88)
Utilisation factor for gains for rest of dwelling n2,m	0.99	0.99	0.98	0.93	0.82	0.62	0.42	0.48	0.77	0.95	0.99	1.00	(89)

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

17.94	18.18	18.58	19.11	19.54	19.77	19.82	19.82	19.68	19.14	18.46	17.91

(90)

Living area fraction — Living area ÷ (4) = 0.52 (91)

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

18.80	19.00	19.33	19.78	20.16	20.37	20.43	20.42	20.28	19.80	19.23	18.77

(92)

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

18.80	19.00	19.33	19.78	20.16	20.37	20.43	20.42	20.28	19.80	19.23	18.77

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.99	0.99	0.97	0.93	0.84	0.67	0.49	0.55	0.80	0.95	0.99	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	319.88	361.59	398.07	424.48	409.01	321.19	225.54	233.56	312.02	329.40	310.58	304.07	(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]	900.56	873.40	793.12	664.74	515.62	348.34	230.92	242.10	374.35	560.98	742.51	896.13	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	432.03	343.94	293.92	172.98	79.32	0.00	0.00	0.00	0.00	172.29	310.99	440.49	

∑(98)1...5, 10...12 = 2245.95 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 49.04 (99)

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

Space heating

Fraction of space heat from secondary/supplementary system (table 11) — 0.00 (201)

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

Fraction of space heat from main system 2 — 0.00 (202)

Fraction of total space heat from main system 1 — (202) x [1- (203)] = 1.00 (204)

Fraction of total space heat from main system 2 — (202) x (203) = 0.00 (205)

Efficiency of main system 1 (%) — 93.40 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	462.56	368.24	314.68	185.20	84.92	0.00	0.00	0.00	0.00	184.47	332.97	471.61	

∑(211)1...5, 10...12 = 2404.66 (211)

Water heating

Efficiency of water heater

87.47	87.28	86.84	85.85	83.99	80.30	80.30	80.30	80.30	85.72	86.98	87.56

(217)

Water heating fuel, kWh/month

178.98	156.70	163.86	147.01	145.47	134.02	128.40	143.14	144.72	154.38	162.39	174.60

∑(219a)1...12 = 1833.67 (219)

Annual totals

Space heating fuel - main system 1 — 2404.66

Water heating fuel — 1833.67

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

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

boiler flue fan — 45.00 (230e)

Total electricity for the above, kWh/year — 75.00 (231)

Electricity for lighting (Appendix L)		218.93	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	4532.26	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2404.66	x	3.48	x 0.01 =	83.68	(240)
Water heating	1833.67	x	3.48	x 0.01 =	63.81	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	218.93	x	13.19	x 0.01 =	28.88	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		306.26	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.42	(257)
SAP value	80.24	
SAP rating (section 13)	80	(258)
SAP band	C	

12a. CO_2 emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	2404.66	x	0.216	=	519.41	(261)
Water heating	1833.67	x	0.216	=	396.07	(264)
Space and water heating			(261) + (262) + (263) + (264) =		915.48	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	218.93	x	0.519	=	113.63	(268)
Total CO_2, kg/year			(265)...(271) =		1068.03	(272)
Dwelling CO_2 emission rate			(272) ÷ (4) =		23.32	(273)
EI value					84.24	
EI rating (section 14)					84	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	2404.66	x	1.22	=	2933.69	(261)
Water heating	1833.67	x	1.22	=	2237.07	(264)
Space and water heating			(261) + (262) + (263) + (264) =		5170.76	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	218.93	x	3.07	=	672.12	(268)
Primary energy kWh/year					6073.13	(272)
Dwelling primary energy rate kWh/m2/year					132.60	(273)

TER Worksheet
Design - Draft

SRS Partnership

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 Stuart Searle	Assessor number	3519
Client	Avis Appleton & Associates	Last modified	14/09/2016
Address	PT5 Liffords Place, London, SW13		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		45.80	(1a) x	2.50	(2a) =	114.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	45.80	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	114.50	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		2	x 10 =	20	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	20	÷ (5) =	0.17	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	5.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.42	(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) = 0.36	(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	0.46	0.45	0.44	0.40	0.39	0.34	0.34	0.33	0.36	0.39	0.41	0.42	(22b)

Calculate effective air change rate for the applicable case:

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.61	0.60	0.60	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.58	0.59	(24d)
Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)	0.61	0.60	0.60	0.58	0.58	0.56	0.56	0.56	0.57	0.58	0.58	0.59	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Door			2.10	x	1.00	=	2.10			(26)
Window			8.32	x	1.33	=	11.03			(27)
External wall			43.83	x	0.18	=	7.89			(29a)
Party wall			17.75	x	0.00	=	0.00			(32)
Roof			50.38	x	0.13	=	6.55			(30)
Total area of external elements ∑A, m²			104.63							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	27.57 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		11.64 (36)
Total fabric heat loss	(33) + (36) =	39.21 (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)	22.89	22.74	22.59	21.87	21.74	21.11	21.11	21.00	21.35	21.74	22.01	22.29	(38)
Heat transfer coefficient, W/K (37)m + (38)m	62.10	61.95	61.80	61.08	60.95	60.32	60.32	60.21	60.56	60.95	61.22	61.50	

Average = ∑(39)1...12/12 = 61.08 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.36	1.35	1.35	1.33	1.33	1.32	1.32	1.31	1.32	1.33	1.34	1.34	

Average = ∑(40)1...12/12 = 1.33 (40)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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	1.57 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	71.43 (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)	78.57	75.72	72.86	70.00	67.14	64.29	64.29	67.14	70.00	72.86	75.72	78.57	

∑(44)1...12 = 857.16 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	116.52	101.91	105.16	91.68	87.97	75.91	70.34	80.72	81.69	95.20	103.92	112.85	

∑(45)1...12 = 1123.87 (45)

Distribution loss 0.15 x (45)m	17.48	15.29	15.77	13.75	13.20	11.39	10.55	12.11	12.25	14.28	15.59	16.93	(46)
Water storage loss calculated for each month (55) x (41)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)
Primary circuit loss for each month from Table 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)
Combi loss for each month from Table 3a, 3b or 3c	40.04	34.85	37.13	34.52	34.22	31.70	32.76	34.22	34.52	37.13	37.34	40.04	(61)
Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m	156.56	136.76	142.29	126.20	122.19	107.62	103.10	114.94	116.21	132.33	141.25	152.89	(62)

Solar DHW input calculated using Appendix G or Appendix H

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

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

	156.56	136.76	142.29	126.20	122.19	107.62	103.10	114.94	116.21	132.33	141.25	152.89

∑(64)1...12 = 1552.34 (64)

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

	48.75	42.60	44.25	39.12	37.80	33.17	31.58	35.39	35.79	40.94	43.89	47.53 (65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	78.38	78.38	78.38	78.38	78.38	78.38	78.38	78.38	78.38	78.38	78.38	78.38	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	12.40	11.01	8.95	6.78	5.07	4.28	4.62	6.01	8.07	10.24	11.95	12.74	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	136.35	137.76	134.19	126.60	117.02	108.02	102.00	100.59	104.15	111.74	121.32	130.33	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	30.84	30.84	30.84	30.84	30.84	30.84	30.84	30.84	30.84	30.84	30.84	30.84	(69)
Pump and fan gains (Table 5a)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (Table 5)	-62.70	-62.70	-62.70	-62.70	-62.70	-62.70	-62.70	-62.70	-62.70	-62.70	-62.70	-62.70	(71)
Water heating gains (Table 5)	65.53	63.39	59.47	54.33	50.81	46.07	42.45	47.57	49.71	55.02	60.95	63.89	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	263.78	261.67	252.14	237.22	222.42	207.88	198.58	203.68	211.44	226.52	243.74	256.47	(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	
NorthWest	0.77	x	4.52	x	11.28	x 0.9 x	0.63	x	0.70	=	15.59	(81)
SouthEast	0.77	x	3.80	x	36.79	x 0.9 x	0.63	x	0.70	=	42.73	(77)

Solar gains in watts ∑(74)m...(82)m

	58.32	104.51	156.75	217.27	264.39	271.74	258.13	221.56	177.48	119.21	70.79	49.30 (83)

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

	322.10	366.18	408.88	454.49	486.81	479.61	456.72	425.24	388.92	345.73	314.54	305.77 (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)	1.00	0.99	0.98	0.95	0.87	0.72	0.56	0.62	0.85	0.97	0.99	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.58	19.75	20.02	20.39	20.72	20.92	20.98	20.97	20.82	20.41	19.93	19.56	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	19.80	19.80	19.80	19.81	19.82	19.83	19.83	19.83	19.82	19.82	19.81	19.81	(88)
Utilisation factor for gains for rest of dwelling n2,m	0.99	0.99	0.98	0.93	0.82	0.62	0.42	0.48	0.77	0.95	0.99	1.00	(89)

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

17.94	18.18	18.58	19.11	19.54	19.77	19.82	19.82	19.68	19.14	18.46	17.91

(90)

Living area fraction — Living area ÷ (4) = 0.52 (91)

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

18.80	19.00	19.33	19.78	20.16	20.37	20.43	20.42	20.28	19.80	19.23	18.77

(92)

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

18.80	19.00	19.33	19.78	20.16	20.37	20.43	20.42	20.28	19.80	19.23	18.77

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.99	0.99	0.97	0.93	0.84	0.67	0.49	0.55	0.80	0.95	0.99	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	319.88	361.59	398.07	424.48	409.01	321.19	225.54	233.56	312.02	329.40	310.58	304.07	(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]	900.56	873.40	793.12	664.74	515.62	348.34	230.92	242.10	374.35	560.98	742.51	896.13	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	432.03	343.94	293.92	172.98	79.32	0.00	0.00	0.00	0.00	172.29	310.99	440.49	

∑(98)1...5, 10...12 = 2245.95 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 49.04 (99)

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

Space heating

Fraction of space heat from secondary/supplementary system (table 11) — 0.00 (201)

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

Fraction of space heat from main system 2 — 0.00 (202)

Fraction of total space heat from main system 1 — (202) x [1- (203)] = 1.00 (204)

Fraction of total space heat from main system 2 — (202) x (203) = 0.00 (205)

Efficiency of main system 1 (%) — 93.40 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	462.56	368.24	314.68	185.20	84.92	0.00	0.00	0.00	0.00	184.47	332.97	471.61	

∑(211)1...5, 10...12 = 2404.66 (211)

Water heating

Efficiency of water heater	87.47	87.28	86.84	85.85	83.99	80.30	80.30	80.30	80.30	85.72	86.98	87.56	(217)
Water heating fuel, kWh/month	178.98	156.70	163.86	147.01	145.47	134.02	128.40	143.14	144.72	154.38	162.39	174.60	

∑(219a)1...12 = 1833.67 (219)

Annual totals

Space heating fuel - main system 1 — 2404.66

Water heating fuel — 1833.67

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

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

boiler flue fan — 45.00 (230e)

Total electricity for the above, kWh/year — 75.00 (231)

Electricity for lighting (Appendix L)		218.93	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	4532.26	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2404.66	x	3.48	x 0.01 =	83.68	(240)
Water heating	1833.67	x	3.48	x 0.01 =	63.81	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	218.93	x	13.19	x 0.01 =	28.88	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		306.26	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.42	(257)
SAP value	80.24	
SAP rating (section 13)	80	(258)
SAP band	C	

12a. CO_2 emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	2404.66	x	0.216	=	519.41	(261)
Water heating	1833.67	x	0.216	=	396.07	(264)
Space and water heating			(261) + (262) + (263) + (264) =		915.48	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	218.93	x	0.519	=	113.63	(268)
Total CO_2, kg/year			(265)...(271) =		1068.03	(272)
Dwelling CO_2 emission rate			(272) ÷ (4) =		23.32	(273)
EI value					84.24	
EI rating (section 14)					84	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	2404.66	x	1.22	=	2933.69	(261)
Water heating	1833.67	x	1.22	=	2237.07	(264)
Space and water heating			(261) + (262) + (263) + (264) =		5170.76	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	218.93	x	3.07	=	672.12	(268)
Primary energy kWh/year					6073.13	(272)
Dwelling primary energy rate kWh/m2/year					132.60	(273)

TER Worksheet
Design - Draft

SRS Partnership

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 Stuart Searle	Assessor number	3519
Client	Avis Appleton & Associates	Last modified	14/09/2016
Address	PT6 Liffords Place, London, SW13		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		79.10	(1a) x	2.50	(2a) =	197.75	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	79.10	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	197.75	(5)

2. Ventilation rate

				m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		3	x 10 =	30	(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) =	30	÷ (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, q50, expressed in cubic metres per hour per square metre of envelope area	5.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.40	(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	(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	0.44	0.43	0.42	0.38	0.37	0.32	0.32	0.32	0.34	0.37	0.38	0.40	(22b)

Calculate effective air change rate for the applicable case:

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

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	(24d)

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	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Door			2.10	x	1.00	=	2.10			(26)
Window			12.10	x	1.33	=	16.04			(27)
External wall			88.80	x	0.18	=	15.98			(29a)
Roof			87.01	x	0.13	=	11.31			(30)
Total area of external elements ∑A, m²			190.01							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	45.44 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		250.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		24.79 (36)
Total fabric heat loss	(33) + (36) =	70.22 (37)

Ventilation heat loss calculated monthly 0.33 x (25)m x (5)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
38.81	38.57	38.34	37.23	37.02	36.06	36.06	35.88	36.43	37.02	37.44	37.88	(38)

Heat transfer coefficient, W/K (37)m + (38)m

109.04	108.80	108.56	107.45	107.25	106.28	106.28	106.11	106.66	107.25	107.67	108.10	

Average = ∑(39)1...12/12 = 107.45 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)

1.38	1.38	1.37	1.36	1.36	1.34	1.34	1.34	1.35	1.36	1.36	1.37	

Average = ∑(40)1...12/12 = 1.36 (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: 2.45 (42)

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36: 92.28 (43)

Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
101.51	97.82	94.13	90.44	86.75	83.05	83.05	86.75	90.44	94.13	97.82	101.51	

∑(44)1...12 = 1107.39 (44)

Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

150.54	131.66	135.86	118.45	113.65	98.07	90.88	104.29	105.53	122.99	134.25	145.79	

∑(45)1...12 = 1451.96 (45)

Distribution loss 0.15 x (45)m

22.58	19.75	20.38	17.77	17.05	14.71	13.63	15.64	15.83	18.45	20.14	21.87	(46)

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

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)

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

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)

Primary circuit loss for each month from Table 3

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)

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

50.96	45.02	47.97	44.60	44.20	40.96	42.32	44.20	44.60	47.97	48.24	50.96	(61)

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

201.50	176.68	183.83	163.05	157.86	139.03	133.20	148.49	150.13	170.95	182.49	196.75	(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

201.50	176.68	183.83	163.05	157.86	139.03	133.20	148.49	150.13	170.95	182.49	196.75	

∑(64)1...12 = 2003.96 (64)

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

62.79	55.03	57.17	50.53	48.84	42.85	40.80	45.73	46.24	52.88	56.70	61.21	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	122.28	122.28	122.28	122.28	122.28	122.28	122.28	122.28	122.28	122.28	122.28	122.28	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	20.42	18.14	14.75	11.17	8.35	7.05	7.61	9.90	13.28	16.87	19.69	20.99	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	217.55	219.81	214.12	202.01	186.72	172.35	162.75	160.50	166.18	178.29	193.58	207.95	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.23	35.23	35.23	35.23	35.23	35.23	35.23	35.23	35.23	35.23	35.23	35.23	(69)
Pump and fan gains (Table 5a)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (Table 5)	-97.82	-97.82	-97.82	-97.82	-97.82	-97.82	-97.82	-97.82	-97.82	-97.82	-97.82	-97.82	(71)
Water heating gains (Table 5)	84.40	81.89	76.84	70.19	65.65	59.51	54.84	61.46	64.22	71.08	78.75	82.28	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	385.05	382.52	368.39	346.04	323.40	301.59	287.89	294.54	306.37	328.93	354.70	373.90	(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	
SouthWest	0.77	x	4.84	x	36.79	x 0.9 x	0.63	x	0.70	=	54.42	(79)
NorthWest	0.77	x	4.84	x	11.28	x 0.9 x	0.63	x	0.70	=	16.69	(81)
SouthEast	0.77	x	2.42	x	36.79	x 0.9 x	0.63	x	0.70	=	27.21	(77)

Solar gains in watts ∑(74)m...(82)m

98.33	173.03	251.47	336.26	399.17	406.19	387.49	339.04	280.60	195.20	118.78	83.49	(83)

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

483.38	555.55	619.86	682.31	722.57	707.79	675.38	633.58	586.97	524.13	473.48	457.39	(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)	1.00	1.00	0.99	0.97	0.92	0.80	0.64	0.70	0.90	0.98	1.00	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.47	19.63	19.90	20.27	20.62	20.87	20.96	20.95	20.76	20.31	19.83	19.45	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	19.78	19.78	19.78	19.80	19.80	19.81	19.81	19.81	19.80	19.80	19.79	19.79	(88)
Utilisation factor for gains for rest of dwelling n2,m	1.00	0.99	0.99	0.96	0.88	0.70	0.49	0.55	0.83	0.97	0.99	1.00	(89)

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

17.77	18.00	18.40	18.93	19.41	19.71	19.79	19.79	19.60	19.00	18.29	17.73

(90)

Living area fraction — Living area ÷ (4) = 0.44 (91)

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

18.51	18.71	19.05	19.52	19.94	20.22	20.30	20.29	20.11	19.57	18.96	18.48

(92)

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

18.51	18.71	19.05	19.52	19.94	20.22	20.30	20.29	20.11	19.57	18.96	18.48

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	1.00	0.99	0.98	0.96	0.89	0.74	0.56	0.61	0.85	0.97	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	481.30	550.98	608.92	651.96	640.88	524.52	377.87	389.30	498.75	507.16	469.68	455.84	(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]	1549.54	1502.71	1362.79	1140.64	883.41	597.13	393.59	413.00	640.51	962.03	1277.17	1543.79	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	794.77	639.56	560.88	351.85	180.44	0.00	0.00	0.00	0.00	338.43	581.39	809.43	

∑(98)1...5, 10...12 = 4256.75 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 53.81 (99)

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

Space heating

Fraction of space heat from secondary/supplementary system (table 11) — 0.00 (201)

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

Fraction of space heat from main system 2 — 0.00 (202)

Fraction of total space heat from main system 1 — (202) x [1- (203)] = 1.00 (204)

Fraction of total space heat from main system 2 — (202) x (203) = 0.00 (205)

Efficiency of main system 1 (%) — 93.40 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	850.93	684.75	600.51	376.71	193.19	0.00	0.00	0.00	0.00	362.34	622.47	866.63	

∑(211)1...5, 10...12 = 4557.55 (211)

Water heating

Efficiency of water heater	88.16	88.00	87.68	86.94	85.39	80.30	80.30	80.30	80.30	86.74	87.76	88.23	(217)
Water heating fuel, kWh/month	228.56	200.77	209.66	187.54	184.87	173.14	165.88	184.92	186.96	197.09	207.93	222.99	

∑(219a)1...12 = 2350.33 (219)

Annual totals

Space heating fuel - main system 1 — 4557.55

Water heating fuel — 2350.33

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

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

boiler flue fan — 45.00 (230e)

Total electricity for the above, kWh/year — 75.00 (231)

Electricity for lighting (Appendix L)		360.60	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	7343.48	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	4557.55	x	3.48	x 0.01 =	158.60	(240)
Water heating	2350.33	x	3.48	x 0.01 =	81.79	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	360.60	x	13.19	x 0.01 =	47.56	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		417.85	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.41	(257)
SAP value	80.27	
SAP rating (section 13)	80	(258)
SAP band	C	

12a. CO_2 emissions - individual heating systems including micro-CHP

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	4557.55	x	0.216	=	984.43	(261)
Water heating	2350.33	x	0.216	=	507.67	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1492.10	(265)
Pumps and fans	75.00	x	0.519	=	38.93	(267)
Electricity for lighting	360.60	x	0.519	=	187.15	(268)
Total CO_2, kg/year				(265)...(271) =	1718.18	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	21.72	(273)
EI value					81.45	
EI rating (section 14)					81	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	4557.55	x	1.22	=	5560.21	(261)
Water heating	2350.33	x	1.22	=	2867.41	(264)
Space and water heating			(261) + (262) + (263) + (264) =		8427.62	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	360.60	x	3.07	=	1107.04	(268)
Primary energy kWh/year					9764.90	(272)
Dwelling primary energy rate kWh/m2/year					123.45	(273)