SAP 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		0	x 10 =	0	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	77.35	(23c)

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

	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(24a)

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

	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(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	1.40	=	2.94			(26)
Window			15.84	x	1.24	=	19.57			(27)
Exposed floor			68.90	x	0.10	=	6.89			(28b
External wall			77.06	x	0.20	=	15.41			(29a)
Total area of external elements ∑A, m²			163.90							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	44.82 (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		18.25 (36)
Total fabric heat loss	(33) + (36) =	63.07 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	15.68	15.50	15.32	14.41	14.23	13.32	13.32	13.14	13.68	14.23	14.59	14.95	(38)
Heat transfer coefficient, W/K (37)m + (38)m	78.75	78.56	78.38	77.48	77.30	76.39	76.39	76.21	76.75	77.30	77.66	78.02	

Average = ∑(39)1...12/12 = 77.43 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.14	1.14	1.14	1.12	1.12	1.11	1.11	1.11	1.11	1.12	1.13	1.13	

Average = ∑(40)1...12/12 = 1.12 (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	2.22 (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)

	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)	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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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	24.43	22.06	24.42	23.63	24.41	23.61	24.40	24.40	23.62	24.42	23.64	24.43	(61)
Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m	166.20	146.05	152.37	135.17	131.44	115.97	109.98	122.61	123.00	140.24	150.06	161.72	(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

166.20	146.05	152.37	135.17	131.44	115.97	109.98	122.61	123.00	140.24	150.06	161.72	

∑(64)1...12 = 1654.81 (64)

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

53.24	46.74	48.65	43.00	41.69	36.61	34.56	38.76	38.95	44.61	47.95	51.76	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	133.15	133.15	133.15	133.15	133.15	133.15	133.15	133.15	133.15	133.15	133.15	133.15	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	43.40	38.55	31.35	23.73	17.74	14.98	16.18	21.04	28.23	35.85	41.84	44.60	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	290.62	293.64	286.04	269.86	249.44	230.24	217.42	214.40	222.00	238.18	258.60	277.80	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.53	50.53	50.53	50.53	50.53	50.53	50.53	50.53	50.53	50.53	50.53	50.53	(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)	71.57	69.56	65.39	59.72	56.03	50.85	46.45	52.09	54.10	59.97	66.59	69.57	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	503.50	499.66	480.69	451.22	421.13	393.99	377.96	385.45	402.25	431.91	464.95	489.88	(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	2.42	x	36.79	x 0.9 x	0.63	x	0.70	=	27.21	(77)
NorthEast	0.77	x	8.58	x	11.28	x 0.9 x	0.63	x	0.70	=	29.59	(75)

Solar gains in watts ∑(74)m...(82)m

111.22	199.28	298.77	413.94	503.58	517.50	491.62	422.06	338.23	227.28	135.01	94.02	(83)

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

614.72	698.93	779.45	865.16	924.71	911.49	869.58	807.50	740.48	659.20	599.96	583.91	(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	0.98	0.95	0.87	0.72	0.53	0.38	0.43	0.67	0.91	0.98	0.99	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.03	20.21	20.46	20.74	20.92	20.99	21.00	21.00	20.96	20.72	20.32	20.00	(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	20.00	19.99	19.98	19.98	19.97	(88)
Utilisation factor for gains for rest of dwelling n2,m	0.98	0.97	0.93	0.83	0.66	0.45	0.30	0.34	0.59	0.87	0.97	0.99	(89)

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

18.71	18.96	19.31	19.70	19.92	19.99	19.99	19.99	19.96	19.68	19.14	18.66

(90)

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

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

19.36	19.57	19.88	20.22	20.41	20.48	20.49	20.49	20.45	20.19	19.72	19.32

(92)

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

19.21	19.42	19.73	20.07	20.26	20.33	20.34	20.34	20.30	20.04	19.57	19.17

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.98	0.97	0.93	0.84	0.67	0.47	0.33	0.37	0.62	0.88	0.97	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	603.35	675.02	724.09	723.73	622.92	432.47	284.90	298.96	457.31	577.62	579.07	575.21	(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]	1174.24	1140.85	1036.70	865.16	661.78	437.63	285.51	300.07	475.95	729.89	968.62	1168.07	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	424.74	313.04	232.58	101.83	28.92	0.00	0.00	0.00	0.00	113.29	280.48	441.09	

∑(98)1...5, 10...12 = 1935.96 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 28.10 (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 (%) — 92.90 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	457.20	336.96	250.36	109.61	31.13	0.00	0.00	0.00	0.00	121.94	301.91	474.80	

∑(211)1...5, 10...12 = 2083.92 (211)

Water heating

Efficiency of water heater	89.15	89.06	88.85	88.40	87.76	87.30	87.30	87.30	87.30	88.44	88.98	89.19	(217)
Water heating fuel, kWh/month	186.42	164.00	171.48	152.91	149.77	132.84	125.98	140.45	140.90	158.56	168.65	181.33	

∑(219a)1...12 = 1873.29 (219)

Annual totals

Space heating fuel - main system 1 — 2083.92

Water heating fuel — 1873.29

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

mechanical ventilation fans - balanced, extract or positive input from outside — 131.34 (230a)

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		206.34	(231)
Electricity for lighting (Appendix L)		306.57	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	4470.12	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2083.92	x	3.48	x 0.01 =	72.52	(240)
Water heating	1873.29	x	3.48	x 0.01 =	65.19	(247)
Pumps and fans	206.34	x	13.19	x 0.01 =	27.22	(249)
Electricity for lighting	306.57	x	13.19	x 0.01 =	40.44	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		325.36	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.20	(257)
SAP value	83.26	
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	2083.92	x	0.216	=	450.13	(261)
Water heating	1873.29	x	0.216	=	404.63	(264)
Space and water heating			(261) + (262) + (263) + (264) =		854.76	(265)
Pumps and fans	206.34	x	0.519	=	107.09	(267)
Electricity for lighting	306.57	x	0.519	=	159.11	(268)
Total CO_2, kg/year				(265)...(271) =	1120.96	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	16.27	(273)
EI value					86.81	
EI rating (section 14)					87	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	2083.92	x	1.22	=	2542.39	(261)
Water heating	1873.29	x	1.22	=	2285.42	(264)
Space and water heating			(261) + (262) + (263) + (264) =		4827.80	(265)
Pumps and fans	206.34	x	3.07	=	633.47	(267)
Electricity for lighting	306.57	x	3.07	=	941.16	(268)
Primary energy kWh/year					6402.43	(272)
Dwelling primary energy rate kWh/m2/year					92.92	(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		0	x 10 =	0	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	77.35	(23c)

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

	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(24a)

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

	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(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	1.40	=	2.94			(26)
Window			15.84	x	1.24	=	19.57			(27)
Exposed floor			68.90	x	0.10	=	6.89			(28b
External wall			57.31	x	0.20	=	11.46			(29a)
Party wall			19.75	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m²			144.15							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	40.87 (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		16.29 (36)
Total fabric heat loss	(33) + (36) =	57.15 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	15.68	15.50	15.32	14.41	14.23	13.32	13.32	13.14	13.68	14.23	14.59	14.95	(38)
Heat transfer coefficient, W/K (37)m + (38)m	72.83	72.65	72.47	71.56	71.38	70.47	70.47	70.29	70.84	71.38	71.74	72.10	

Average = ∑(39)1...12/12 = 71.52 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.06	1.05	1.05	1.04	1.04	1.02	1.02	1.02	1.03	1.04	1.04	1.05	

Average = ∑(40)1...12/12 = 1.04 (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)

	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	24.43	22.06	24.42	23.63	24.41	23.61	24.40	24.40	23.62	24.42	23.64	24.43	(61)
Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m	166.20	146.05	152.37	135.17	131.44	115.97	109.98	122.61	123.00	140.24	150.06	161.72	(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

	166.20	146.05	152.37	135.17	131.44	115.97	109.98	122.61	123.00	140.24	150.06	161.72

∑(64)1...12 = 1654.81 (64)

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

	53.24	46.74	48.65	43.00	41.69	36.61	34.56	38.76	38.95	44.61	47.95	51.76 (65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	133.15	133.15	133.15	133.15	133.15	133.15	133.15	133.15	133.15	133.15	133.15	133.15	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	43.40	38.55	31.35	23.73	17.74	14.98	16.18	21.04	28.23	35.85	41.84	44.60	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	290.62	293.64	286.04	269.86	249.44	230.24	217.42	214.40	222.00	238.18	258.60	277.80	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.53	50.53	50.53	50.53	50.53	50.53	50.53	50.53	50.53	50.53	50.53	50.53	(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)	71.57	69.56	65.39	59.72	56.03	50.85	46.45	52.09	54.10	59.97	66.59	69.57	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	503.50	499.66	480.69	451.22	421.13	393.99	377.96	385.45	402.25	431.91	464.95	489.88	(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	2.42	x	11.28	x 0.9 x	0.63	x	0.70	=	8.34	(81)
NorthEast	0.77	x	8.58	x	11.28	x 0.9 x	0.63	x	0.70	=	29.59	(75)

Solar gains in watts ∑(74)m...(82)m

	92.35	169.91	265.95	385.61	483.12	502.15	474.75	398.56	306.84	196.81	112.91	77.55 (83)

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

	595.86	669.57	746.63	836.84	904.25	896.13	852.71	784.01	709.09	628.72	577.87	567.44 (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	0.98	0.95	0.86	0.69	0.50	0.36	0.41	0.66	0.91	0.98	0.99	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.13	20.29	20.52	20.80	20.95	20.99	21.00	21.00	20.97	20.76	20.40	20.10	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	20.04	20.04	20.04	20.05	20.05	20.06	20.06	20.07	20.06	20.05	20.05	20.04	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.99	0.97	0.93	0.82	0.63	0.43	0.29	0.33	0.58	0.87	0.97	0.99	(89)

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

18.90	19.13	19.46	19.83	20.01	20.06	20.06	20.07	20.04	19.80	19.30	18.86	(90)

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

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

19.51	19.70	19.99	20.31	20.47	20.52	20.52	20.52	20.50	20.27	19.84	19.47	(92)

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

19.36	19.55	19.84	20.16	20.32	20.37	20.37	20.37	20.35	20.12	19.69	19.32	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.98	0.97	0.93	0.83	0.65	0.45	0.31	0.36	0.61	0.88	0.97	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	585.42	648.02	694.50	693.36	589.20	403.73	265.68	278.78	429.49	550.97	558.50	559.44	(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]	1096.52	1064.05	966.37	805.46	615.31	406.57	265.97	279.37	442.52	679.61	903.24	1090.23	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	380.26	279.58	202.27	80.71	19.43	0.00	0.00	0.00	0.00	95.71	248.21	394.91	

∑(98)1...5, 10...12 = 1701.08 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 24.69 (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 (%) — 92.90 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	409.33	300.95	217.73	86.88	20.91	0.00	0.00	0.00	0.00	103.02	267.18	425.09	

∑(211)1...5, 10...12 = 1831.09 (211)

Water heating

Efficiency of water heater

89.09	88.99	88.76	88.25	87.63	87.30	87.30	87.30	87.30	88.34	88.90	89.13	(217)

Water heating fuel, kWh/month

186.54	164.12	171.65	153.16	150.00	132.84	125.98	140.45	140.90	158.75	168.80	181.45	

∑(219a)1...5, 10...12 = 1874.64 (219)

Annual totals

Space heating fuel - main system 1 — 1831.09

Water heating fuel — 1874.64

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

mechanical ventilation fans - balanced, extract or positive input from outside — 131.34 (230a)

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					206.34	(231)
Electricity for lighting (Appendix L)					306.57	(232)
Total delivered energy for all uses				(211)...(221) + (231) + (232)...(237b) =	4218.64	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	1831.09	x	3.48	x 0.01 =	63.72	(240)
Water heating	1874.64	x	3.48	x 0.01 =	65.24	(247)
Pumps and fans	206.34	x	13.19	x 0.01 =	27.22	(249)
Electricity for lighting	306.57	x	13.19	x 0.01 =	40.44	(250)
Additional standing charges					120.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	316.61	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.17	(257)
SAP value	83.71	
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	1831.09	x	0.216	=	395.52	(261)
Water heating	1874.64	x	0.216	=	404.92	(264)
Space and water heating				(261) + (262) + (263) + (264) =	800.44	(265)
Pumps and fans	206.34	x	0.519	=	107.09	(267)
Electricity for lighting	306.57	x	0.519	=	159.11	(268)
Total CO_2, kg/year				(265)...(271) =	1066.64	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	15.48	(273)
EI value					87.45	
EI rating (section 14)					87	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	1831.09	x	1.22	=	2233.93	(261)
Water heating	1874.64	x	1.22	=	2287.06	(264)
Space and water heating				(261) + (262) + (263) + (264) =	4520.99	(265)
Pumps and fans	206.34	x	3.07	=	633.47	(267)
Electricity for lighting	306.57	x	3.07	=	941.16	(268)
Primary energy kWh/year					6095.62	(272)
Dwelling primary energy rate kWh/m2/year					88.47	(273)

SAP 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	0	x 10 =	0	(7a)
Number of passive vents	0	x 10 =	0	(7b)
Number of flueless gas fires	0	x 40 =	0	(7c)

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

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	75.65	(23c)

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

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

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

0.28	0.28	0.28	0.26	0.26	0.24	0.24	0.24	0.25	0.26	0.27	0.27	(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	1.40	=	2.94			(26)
Window			14.86	x	1.24	=	18.36			(27)
Exposed floor			42.60	x	0.10	=	4.26			(28b
External wall			104.59	x	0.20	=	20.92			(29a)
Party wall			43.45	x	0.00	=	0.00			(32)
Roof			7.92	x	0.10	=	0.79			(30)
Total area of external elements ∑A, m²			172.07							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	47.27 (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		17.40 (36)
Total fabric heat loss	(33) + (36) =	64.67 (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	
21.98	21.74	21.49	20.26	20.01	18.78	18.78	18.53	19.27	20.01	20.50	21.00	(38)

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

86.65	86.41	86.16	84.93	84.68	83.45	83.45	83.20	83.94	84.68	85.18	85.67	

Average = ∑(39)1...12/12 = 84.87 (39)

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

1.02	1.01	1.01	1.00	0.99	0.98	0.98	0.98	0.99	0.99	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	2.55 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	94.86 (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	
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

24.44	22.07	24.43	23.63	24.42	23.62	24.40	24.41	23.63	24.43	23.65	24.44	(61)

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

179.19	157.41	164.09	145.39	141.25	124.44	117.82	131.61	132.11	150.85	161.65	174.30	(62)

Solar DHW input calculated using Appendix G or Appendix H

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

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

179.19	157.41	164.09	145.39	141.25	124.44	117.82	131.61	132.11	150.85	161.65	174.30	

∑(64)1...12 = 1780.11 (64)

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

57.56	50.52	52.54	46.39	44.95	39.43	37.16	41.75	41.98	48.14	51.80	55.94	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	153.25	153.25	153.25	153.25	153.25	153.25	153.25	153.25	153.25	153.25	153.25	153.25	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	52.62	46.74	38.01	28.78	21.51	18.16	19.62	25.51	34.24	43.47	50.74	54.09	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	343.23	346.79	337.82	318.71	294.59	271.92	256.78	253.22	262.19	281.30	305.42	328.09	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	52.88	52.88	52.88	52.88	52.88	52.88	52.88	52.88	52.88	52.88	52.88	52.88	(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)	77.37	75.18	70.62	64.44	60.42	54.76	49.95	56.11	58.30	64.71	71.94	75.19	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	580.19	575.67	553.42	518.88	483.48	451.80	433.31	441.80	461.69	496.44	535.06	564.32	(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

747.28	860.30	942.85	1001.42	1023.96	988.37	950.62	915.88	883.37	811.01	735.20	707.32	(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	0.97	0.94	0.86	0.72	0.53	0.39	0.42	0.63	0.88	0.97	0.99	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.20	20.37	20.59	20.81	20.94	20.99	21.00	21.00	20.98	20.81	20.47	20.16	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	20.07	20.07	20.07	20.09	20.09	20.10	20.10	20.10	20.10	20.09	20.08	20.08	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.98	0.96	0.92	0.83	0.66	0.46	0.31	0.34	0.56	0.85	0.96	0.99

(89)

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

19.02	19.28	19.58	19.88	20.04	20.10	20.10	20.10	20.08	19.89	19.42	18.98

(90)

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

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

19.52	19.74	20.01	20.27	20.42	20.47	20.48	20.48	20.46	20.28	19.87	19.48

(92)

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

19.37	19.59	19.86	20.12	20.27	20.32	20.33	20.33	20.31	20.13	19.72	19.33

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.98	0.96	0.92	0.83	0.68	0.48	0.33	0.36	0.58	0.85	0.96	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m	732.49	825.78	866.10	829.00	692.25	473.81	310.91	326.49	510.39	687.56	705.39	696.34	(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]	1305.94	1269.26	1150.71	953.32	725.79	477.67	311.26	327.06	521.28	807.17	1074.54	1296.24	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	426.65	298.02	211.75	89.52	24.96	0.00	0.00	0.00	0.00	88.99	265.79	446.33	

∑(98)1...5, 10...12 = 1852.00 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 21.74 (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 (%) — 92.90 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	459.26	320.80	227.93	96.36	26.86	0.00	0.00	0.00	0.00	95.79	286.10	480.44	

∑(211)1...5, 10...12 = 1993.54 (211)

Water heating

Efficiency of water heater	89.12	88.98	88.75	88.27	87.68	87.30	87.30	87.30	87.30	88.25	88.90	89.15	(217)
Water heating fuel, kWh/month	201.07	176.90	184.90	164.71	161.09	142.54	134.96	150.76	151.33	170.94	181.84	195.50	

∑(219a)1...12 = 2016.55 (219)

Annual totals

Space heating fuel - main system 1 — 1993.54

Water heating fuel — 2016.55

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

mechanical ventilation fans - balanced, extract or positive input from outside — 217.96 (230a)

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		292.96	(231)
Electricity for lighting (Appendix L)		371.74	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	4674.78	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	1993.54	x	3.48	x 0.01 =	69.38	(240)
Water heating	2016.55	x	3.48	x 0.01 =	70.18	(247)
Pumps and fans	292.96	x	13.19	x 0.01 =	38.64	(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) =		347.22	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.12	(257)
SAP value	84.37	
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	1993.54	x	0.216	=	430.60	(261)
Water heating	2016.55	x	0.216	=	435.57	(264)
Space and water heating			(261) + (262) + (263) + (264) =		866.18	(265)
Pumps and fans	292.96	x	0.519	=	152.04	(267)
Electricity for lighting	371.74	x	0.519	=	192.93	(268)
Total CO_2, kg/year				(265)...(271) =	1211.15	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	14.22	(273)
EI value					87.53	
EI rating (section 14)					88	(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	1993.54	x	1.22	=	2432.12	(261)
Water heating	2016.55	x	1.22	=	2460.19	(264)
Space and water heating			(261) + (262) + (263) + (264) =		4892.31	(265)
Pumps and fans	292.96	x	3.07	=	899.38	(267)
Electricity for lighting	371.74	x	3.07	=	1141.23	(268)
Primary energy kWh/year					6932.92	(272)
Dwelling primary energy rate kWh/m2/year					81.37	(273)

SAP 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		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		77.35 (23c)

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

0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(24a)

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

0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(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	1.40	=	2.94			(26)
Window			18.32	x	1.24	=	22.64			(27)
Exposed floor			102.40	x	0.10	=	10.24			(28b
External wall			89.58	x	0.20	=	17.92			(29a)
Total area of external elements ∑A, m²			212.40							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	53.73 (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		20.47 (36)
Total fabric heat loss	(33) + (36) =	74.20 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	23.30	23.03	22.76	21.42	21.15	19.80	19.80	19.53	20.34	21.15	21.68	22.22	(38)
Heat transfer coefficient, W/K (37)m + (38)m	97.50	97.23	96.96	95.62	95.35	94.00	94.00	93.73	94.54	95.35	95.89	96.43	

Average = ∑(39)1...12/12 = 95.55 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	0.95	0.95	0.95	0.93	0.93	0.92	0.92	0.92	0.92	0.93	0.94	0.94	

Average = ∑(40)1...12/12 = 0.93 (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)

	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)

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	24.45	22.08	24.44	23.64	24.42	23.63	24.41	24.42	23.63	24.43	23.65	24.44	(61)
Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m	187.19	164.41	171.32	151.69	147.29	129.65	122.66	137.16	137.72	157.39	168.79	182.05	(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

187.19	164.41	171.32	151.69	147.29	129.65	122.66	137.16	137.72	157.39	168.79	182.05	

∑(64)1...12 = 1857.34 (64)

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

60.22	52.85	54.95	48.49	46.96	41.16	38.77	43.59	43.84	50.32	54.17	58.52	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	165.64	165.64	165.64	165.64	165.64	165.64	165.64	165.64	165.64	165.64	165.64	165.64	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	59.28	52.65	42.82	32.42	24.23	20.46	22.10	28.73	38.56	48.97	57.15	60.93	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	388.28	392.31	382.16	360.54	333.26	307.61	290.48	286.45	296.61	318.22	345.51	371.15	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.32	54.32	54.32	54.32	54.32	54.32	54.32	54.32	54.32	54.32	54.32	54.32	(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)	80.95	78.64	73.85	67.34	63.12	57.17	52.11	58.59	60.89	67.63	75.24	78.65	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	641.05	636.14	611.37	572.84	533.15	497.78	477.24	486.31	508.60	547.36	590.43	623.27	(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

779.69	882.19	974.31	1066.61	1126.42	1104.45	1054.77	986.91	916.43	826.38	758.30	740.75	(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	0.98	0.96	0.89	0.74	0.54	0.39	0.44	0.68	0.92	0.98	0.99	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.19	20.34	20.55	20.80	20.95	20.99	21.00	21.00	20.97	20.78	20.44	20.16	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	20.12	20.13	20.13	20.14	20.14	20.15	20.15	20.15	20.15	20.14	20.14	20.13	(88)
Utilisation factor for gains for rest of dwelling n2,m	0.99	0.98	0.95	0.86	0.68	0.47	0.32	0.36	0.61	0.89	0.98	0.99	(89)

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

	19.05	19.27	19.58	19.92	20.09	20.15	20.15	20.15	20.13	19.90	19.43	19.01 (90)

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

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

	19.51	19.70	19.97	20.28	20.44	20.49	20.50	20.50	20.47	20.26	19.84	19.48 (92)

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

	19.36	19.55	19.82	20.13	20.29	20.34	20.35	20.35	20.32	20.11	19.69	19.33 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.99	0.98	0.95	0.86	0.69	0.49	0.33	0.37	0.63	0.89	0.98	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	770.63	861.32	921.24	916.22	781.67	536.04	351.83	369.35	572.97	738.04	739.78	734.07	(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]	1468.59	1424.63	1291.85	1073.45	819.05	539.70	352.14	369.96	588.30	906.68	1207.11	1458.81	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	519.28	378.54	275.74	113.20	27.81	0.00	0.00	0.00	0.00	125.47	336.48	539.21	

∑(98)1...5, 10...12 = 2315.73 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 22.61 (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 (%) — 92.90 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	558.97	407.47	296.81	121.86	29.94	0.00	0.00	0.00	0.00	135.06	362.20	580.42	

∑(211)1...5, 10...12 = 2492.71 (211)

Water heating

Efficiency of water heater

	89.20	89.10	88.89	88.39	87.70	87.30	87.30	87.30	87.30	88.43	89.01	89.23 (217)

Water heating fuel, kWh/month

	209.86	184.54	192.74	171.61	167.94	148.51	140.50	157.11	157.76	177.98	189.62	204.03

∑(219a)1...5, 10...12 = 2102.21 (219)

Annual totals

Space heating fuel - main system 1 — 2492.71

Water heating fuel — 2102.21

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

mechanical ventilation fans - balanced, extract or positive input from outside — 195.20 (230a)

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 — 270.20 (231)

Electricity for lighting (Appendix L)		418.75	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	5283.87	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2492.71	x	3.48	x 0.01 =	86.75	(240)
Water heating	2102.21	x	3.48	x 0.01 =	73.16	(247)
Pumps and fans	270.20	x	13.19	x 0.01 =	35.64	(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) =		370.78	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.06	(257)
SAP value	85.26	
SAP rating (section 13)	85	(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	2492.71	x	0.216	=	538.43	(261)
Water heating	2102.21	x	0.216	=	454.08	(264)
Space and water heating			(261) + (262) + (263) + (264) =		992.50	(265)
Pumps and fans	270.20	x	0.519	=	140.23	(267)
Electricity for lighting	418.75	x	0.519	=	217.33	(268)
Total CO_2, kg/year			(265)...(271) =		1350.07	(272)
Dwelling CO_2 emission rate			(272) ÷ (4) =		13.18	(273)
EI value					87.73	
EI rating (section 14)					88	(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	2492.71	x	1.22	=	3041.11	(261)
Water heating	2102.21	x	1.22	=	2564.69	(264)
Space and water heating			(261) + (262) + (263) + (264) =		5605.80	(265)
Pumps and fans	270.20	x	3.07	=	829.51	(267)
Electricity for lighting	418.75	x	3.07	=	1285.55	(268)
Primary energy kWh/year					7720.87	(272)
Dwelling primary energy rate kWh/m2/year					75.40	(273)

SAP 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	0	x 10 =	0	(7a)
Number of passive vents	0	x 10 =	0	(7b)
Number of flueless gas fires	0	x 40 =	0	(7c)

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

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	77.35	(23c)

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

	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(24a)

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

	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(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	1.40	=	2.94			(26)
Window			12.10	x	1.24	=	14.95			(27)
Exposed floor			79.10	x	0.10	=	7.91			(28b
External wall			88.80	x	0.20	=	17.76			(29a)
Total area of external elements ∑A, m²			182.10							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	43.56 (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		19.35 (36)
Total fabric heat loss	(33) + (36) =	62.91 (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)	18.00	17.79	17.58	16.54	16.33	15.29	15.29	15.09	15.71	16.33	16.75	17.17	(38)
Heat transfer coefficient, W/K (37)m + (38)m	80.91	80.70	80.49	79.45	79.25	78.21	78.21	78.00	78.62	79.25	79.66	80.08	

Average = ∑(39)1...12/12 = 79.40 (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	1.01	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)

	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)	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	24.44	22.07	24.43	23.63	24.41	23.62	24.40	24.41	23.63	24.42	23.64	24.44	(61)
Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m	174.98	153.73	160.29	142.08	138.07	121.69	115.28	128.70	129.16	147.41	157.89	170.22	(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

174.98	153.73	160.29	142.08	138.07	121.69	115.28	128.70	129.16	147.41	157.89	170.22	

∑(64)1...12 = 1739.50 (64)

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

56.16	49.29	51.28	45.29	43.89	38.51	36.32	40.78	41.00	47.00	50.55	54.58	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	146.73	146.73	146.73	146.73	146.73	146.73	146.73	146.73	146.73	146.73	146.73	146.73	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	51.05	45.34	36.87	27.91	20.87	17.62	19.04	24.74	33.21	42.17	49.22	52.47	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	324.70	328.07	319.58	301.50	278.69	257.24	242.91	239.54	248.04	266.11	288.93	310.37	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	52.12	52.12	52.12	52.12	52.12	52.12	52.12	52.12	52.12	52.12	52.12	52.12	(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)	75.49	73.36	68.93	62.91	59.00	53.49	48.81	54.81	56.94	63.17	70.21	73.36	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	555.27	550.79	529.41	496.35	462.58	432.38	414.79	423.13	442.21	475.48	512.38	540.23	(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

653.59	723.82	780.88	832.62	861.75	838.57	802.28	762.17	722.81	670.68	631.16	623.73	(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	0.98	0.96	0.90	0.78	0.58	0.43	0.47	0.71	0.92	0.98	0.99	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.14	20.28	20.49	20.74	20.92	20.99	21.00	21.00	20.96	20.75	20.40	20.12	(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	20.09	20.09	20.08	20.08	20.07	(88)
Utilisation factor for gains for rest of dwelling n2,m	0.99	0.98	0.95	0.87	0.72	0.51	0.34	0.38	0.63	0.89	0.97	0.99	(89)

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

18.94	19.15	19.44	19.79	20.01	20.08	20.09	20.09	20.06	19.81	19.33	18.91

(90)

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

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

19.47	19.64	19.90	20.21	20.40	20.48	20.49	20.49	20.45	20.22	19.80	19.43

(92)

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

19.32	19.49	19.75	20.06	20.25	20.33	20.34	20.34	20.30	20.07	19.65	19.28

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.98	0.97	0.95	0.87	0.73	0.53	0.36	0.40	0.65	0.89	0.97	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	643.60	704.17	738.30	727.71	630.63	441.93	291.67	306.08	469.27	598.43	612.52	616.05	(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]	1215.02	1177.64	1066.71	886.56	677.75	447.94	292.27	307.12	487.75	750.35	999.64	1207.92	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	425.14	318.17	244.34	114.37	35.05	0.00	0.00	0.00	0.00	113.03	278.73	440.36	

∑(98)1...5, 10...12 = 1969.19 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 24.89 (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 (%) — 92.90 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	457.63	342.49	263.01	123.11	37.73	0.00	0.00	0.00	0.00	121.67	300.03	474.01	

∑(211)1...5, 10...12 = 2119.68 (211)

Water heating

Efficiency of water heater	89.13	89.04	88.85	88.44	87.81	87.30	87.30	87.30	87.30	88.41	88.94	89.16	(217)
Water heating fuel, kWh/month	196.32	172.66	180.40	160.65	157.23	139.40	132.05	147.42	147.95	166.73	177.52	190.92	

∑(219a)1...12 = 1969.26 (219)

Annual totals

Space heating fuel - main system 1 — 2119.68

Water heating fuel — 1969.26

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

mechanical ventilation fans - balanced, extract or positive input from outside — 150.78 (230a)

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		225.78	(231)
Electricity for lighting (Appendix L)		360.60	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	4675.32	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2119.68	x	3.48	x 0.01 =	73.76	(240)
Water heating	1969.26	x	3.48	x 0.01 =	68.53	(247)
Pumps and fans	225.78	x	13.19	x 0.01 =	29.78	(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) =	339.64	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.15	(257)
SAP value	83.96	
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	2119.68	x	0.216	=	457.85	(261)
Water heating	1969.26	x	0.216	=	425.36	(264)
Space and water heating			(261) + (262) + (263) + (264) =		883.21	(265)
Pumps and fans	225.78	x	0.519	=	117.18	(267)
Electricity for lighting	360.60	x	0.519	=	187.15	(268)
Total CO_2, kg/year				(265)...(271) =	1187.54	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	15.01	(273)
EI value					87.18	
EI rating (section 14)					87	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	2119.68	x	1.22	=	2586.01	(261)
Water heating	1969.26	x	1.22	=	2402.49	(264)
Space and water heating			(261) + (262) + (263) + (264) =		4988.51	(265)
Pumps and fans	225.78	x	3.07	=	693.16	(267)
Electricity for lighting	360.60	x	3.07	=	1107.04	(268)
Primary energy kWh/year					6788.70	(272)
Dwelling primary energy rate kWh/m2/year					85.82	(273)

SAP 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		0	x 10 =	0	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	77.35	(23c)

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

	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(24a)

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

	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(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	1.40	=	2.94			(26)
Window			15.84	x	1.24	=	19.57			(27)
External wall			77.06	x	0.20	=	15.41			(29a)
Roof			9.20	x	0.10	=	0.92			(30)
Total area of external elements ∑A, m²			104.20							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	38.85 (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) =	52.44 (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	
15.68	15.50	15.32	14.41	14.23	13.32	13.32	13.14	13.68	14.23	14.59	14.95	(38)

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

68.12	67.94	67.76	66.85	66.67	65.77	65.77	65.59	66.13	66.67	67.03	67.40	

Average = ∑(39)1...12/12 = 66.81 (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	2.22 (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

24.43	22.06	24.42	23.63	24.41	23.61	24.40	24.40	23.62	24.42	23.64	24.43	(61)

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

166.20	146.05	152.37	135.17	131.44	115.97	109.98	122.61	123.00	140.24	150.06	161.72	(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

166.20	146.05	152.37	135.17	131.44	115.97	109.98	122.61	123.00	140.24	150.06	161.72	

∑(64)1...12 = 1654.81 (64)

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

53.24	46.74	48.65	43.00	41.69	36.61	34.56	38.76	38.95	44.61	47.95	51.76	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	133.15	133.15	133.15	133.15	133.15	133.15	133.15	133.15	133.15	133.15	133.15	133.15	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	43.40	38.55	31.35	23.73	17.74	14.98	16.18	21.04	28.23	35.85	41.84	44.60	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	290.62	293.64	286.04	269.86	249.44	230.24	217.42	214.40	222.00	238.18	258.60	277.80	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.53	50.53	50.53	50.53	50.53	50.53	50.53	50.53	50.53	50.53	50.53	50.53	(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)	71.57	69.56	65.39	59.72	56.03	50.85	46.45	52.09	54.10	59.97	66.59	69.57	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	503.50	499.66	480.69	451.22	421.13	393.99	377.96	385.45	402.25	431.91	464.95	489.88	(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	2.42	x	36.79	x 0.9 x	0.63	x	0.70	=	27.21	(77)
NorthEast	0.77	x	8.58	x	11.28	x 0.9 x	0.63	x	0.70	=	29.59	(75)

Solar gains in watts ∑(74)m...(82)m

111.22	199.28	298.77	413.94	503.58	517.50	491.62	422.06	338.23	227.28	135.01	94.02	(83)

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

614.72	698.93	779.45	865.16	924.71	911.49	869.58	807.50	740.48	659.20	599.96	583.91	(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	0.97	0.93	0.82	0.65	0.46	0.33	0.37	0.60	0.87	0.97	0.99	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.25	20.42	20.64	20.86	20.97	21.00	21.00	21.00	20.98	20.83	20.51	20.22	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	20.09	20.09	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	0.98	0.96	0.91	0.78	0.59	0.40	0.27	0.30	0.53	0.84	0.96	0.99	(89)

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

19.12	19.35	19.66	19.96	20.08	20.12	20.12	20.12	20.11	19.94	19.50	19.08

(90)

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

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

19.68	19.88	20.14	20.41	20.52	20.55	20.55	20.55	20.54	20.38	19.99	19.64

(92)

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

19.53	19.73	19.99	20.26	20.37	20.40	20.40	20.40	20.39	20.23	19.84	19.49

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.98	0.96	0.91	0.79	0.61	0.42	0.29	0.32	0.55	0.84	0.96	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m	601.52	669.72	709.08	684.67	563.11	380.14	250.01	262.38	409.40	554.45	574.26	573.94	(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]	1037.38	1007.34	914.29	759.16	578.04	381.51	250.14	262.62	415.86	641.99	854.28	1030.51	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	324.28	226.89	152.68	53.63	11.10	0.00	0.00	0.00	0.00	65.13	201.61	339.69	

∑(98)1...5, 10...12 = 1375.01 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 19.96 (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 (%) — 92.90 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	349.07	244.23	164.35	57.73	11.95	0.00	0.00	0.00	0.00	70.11	217.02	365.65	

∑(211)1...5, 10...12 = 1480.10 (211)

Water heating

Efficiency of water heater	89.00	88.86	88.58	88.02	87.50	87.30	87.30	87.30	87.30	88.11	88.77	89.04	(217)
Water heating fuel, kWh/month	186.73	164.35	172.00	153.56	150.22	132.84	125.98	140.45	140.90	159.16	169.04	181.62	

∑(219a)1...12 = 1876.87 (219)

Annual totals

Space heating fuel - main system 1 — 1480.10

Water heating fuel — 1876.87

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

mechanical ventilation fans - balanced, extract or positive input from outside	131.34	(230a)
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		206.34	(231)
Electricity for lighting (Appendix L)		306.57	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	3869.88	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	1480.10	x	3.48	x 0.01 =	51.51	(240)
Water heating	1876.87	x	3.48	x 0.01 =	65.32	(247)
Pumps and fans	206.34	x	13.19	x 0.01 =	27.22	(249)
Electricity for lighting	306.57	x	13.19	x 0.01 =	40.44	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		304.48	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.12	(257)
SAP value	84.34	
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	1480.10	x	0.216	=	319.70	(261)
Water heating	1876.87	x	0.216	=	405.40	(264)
Space and water heating			(261) + (262) + (263) + (264) =		725.11	(265)
Pumps and fans	206.34	x	0.519	=	107.09	(267)
Electricity for lighting	306.57	x	0.519	=	159.11	(268)
Total CO_2, kg/year				(265)...(271) =	991.30	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	14.39	(273)
EI value					88.34	
EI rating (section 14)					88	(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	1480.10	x	1.22	=	1805.72	(261)
Water heating	1876.87	x	1.22	=	2289.78	(264)
Space and water heating			(261) + (262) + (263) + (264) =		4095.51	(265)
Pumps and fans	206.34	x	3.07	=	633.47	(267)
Electricity for lighting	306.57	x	3.07	=	941.16	(268)
Primary energy kWh/year					5670.13	(272)
Dwelling primary energy rate kWh/m2/year					82.30	(273)

SAP 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		0	x 10 =	0	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	77.35	(23c)

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

	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(24a)

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

	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(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	1.40	=	2.94			(26)
Window			15.84	x	1.24	=	19.57			(27)
External wall			57.31	x	0.20	=	11.46			(29a)
Party wall			19.75	x	0.00	=	0.00			(32)
Roof			9.20	x	0.10	=	0.92			(30)
Total area of external elements ∑A, m²			84.45							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	34.90 (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		12.34 (36)
Total fabric heat loss	(33) + (36) =	47.24 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	15.68	15.50	15.32	14.41	14.23	13.32	13.32	13.14	13.68	14.23	14.59	14.95	(38)
Heat transfer coefficient, W/K (37)m + (38)m	62.92	62.73	62.55	61.65	61.47	60.56	60.56	60.38	60.92	61.47	61.83	62.19	

Average = ∑(39)1...12/12 = 61.60 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	0.91	0.91	0.91	0.89	0.89	0.88	0.88	0.88	0.88	0.89	0.90	0.90	

Average = ∑(40)1...12/12 = 0.89 (40)

Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.22 (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	24.43	22.06	24.42	23.63	24.41	23.61	24.40	24.40	23.62	24.42	23.64	24.43	(61)
Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m	166.20	146.05	152.37	135.17	131.44	115.97	109.98	122.61	123.00	140.24	150.06	161.72	(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

	166.20	146.05	152.37	135.17	131.44	115.97	109.98	122.61	123.00	140.24	150.06	161.72

∑(64)1...12 = 1654.81 (64)

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

	53.24	46.74	48.65	43.00	41.69	36.61	34.56	38.76	38.95	44.61	47.95	51.76 (65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	133.15	133.15	133.15	133.15	133.15	133.15	133.15	133.15	133.15	133.15	133.15	133.15	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	43.40	38.55	31.35	23.73	17.74	14.98	16.18	21.04	28.23	35.85	41.84	44.60	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	290.62	293.64	286.04	269.86	249.44	230.24	217.42	214.40	222.00	238.18	258.60	277.80	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	50.53	50.53	50.53	50.53	50.53	50.53	50.53	50.53	50.53	50.53	50.53	50.53	(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)	71.57	69.56	65.39	59.72	56.03	50.85	46.45	52.09	54.10	59.97	66.59	69.57	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	503.50	499.66	480.69	451.22	421.13	393.99	377.96	385.45	402.25	431.91	464.95	489.88	(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	2.42	x	11.28	x 0.9 x	0.63	x	0.70	=	8.34	(81)
NorthEast	0.77	x	8.58	x	11.28	x 0.9 x	0.63	x	0.70	=	29.59	(75)

Solar gains in watts ∑(74)m...(82)m

	92.35	169.91	265.95	385.61	483.12	502.15	474.75	398.56	306.84	196.81	112.91	77.55 (83)

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

	595.86	669.57	746.63	836.84	904.25	896.13	852.71	784.01	709.09	628.72	577.87	567.44 (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	0.97	0.93	0.81	0.62	0.43	0.31	0.35	0.58	0.87	0.97	0.99	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.34	20.49	20.69	20.90	20.98	21.00	21.00	21.00	20.99	20.87	20.57	20.31	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	20.16	20.16	20.16	20.17	20.17	20.19	20.19	20.19	20.18	20.17	20.17	20.17	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.98	0.96	0.91	0.77	0.57	0.38	0.25	0.29	0.52	0.83	0.96	0.99	(89)

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

19.30	19.51	19.80	20.07	20.16	20.18	20.19	20.19	20.17	20.04	19.64	19.26	(90)

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

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

19.81	19.99	20.24	20.48	20.56	20.58	20.59	20.59	20.58	20.44	20.10	19.78	(92)

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

19.66	19.84	20.09	20.33	20.41	20.43	20.44	20.44	20.43	20.29	19.95	19.63	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.98	0.96	0.91	0.78	0.58	0.39	0.27	0.31	0.54	0.84	0.96	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m	583.31	642.34	678.19	650.13	526.86	352.74	232.27	243.65	381.42	526.10	553.15	557.94	(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]	966.36	937.18	849.96	704.35	535.60	353.36	232.32	243.76	385.39	595.88	794.43	959.36	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	284.99	198.13	127.79	39.04	6.50	0.00	0.00	0.00	0.00	51.91	173.72	298.66	

∑(98)1...5, 10...12 = 1180.75 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 17.14 (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 (%) — 92.90 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	306.77	213.27	137.56	42.02	7.00	0.00	0.00	0.00	0.00	55.88	187.00	321.49	

∑(211)1...5, 10...12 = 1270.99 (211)

Water heating

Efficiency of water heater

88.92	88.78	88.47	87.87	87.42	87.30	87.30	87.30	87.30	87.99	88.68	88.97	(217)

Water heating fuel, kWh/month

186.90	164.51	172.23	153.83	150.35	132.84	125.98	140.45	140.90	159.38	169.23	181.77	

∑(219a)1...12 = 1878.37 (219)

Annual totals

Space heating fuel - main system 1 — 1270.99

Water heating fuel — 1878.37

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

mechanical ventilation fans - balanced, extract or positive input from outside — 131.34 (230a)

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		206.34	(231)
Electricity for lighting (Appendix L)		306.57	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	3662.27	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	1270.99	x	3.48	x 0.01 =	44.23	(240)
Water heating	1878.37	x	3.48	x 0.01 =	65.37	(247)
Pumps and fans	206.34	x	13.19	x 0.01 =	27.22	(249)
Electricity for lighting	306.57	x	13.19	x 0.01 =	40.44	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		297.25	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.10	(257)
SAP value	84.71	
SAP rating (section 13)	85	(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	1270.99	x	0.216	=	274.53	(261)
Water heating	1878.37	x	0.216	=	405.73	(264)
Space and water heating			(261) + (262) + (263) + (264) =		680.26	(265)
Pumps and fans	206.34	x	0.519	=	107.09	(267)
Electricity for lighting	306.57	x	0.519	=	159.11	(268)
Total CO_2, kg/year				(265)...(271) =	946.46	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	13.74	(273)
EI value					88.87	
EI rating (section 14)					89	(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	1270.99	x	1.22	=	1550.61	(261)
Water heating	1878.37	x	1.22	=	2291.61	(264)
Space and water heating			(261) + (262) + (263) + (264) =		3842.23	(265)
Pumps and fans	206.34	x	3.07	=	633.47	(267)
Electricity for lighting	306.57	x	3.07	=	941.16	(268)
Primary energy kWh/year					5416.85	(272)
Dwelling primary energy rate kWh/m2/year					78.62	(273)

SAP 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		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		77.35 (23c)

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

0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(24a)

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

0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(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	1.40	=	2.94			(26)
Window			18.32	x	1.24	=	22.64			(27)
External wall			89.58	x	0.20	=	17.92			(29a)
Total area of external elements ∑A, m²			110.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	43.49 (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		13.19 (36)
Total fabric heat loss	(33) + (36) =	56.69 (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)	23.30	23.03	22.76	21.42	21.15	19.80	19.80	19.53	20.34	21.15	21.68	22.22	(38)
Heat transfer coefficient, W/K (37)m + (38)m	79.99	79.72	79.45	78.10	77.83	76.49	76.49	76.22	77.03	77.83	78.37	78.91	

Average = ∑(39)1...12/12 = 78.04 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	0.78	0.78	0.78	0.76	0.76	0.75	0.75	0.74	0.75	0.76	0.77	0.77	

Average = ∑(40)1...12/12 = 0.76 (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)

	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)

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	24.45	22.08	24.44	23.64	24.42	23.63	24.41	24.42	23.63	24.43	23.65	24.44	(61)
Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m	187.19	164.41	171.32	151.69	147.29	129.65	122.66	137.16	137.72	157.39	168.79	182.05	(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

187.19	164.41	171.32	151.69	147.29	129.65	122.66	137.16	137.72	157.39	168.79	182.05

∑(64)1...12 = 1857.34 (64)

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

60.22	52.85	54.95	48.49	46.96	41.16	38.77	43.59	43.84	50.32	54.17	58.52

(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	165.64	165.64	165.64	165.64	165.64	165.64	165.64	165.64	165.64	165.64	165.64	165.64	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	59.28	52.65	42.82	32.42	24.23	20.46	22.10	28.73	38.56	48.97	57.15	60.93	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	388.28	392.31	382.16	360.54	333.26	307.61	290.48	286.45	296.61	318.22	345.51	371.15	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	54.32	54.32	54.32	54.32	54.32	54.32	54.32	54.32	54.32	54.32	54.32	54.32	(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)	80.95	78.64	73.85	67.34	63.12	57.17	52.11	58.59	60.89	67.63	75.24	78.65	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	641.05	636.14	611.37	572.84	533.15	497.78	477.24	486.31	508.60	547.36	590.43	623.27	(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

779.69	882.19	974.31	1066.61	1126.42	1104.45	1054.77	986.91	916.43	826.38	758.30	740.75

(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	0.98	0.93	0.82	0.63	0.44	0.32	0.36	0.57	0.87	0.98	0.99	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.45	20.58	20.76	20.93	20.99	21.00	21.00	21.00	21.00	20.91	20.65	20.42	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	20.27	20.27	20.27	20.29	20.29	20.30	20.30	20.30	20.29	20.29	20.28	20.28	(88)
Utilisation factor for gains for rest of dwelling n2,m	0.99	0.97	0.92	0.78	0.59	0.39	0.27	0.30	0.52	0.83	0.97	0.99	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)	19.54	19.74	19.99	20.21	20.28	20.30	20.30	20.30	20.29	20.19	19.85	19.51	(90)

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

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

19.91	20.08	20.30	20.50	20.57	20.58	20.58	20.59	20.58	20.48	20.18	19.88 (92)

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

19.76	19.93	20.15	20.35	20.42	20.43	20.43	20.44	20.43	20.33	20.03	19.73 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.98	0.97	0.92	0.79	0.60	0.40	0.28	0.31	0.53	0.84	0.96	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	767.56	851.80	892.63	839.54	670.92	445.80	293.23	307.52	484.89	690.16	730.89	731.98	(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]	1236.36	1198.32	1084.68	894.34	678.46	446.19	293.26	307.57	487.39	757.59	1013.13	1225.23	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	348.79	232.86	142.88	39.46	5.61	0.00	0.00	0.00	0.00	50.16	203.21	366.98	

∑(98)1...5, 10...12 = 1389.94 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 13.57 (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 (%) — 92.90 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	375.44	250.65	153.80	42.47	6.03	0.00	0.00	0.00	0.00	54.00	218.74	395.03	

∑(211)1...5, 10...12 = 1496.17 (211)

Water heating

Efficiency of water heater	88.97	88.81	88.46	87.82	87.39	87.30	87.30	87.30	87.30	87.91	88.70	89.02	(217)
Water heating fuel, kWh/month	210.39	185.14	193.66	172.72	168.54	148.51	140.50	157.11	157.76	179.03	190.29	204.51	

∑(219a)1...12 = 2108.16 (219)

Annual totals

Space heating fuel - main system 1 — 1496.17

Water heating fuel — 2108.16

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

mechanical ventilation fans - balanced, extract or positive input from outside — 195.20 (230a)

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 — 270.20 (231)

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

Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	4293.28	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	1496.17	x	3.48	x 0.01 =	52.07	(240)
Water heating	2108.16	x	3.48	x 0.01 =	73.36	(247)
Pumps and fans	270.20	x	13.19	x 0.01 =	35.64	(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) =	336.30	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	0.96	(257)
SAP value	86.63	
SAP rating (section 13)	87	(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	1496.17	x	0.216	=	323.17	(261)
Water heating	2108.16	x	0.216	=	455.36	(264)
Space and water heating				(261) + (262) + (263) + (264) =	778.54	(265)
Pumps and fans	270.20	x	0.519	=	140.23	(267)
Electricity for lighting	418.75	x	0.519	=	217.33	(268)
Total CO_2, kg/year				(265)...(271) =	1136.10	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	11.09	(273)
EI value					89.67	
EI rating (section 14)					90	(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	1496.17	x	1.22	=	1825.33	(261)
Water heating	2108.16	x	1.22	=	2571.96	(264)
Space and water heating				(261) + (262) + (263) + (264) =	4397.29	(265)
Pumps and fans	270.20	x	3.07	=	829.51	(267)
Electricity for lighting	418.75	x	3.07	=	1285.55	(268)
Primary energy kWh/year					6512.35	(272)
Dwelling primary energy rate kWh/m2/year					63.60	(273)

SAP 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		0	x 10 =	0	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	77.35	(23c)

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

	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(24a)

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

	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(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	1.40	=	2.94			(26)
Window			12.10	x	1.24	=	14.95			(27)
External wall			88.80	x	0.20	=	17.76			(29a)
Total area of external elements ∑A, m²			103.00							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	35.65 (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		10.67 (36)
Total fabric heat loss	(33) + (36) =	46.33 (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)	18.00	17.79	17.58	16.54	16.33	15.29	15.29	15.09	15.71	16.33	16.75	17.17	(38)
Heat transfer coefficient, W/K (37)m + (38)m	64.32	64.12	63.91	62.87	62.66	61.62	61.62	61.41	62.04	62.66	63.08	63.49	

Average = ∑(39)1...12/12 = 62.82 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	0.81	0.81	0.81	0.79	0.79	0.78	0.78	0.78	0.78	0.79	0.80	0.80	

Average = ∑(40)1...12/12 = 0.79 (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	2.45 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	92.28 (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)	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)

	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)	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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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	24.44	22.07	24.43	23.63	24.41	23.62	24.40	24.41	23.63	24.42	23.64	24.44	(61)
Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m	174.98	153.73	160.29	142.08	138.07	121.69	115.28	128.70	129.16	147.41	157.89	170.22	(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

174.98	153.73	160.29	142.08	138.07	121.69	115.28	128.70	129.16	147.41	157.89	170.22

∑(64)1...12 = 1739.50 (64)

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

56.16	49.29	51.28	45.29	43.89	38.51	36.32	40.78	41.00	47.00	50.55	54.58

(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	146.73	146.73	146.73	146.73	146.73	146.73	146.73	146.73	146.73	146.73	146.73	146.73	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	51.05	45.34	36.87	27.91	20.87	17.62	19.04	24.74	33.21	42.17	49.22	52.47	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	324.70	328.07	319.58	301.50	278.69	257.24	242.91	239.54	248.04	266.11	288.93	310.37	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	52.12	52.12	52.12	52.12	52.12	52.12	52.12	52.12	52.12	52.12	52.12	52.12	(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)	75.49	73.36	68.93	62.91	59.00	53.49	48.81	54.81	56.94	63.17	70.21	73.36	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	555.27	550.79	529.41	496.35	462.58	432.38	414.79	423.13	442.21	475.48	512.38	540.23	(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

653.59	723.82	780.88	832.62	861.75	838.57	802.28	762.17	722.81	670.68	631.16	623.73

(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	0.97	0.93	0.83	0.66	0.47	0.34	0.37	0.59	0.86	0.97	0.99	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.46	20.58	20.75	20.91	20.98	21.00	21.00	21.00	20.99	20.90	20.66	20.43	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	20.24	20.24	20.25	20.26	20.26	20.27	20.27	20.27	20.27	20.26	20.26	20.25	(88)
Utilisation factor for gains for rest of dwelling n2,m	0.98	0.96	0.92	0.80	0.61	0.42	0.28	0.31	0.53	0.82	0.96	0.99	(89)

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

	19.53	19.71	19.94	20.16	20.25	20.27	20.27	20.27	20.26	20.16	19.84	19.50 (90)

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

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

	19.93	20.09	20.29	20.49	20.57	20.59	20.59	20.59	20.58	20.49	20.20	19.91 (92)

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

	19.78	19.94	20.14	20.34	20.42	20.44	20.44	20.44	20.43	20.34	20.05	19.76 (93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.98	0.96	0.91	0.80	0.62	0.43	0.29	0.33	0.54	0.83	0.95	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m	639.65	694.28	713.24	666.31	537.12	359.17	236.54	248.06	390.11	555.07	602.50	613.19	(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]	996.02	964.43	872.00	719.17	546.20	359.75	236.57	248.13	392.79	610.04	816.65	987.67	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	265.14	181.54	118.12	38.06	6.75	0.00	0.00	0.00	0.00	40.90	154.19	278.62	

∑(98)1...5, 10...12 = 1083.33 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 13.70 (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 (%) — 92.90 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	285.40	195.42	127.15	40.97	7.27	0.00	0.00	0.00	0.00	44.03	165.97	299.91	

∑(211)1...5, 10...12 = 1166.12 (211)

Water heating

Efficiency of water heater

	88.85	88.69	88.38	87.84	87.42	87.30	87.30	87.30	87.30	87.85	88.57	88.90 (217)

Water heating fuel, kWh/month

	196.94	173.34	181.36	161.75	157.94	139.40	132.05	147.42	147.95	167.79	178.28	191.49

∑(219a)1...5, 10...12 = 1975.70 (219)

Annual totals

Space heating fuel - main system 1 — 1166.12

Water heating fuel — 1975.70

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

mechanical ventilation fans - balanced, extract or positive input from outside	150.78	(230a)
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 — 225.78 (231)

Electricity for lighting (Appendix L)		360.60	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	3728.20	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	1166.12	x	3.48	x 0.01 =	40.58	(240)
Water heating	1975.70	x	3.48	x 0.01 =	68.75	(247)
Pumps and fans	225.78	x	13.19	x 0.01 =	29.78	(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) =		306.68	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.04	(257)
SAP value	85.52	
SAP rating (section 13)	86	(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	1166.12	x	0.216	=	251.88	(261)
Water heating	1975.70	x	0.216	=	426.75	(264)
Space and water heating			(261) + (262) + (263) + (264) =		678.63	(265)
Pumps and fans	225.78	x	0.519	=	117.18	(267)
Electricity for lighting	360.60	x	0.519	=	187.15	(268)
Total CO_2, kg/year			(265)...(271) =		982.97	(272)
Dwelling CO_2 emission rate			(272) ÷ (4) =		12.43	(273)
EI value					89.39	
EI rating (section 14)					89	(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	1166.12	x	1.22	=	1422.67	(261)
Water heating	1975.70	x	1.22	=	2410.35	(264)
Space and water heating			(261) + (262) + (263) + (264) =		3833.02	(265)
Pumps and fans	225.78	x	3.07	=	693.16	(267)
Electricity for lighting	360.60	x	3.07	=	1107.04	(268)
Primary energy kWh/year					5633.21	(272)
Dwelling primary energy rate kWh/m2/year					71.22	(273)

SAP 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		0	x 10 =	0	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	77.35	(23c)

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

	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(24a)

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

	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(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	1.40	=	2.94			(26)
Window			14.86	x	1.24	=	18.36			(27)
External wall			66.04	x	0.20	=	13.21			(29a)
Roof			57.64	x	0.15	=	8.65			(30)
Total area of external elements ∑A, m²			140.64							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	43.16 (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		15.85 (36)
Total fabric heat loss	(33) + (36) =	59.01 (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	
11.92	11.79	11.65	10.96	10.82	10.13	10.13	9.99	10.41	10.82	11.10	11.37	(38)

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

70.93	70.79	70.65	69.97	69.83	69.14	69.14	69.00	69.41	69.83	70.10	70.38	

Average = ∑(39)1...12/12 = 69.93 (39)

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

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

Average = ∑(40)1...12/12 = 1.33 (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

24.42	22.05	24.41	23.61	24.40	23.61	24.39	24.39	23.61	24.40	23.62	24.41	(61)

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

148.43	130.51	136.33	121.19	118.02	104.40	99.26	110.30	110.55	125.72	134.22	144.51	(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

148.43	130.51	136.33	121.19	118.02	104.40	99.26	110.30	110.55	125.72	134.22	144.51	

∑(64)1...12 = 1483.43 (64)

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

47.34	41.58	43.32	38.35	37.23	32.76	30.99	34.66	34.81	39.79	42.68	46.04	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	105.65	105.65	105.65	105.65	105.65	105.65	105.65	105.65	105.65	105.65	105.65	105.65	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	34.20	30.38	24.71	18.70	13.98	11.80	12.75	16.58	22.25	28.25	32.98	35.15	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	229.05	231.43	225.44	212.69	196.59	181.46	171.36	168.98	174.97	187.72	203.82	218.94	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	47.33	47.33	47.33	47.33	47.33	47.33	47.33	47.33	47.33	47.33	47.33	47.33	(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)	63.63	61.87	58.22	53.26	50.04	45.51	41.65	46.59	48.35	53.48	59.27	61.88	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	412.42	409.22	393.91	370.19	346.16	324.32	311.31	317.69	331.11	355.00	381.61	401.52	(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	7.26	x	36.79	x 0.9 x	0.63	x	0.70	=	81.64	(79)
NorthEast	0.77	x	7.60	x	11.28	x 0.9 x	0.63	x	0.70	=	26.21	(75)

Solar gains in watts ∑(74)m...(82)m

107.84	192.40	286.37	393.58	476.22	488.34	464.33	400.30	323.13	218.88	130.76	91.27	(83)

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

520.26	601.62	680.28	763.78	822.38	812.65	775.64	718.00	654.23	573.87	512.37	492.78	(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	0.97	0.94	0.86	0.71	0.53	0.39	0.44	0.67	0.90	0.97	0.99	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.84	20.04	20.33	20.67	20.89	20.98	21.00	20.99	20.93	20.64	20.17	19.80	(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	0.98	0.96	0.92	0.82	0.64	0.44	0.29	0.33	0.58	0.86	0.96	0.98	(89)

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

18.31	18.60	19.01	19.46	19.72	19.81	19.82	19.82	19.78	19.44	18.80	18.25	(90)

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

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

19.01	19.26	19.62	20.02	20.26	20.35	20.37	20.36	20.31	19.99	19.44	18.96	(92)

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

18.86	19.11	19.47	19.87	20.11	20.20	20.22	20.21	20.16	19.84	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	0.98	0.96	0.91	0.82	0.66	0.47	0.32	0.36	0.61	0.86	0.96	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m	507.50	575.17	621.94	625.50	542.93	379.89	248.91	261.37	398.06	494.52	490.02	482.87	(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]	1033.07	1006.16	916.37	767.29	587.09	387.18	249.94	263.17	420.70	645.18	854.23	1028.58	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	391.02	289.62	219.06	102.08	32.86	0.00	0.00	0.00	0.00	112.09	262.23	406.01	

∑(98)1...5, 10...12 = 1814.98 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 34.64 (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 (%) — 92.90 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	420.91	311.76	235.80	109.88	35.37	0.00	0.00	0.00	0.00	120.66	282.27	437.04	

∑(211)1...5, 10...12 = 1953.69 (211)

Water heating

Efficiency of water heater

89.17	89.08	88.88	88.47	87.85	87.30	87.30	87.30	87.30	88.51	89.00	89.20	(217)

Water heating fuel, kWh/month

166.45	146.52	153.38	136.98	134.34	119.59	113.69	126.35	126.63	142.04	150.80	162.00	

∑(219a)1...12 = 1678.78 (219)

Annual totals

Space heating fuel - main system 1 — 1953.69

Water heating fuel — 1678.78

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

mechanical ventilation fans - balanced, extract or positive input from outside — 83.91 (230a)

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 — 158.91 (231)

Electricity for lighting (Appendix L)		241.62	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	4032.99	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	1953.69	x	3.48	x 0.01 =	67.99	(240)
Water heating	1678.78	x	3.48	x 0.01 =	58.42	(247)
Pumps and fans	158.91	x	13.19	x 0.01 =	20.96	(249)
Electricity for lighting	241.62	x	13.19	x 0.01 =	31.87	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		299.24	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.29	(257)
SAP value	82.00	
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	1953.69	x	0.216	=	422.00	(261)
Water heating	1678.78	x	0.216	=	362.62	(264)
Space and water heating			(261) + (262) + (263) + (264) =		784.61	(265)
Pumps and fans	158.91	x	0.519	=	82.47	(267)
Electricity for lighting	241.62	x	0.519	=	125.40	(268)
Total CO_2, kg/year			(265)...(271) =		992.48	(272)
Dwelling CO_2 emission rate			(272) ÷ (4) =		18.94	(273)
EI value					86.35	
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	1953.69	x	1.22	=	2383.50	(261)
Water heating	1678.78	x	1.22	=	2048.11	(264)
Space and water heating			(261) + (262) + (263) + (264) =		4431.61	(265)
Pumps and fans	158.91	x	3.07	=	487.84	(267)
Electricity for lighting	241.62	x	3.07	=	741.76	(268)
Primary energy kWh/year					5661.22	(272)
Dwelling primary energy rate kWh/m2/year					108.04	(273)

SAP 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		0	x 10 =	0	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	77.35	(23c)

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

	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(24a)

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

	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(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	1.40	=	2.94			(26)
Window			14.86	x	1.24	=	18.36			(27)
External wall			52.29	x	0.20	=	10.46			(29a)
Party wall			13.75	x	0.00	=	0.00			(32)
Roof			57.64	x	0.15	=	8.65			(30)
Total area of external elements ∑A, m²			126.89							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	40.41 (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		13.78 (36)
Total fabric heat loss	(33) + (36) =	54.18 (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)	11.92	11.79	11.65	10.96	10.82	10.13	10.13	9.99	10.41	10.82	11.10	11.37	(38)
Heat transfer coefficient, W/K (37)m + (38)m	66.11	65.97	65.83	65.14	65.00	64.31	64.31	64.18	64.59	65.00	65.28	65.55	

Average = ∑(39)1...12/12 = 65.11 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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	1.25	1.25	

Average = ∑(40)1...12/12 = 1.24 (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	1.76 (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)

	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)	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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
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	24.42	22.05	24.41	23.61	24.40	23.61	24.39	24.39	23.61	24.40	23.62	24.41	(61)
Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m	148.43	130.51	136.33	121.19	118.02	104.40	99.26	110.30	110.55	125.72	134.22	144.51	(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

	148.43	130.51	136.33	121.19	118.02	104.40	99.26	110.30	110.55	125.72	134.22	144.51

∑(64)1...12 = 1483.43 (64)

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

	47.34	41.58	43.32	38.35	37.23	32.76	30.99	34.66	34.81	39.79	42.68	46.04 (65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	105.65	105.65	105.65	105.65	105.65	105.65	105.65	105.65	105.65	105.65	105.65	105.65	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	34.20	30.38	24.71	18.70	13.98	11.80	12.75	16.58	22.25	28.25	32.98	35.15	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	229.05	231.43	225.44	212.69	196.59	181.46	171.36	168.98	174.97	187.72	203.82	218.94	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	47.33	47.33	47.33	47.33	47.33	47.33	47.33	47.33	47.33	47.33	47.33	47.33	(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)	63.63	61.87	58.22	53.26	50.04	45.51	41.65	46.59	48.35	53.48	59.27	61.88	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	412.42	409.22	393.91	370.19	346.16	324.32	311.31	317.69	331.11	355.00	381.61	401.52	(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	7.26	x	36.79	x 0.9 x	0.63	x	0.70	=	81.64	(79)
NorthEast	0.77	x	7.60	x	11.28	x 0.9 x	0.63	x	0.70	=	26.21	(75)

Solar gains in watts ∑(74)m...(82)m

	107.84	192.40	286.37	393.58	476.22	488.34	464.33	400.30	323.13	218.88	130.76	91.27 (83)

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

	520.26	601.62	680.28	763.78	822.38	812.65	775.64	718.00	654.23	573.87	512.37	492.78 (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)	0.98	0.97	0.93	0.84	0.68	0.50	0.36	0.41	0.64	0.89	0.97	0.99	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.96	20.16	20.44	20.74	20.92	20.99	21.00	21.00	20.95	20.70	20.28	19.92	(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	0.98	0.96	0.91	0.80	0.62	0.42	0.27	0.31	0.55	0.85	0.96	0.98	(89)

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

18.53	18.82	19.21	19.61	19.82	19.89	19.90	19.90	19.86	19.58	19.00	18.48

(90)

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

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

19.19	19.44	19.77	20.13	20.33	20.40	20.41	20.41	20.37	20.10	19.59	19.14

(92)

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

19.04	19.29	19.62	19.98	20.18	20.25	20.26	20.26	20.22	19.95	19.44	18.99

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.97	0.95	0.91	0.80	0.63	0.44	0.30	0.34	0.58	0.85	0.95	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m	506.95	573.37	616.75	611.96	520.70	358.78	234.54	246.42	380.08	486.86	488.49	482.51	(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]	974.55	948.97	863.91	721.87	551.12	363.12	235.09	247.42	395.13	607.80	805.44	969.78	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	347.89	252.40	183.88	79.13	22.63	0.00	0.00	0.00	0.00	89.98	228.21	362.53	

∑(98)1...5, 10...12 = 1566.67 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 29.90 (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 (%) — 92.90 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	374.48	271.70	197.94	85.18	24.36	0.00	0.00	0.00	0.00	96.86	245.65	390.24	

∑(211)1...5, 10...12 = 1686.40 (211)

Water heating

Efficiency of water heater	89.11	89.00	88.77	88.31	87.71	87.30	87.30	87.30	87.30	88.37	88.92	89.14	(217)
Water heating fuel, kWh/month	166.57	146.65	153.57	137.23	134.56	119.59	113.69	126.35	126.63	142.27	150.94	162.11	

∑(219a)1...12 = 1680.17 (219)

Annual totals

Space heating fuel - main system 1 — 1686.40

Water heating fuel — 1680.17

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

mechanical ventilation fans - balanced, extract or positive input from outside — 83.91 (230a)

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		158.91	(231)
Electricity for lighting (Appendix L)		241.62	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	3767.09	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	1686.40	x	3.48	x 0.01 =	58.69	(240)
Water heating	1680.17	x	3.48	x 0.01 =	58.47	(247)
Pumps and fans	158.91	x	13.19	x 0.01 =	20.96	(249)
Electricity for lighting	241.62	x	13.19	x 0.01 =	31.87	(250)
Additional standing charges					120.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	289.99	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.25	(257)
SAP value	82.56	
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	1686.40	x	0.216	=	364.26	(261)
Water heating	1680.17	x	0.216	=	362.92	(264)
Space and water heating				(261) + (262) + (263) + (264) =	727.18	(265)
Pumps and fans	158.91	x	0.519	=	82.47	(267)
Electricity for lighting	241.62	x	0.519	=	125.40	(268)
Total CO_2, kg/year				(265)...(271) =	935.05	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	17.84	(273)
EI value					87.14	
EI rating (section 14)					87	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	1686.40	x	1.22	=	2057.41	(261)
Water heating	1680.17	x	1.22	=	2049.80	(264)
Space and water heating				(261) + (262) + (263) + (264) =	4107.21	(265)
Pumps and fans	158.91	x	3.07	=	487.84	(267)
Electricity for lighting	241.62	x	3.07	=	741.76	(268)
Primary energy kWh/year					5336.81	(272)
Dwelling primary energy rate kWh/m2/year					101.85	(273)

SAP 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		0	x 10 =	0	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	77.35	(23c)

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

	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(24a)

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

	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(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	1.40	=	2.94			(26)
Window			6.22	x	1.24	=	7.69			(27)
External wall			40.93	x	0.20	=	8.19			(29a)
Party wall			13.75	x	0.00	=	0.00			(32)
Roof			40.70	x	0.15	=	6.11			(30)
Total area of external elements ∑A, m²			89.95							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	24.92 (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		8.26 (36)
Total fabric heat loss	(33) + (36) =	33.18 (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	
8.42	8.32	8.22	7.74	7.64	7.15	7.15	7.06	7.35	7.64	7.84	8.03	(38)

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

41.59	41.50	41.40	40.91	40.82	40.33	40.33	40.23	40.52	40.82	41.01	41.21	

Average = ∑(39)1...12/12 = 40.89 (39)

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

1.12	1.12	1.12	1.11	1.10	1.09	1.09	1.09	1.10	1.10	1.11	1.11	

Average = ∑(40)1...12/12 = 1.11 (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)

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	
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

24.40	22.04	24.40	23.61	24.39	23.60	24.38	24.39	23.60	24.39	23.61	24.40	(61)

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

131.68	115.87	121.22	108.02	105.39	93.49	89.15	98.71	98.81	112.04	119.29	128.30	(62)

Solar DHW input calculated using Appendix G or Appendix H

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

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

	131.68	115.87	121.22	108.02	105.39	93.49	89.15	98.71	98.81	112.04	119.29	128.30

∑(64)1...12 = 1321.96 (64)

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

	41.77	36.71	38.29	33.97	33.03	29.14	27.63	30.81	30.91	35.24	37.71	40.65 (65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	79.75	79.75	79.75	79.75	79.75	79.75	79.75	79.75	79.75	79.75	79.75	79.75	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	26.27	23.34	18.98	14.37	10.74	9.07	9.80	12.74	17.09	21.70	25.33	27.00	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	170.25	172.02	167.57	158.09	146.13	134.88	127.37	125.60	130.05	139.53	151.50	162.74	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	44.30	44.30	44.30	44.30	44.30	44.30	44.30	44.30	44.30	44.30	44.30	44.30	(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)	56.14	54.62	51.47	47.18	44.39	40.47	37.14	41.41	42.93	47.37	52.38	54.63	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	326.56	323.87	311.90	293.52	275.14	258.30	248.19	253.63	263.96	282.49	303.09	318.26	(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

	396.50	443.00	474.91	495.50	501.37	482.90	464.72	452.07	440.46	414.16	386.87	378.12 (84)

7. Mean internal temperature (heating season)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	0.97	0.96	0.92	0.84	0.70	0.53	0.38	0.41	0.61	0.85	0.95	0.98	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.21	20.38	20.58	20.80	20.93	20.99	21.00	21.00	20.97	20.81	20.48	20.18	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	19.98	19.98	19.99	20.00	20.00	20.01	20.01	20.01	20.00	20.00	19.99	19.99	(88)
Utilisation factor for gains for rest of dwelling n2,m	0.97	0.94	0.90	0.80	0.64	0.45	0.30	0.32	0.53	0.80	0.94	0.97	(89)

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

18.98	19.21	19.49	19.78	19.94	20.00	20.01	20.01	19.99	19.81	19.37	18.93

(90)

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

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

19.63	19.82	20.06	20.32	20.46	20.52	20.53	20.53	20.51	20.34	19.96	19.59

(92)

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

19.48	19.67	19.91	20.17	20.31	20.37	20.38	20.38	20.36	20.19	19.81	19.44

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.96	0.94	0.89	0.81	0.66	0.48	0.33	0.35	0.56	0.81	0.93	0.97	(94)
Useful gains, ηmGm, W (94)m x (84)m	382.02	416.10	425.03	399.65	332.87	230.13	152.15	159.70	247.38	337.12	361.53	366.61	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	631.39	613.01	555.37	460.89	351.54	232.77	152.45	160.14	253.58	391.37	521.18	627.91	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	185.53	132.33	96.97	44.10	13.89	0.00	0.00	0.00	0.00	40.36	114.94	194.41	

∑(98)1...5, 10...12 = 822.52 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 22.23 (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 (%) — 92.90 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	199.71	142.44	104.38	47.47	14.95	0.00	0.00	0.00	0.00	43.45	123.73	209.26	

∑(211)1...5, 10...12 = 885.38 (211)

Water heating

Efficiency of water heater

88.80	88.67	88.44	88.04	87.60	87.30	87.30	87.30	87.30	87.97	88.56	88.85

(217)

Water heating fuel, kWh/month

148.29	130.68	137.07	122.69	120.31	107.09	102.12	113.07	113.19	127.36	134.70	144.40

∑(219a)1...12 = 1500.97 (219)

Annual totals

Space heating fuel - main system 1 — 885.38

Water heating fuel — 1500.97

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

mechanical ventilation fans - balanced, extract or positive input from outside	59.25	(230a)
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		134.25	(231)
Electricity for lighting (Appendix L)		185.61	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	2706.20	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	885.38	x	3.48	x 0.01 =	30.81	(240)
Water heating	1500.97	x	3.48	x 0.01 =	52.23	(247)
Pumps and fans	134.25	x	13.19	x 0.01 =	17.71	(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) =		245.23	(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	82.48	
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	885.38	x	0.216	=	191.24	(261)
Water heating	1500.97	x	0.216	=	324.21	(264)
Space and water heating			(261) + (262) + (263) + (264) =		515.45	(265)
Pumps and fans	134.25	x	0.519	=	69.67	(267)
Electricity for lighting	185.61	x	0.519	=	96.33	(268)
Total CO_2, kg/year			(265)...(271) =		681.45	(272)
Dwelling CO_2 emission rate			(272) ÷ (4) =		18.42	(273)
EI value					88.86	
EI rating (section 14)					89	(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	885.38	x	1.22	=	1080.17	(261)
Water heating	1500.97	x	1.22	=	1831.18	(264)
Space and water heating			(261) + (262) + (263) + (264) =		2911.34	(265)
Pumps and fans	134.25	x	3.07	=	412.14	(267)
Electricity for lighting	185.61	x	3.07	=	569.81	(268)
Primary energy kWh/year					3893.29	(272)
Dwelling primary energy rate kWh/m2/year					105.22	(273)

SAP 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		0	x 10 =	0 (7a)
Number of passive vents		0	x 10 =	0 (7b)
Number of flueless gas fires		0	x 40 =	0 (7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00 (8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15 (18)
Number of sides on which the dwelling is sheltered		2 (19)
Shelter factor	1 - [0.075 x (19)] =	0.85 (20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.13 (21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system		0.50 (23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h		77.35 (23c)

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

0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(24a)

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

0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(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	1.40	=	2.94			(26)
Window			8.32	x	1.24	=	10.28			(27)
External wall			43.83	x	0.20	=	8.77			(29a)
Party wall			17.75	x	0.00	=	0.00			(32)
Roof			50.38	x	0.15	=	7.56			(30)
Total area of external elements ∑A, m²			104.63							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	29.54 (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		9.63 (36)
Total fabric heat loss	(33) + (36) =	39.18 (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)	10.42	10.30	10.18	9.58	9.46	8.86	8.86	8.74	9.10	9.46	9.70	9.94	(38)
Heat transfer coefficient, W/K (37)m + (38)m	49.60	49.48	49.36	48.76	48.64	48.03	48.03	47.91	48.28	48.64	48.88	49.12	

Average = ∑(39)1...12/12 = 48.73 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.08	1.08	1.08	1.06	1.06	1.05	1.05	1.05	1.05	1.06	1.07	1.07	

Average = ∑(40)1...12/12 = 1.06 (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	1.57 (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	24.41	22.04	24.40	23.61	24.39	23.60	24.39	24.39	23.61	24.40	23.62	24.41	(61)
Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m	140.93	123.96	129.57	115.29	112.37	99.52	94.73	105.11	105.29	119.60	127.53	137.25	(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

	140.93	123.96	129.57	115.29	112.37	99.52	94.73	105.11	105.29	119.60	127.53	137.25

∑(64)1...12 = 1411.15 (64)

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

	44.85	39.40	41.07	36.39	35.35	31.14	29.49	32.94	33.06	37.75	40.46	43.62 (65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	94.06	94.06	94.06	94.06	94.06	94.06	94.06	94.06	94.06	94.06	94.06	94.06	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	30.99	27.53	22.39	16.95	12.67	10.70	11.56	15.02	20.16	25.60	29.88	31.85	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	203.50	205.61	200.29	188.96	174.66	161.22	152.24	150.13	155.45	166.78	181.08	194.52	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	45.97	45.97	45.97	45.97	45.97	45.97	45.97	45.97	45.97	45.97	45.97	45.97	(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)	60.28	58.63	55.20	50.54	47.51	43.25	39.63	44.27	45.92	50.74	56.19	58.63	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	375.09	372.09	358.20	336.77	315.17	295.49	283.76	289.75	301.86	323.45	347.48	365.33	(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

	433.41	476.60	514.95	554.04	579.56	567.23	541.89	511.31	479.34	442.66	418.27	414.63 (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)	0.98	0.97	0.94	0.87	0.72	0.53	0.39	0.43	0.66	0.89	0.97	0.99	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.17	20.31	20.52	20.77	20.93	20.99	21.00	21.00	20.97	20.77	20.43	20.13	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	20.01	20.02	20.02	20.03	20.03	20.04	20.04	20.05	20.04	20.03	20.03	20.02	(88)
Utilisation factor for gains for rest of dwelling n2,m	0.98	0.96	0.93	0.83	0.66	0.46	0.30	0.34	0.58	0.86	0.96	0.98	(89)

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

18.94	19.14	19.44	19.78	19.97	20.04	20.04	20.04	20.02	19.79	19.32	18.90

(90)

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

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

19.58	19.75	20.01	20.30	20.47	20.54	20.54	20.54	20.51	20.30	19.90	19.55

(92)

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

19.43	19.60	19.86	20.15	20.32	20.39	20.39	20.39	20.36	20.15	19.75	19.40

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.98	0.96	0.93	0.84	0.68	0.48	0.34	0.37	0.61	0.86	0.96	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m	422.96	457.69	476.35	464.45	395.96	274.90	181.88	190.77	292.58	381.77	399.95	406.33	(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]	750.46	727.44	659.37	548.60	419.44	277.91	182.21	191.35	302.40	464.65	618.49	746.40	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	243.66	181.27	136.17	60.58	17.47	0.00	0.00	0.00	0.00	61.66	157.35	253.01	

∑(98)1...5, 10...12 = 1111.18 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 24.26 (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 (%) — 92.90 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	262.28	195.13	146.57	65.21	18.81	0.00	0.00	0.00	0.00	66.37	169.38	272.34	

∑(211)1...5, 10...12 = 1196.10 (211)

Water heating

Efficiency of water heater

88.93	88.83	88.61	88.18	87.64	87.30	87.30	87.30	87.30	88.17	88.72	88.97

(217)

Water heating fuel, kWh/month

158.48	139.55	146.21	130.75	128.21	113.99	108.51	120.40	120.61	135.65	143.75	154.27

∑(219a)1...12 = 1600.39 (219)

Annual totals

Space heating fuel - main system 1 — 1196.10

Water heating fuel — 1600.39

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

mechanical ventilation fans - balanced, extract or positive input from outside	73.34	(230a)
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		148.34	(231)
Electricity for lighting (Appendix L)		218.93	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	3163.76	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	1196.10	x	3.48	x 0.01 =	41.62	(240)
Water heating	1600.39	x	3.48	x 0.01 =	55.69	(247)
Pumps and fans	148.34	x	13.19	x 0.01 =	19.57	(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) =		265.76	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.23	(257)
SAP value	82.85	
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	1196.10	x	0.216	=	258.36	(261)
Water heating	1600.39	x	0.216	=	345.68	(264)
Space and water heating			(261) + (262) + (263) + (264) =		604.04	(265)
Pumps and fans	148.34	x	0.519	=	76.99	(267)
Electricity for lighting	218.93	x	0.519	=	113.63	(268)
Total CO_2, kg/year				(265)...(271) =	794.66	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	17.35	(273)
EI value					88.27	
EI rating (section 14)					88	(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	1196.10	x	1.22	=	1459.24	(261)
Water heating	1600.39	x	1.22	=	1952.48	(264)
Space and water heating			(261) + (262) + (263) + (264) =		3411.72	(265)
Pumps and fans	148.34	x	3.07	=	455.40	(267)
Electricity for lighting	218.93	x	3.07	=	672.12	(268)
Primary energy kWh/year					4539.24	(272)
Dwelling primary energy rate kWh/m2/year					99.11	(273)

SAP 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		0	x 10 =	0	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	77.35	(23c)

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

	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(24a)

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

	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(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	1.40	=	2.94			(26)
Window			8.32	x	1.24	=	10.28			(27)
External wall			43.83	x	0.20	=	8.77			(29a)
Party wall			17.75	x	0.00	=	0.00			(32)
Roof			50.38	x	0.15	=	7.56			(30)
Total area of external elements ∑A, m²			104.63							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	29.54 (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		9.63 (36)
Total fabric heat loss	(33) + (36) =	39.18 (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)	10.42	10.30	10.18	9.58	9.46	8.86	8.86	8.74	9.10	9.46	9.70	9.94	(38)
Heat transfer coefficient, W/K (37)m + (38)m	49.60	49.48	49.36	48.76	48.64	48.03	48.03	47.91	48.28	48.64	48.88	49.12	

Average = ∑(39)1...12/12 = 48.73 (39)

Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.08	1.08	1.08	1.06	1.06	1.05	1.05	1.05	1.05	1.06	1.07	1.07	

Average = ∑(40)1...12/12 = 1.06 (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	1.57 (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	24.41	22.04	24.40	23.61	24.39	23.60	24.39	24.39	23.61	24.40	23.62	24.41	(61)
Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m	140.93	123.96	129.57	115.29	112.37	99.52	94.73	105.11	105.29	119.60	127.53	137.25	(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

	140.93	123.96	129.57	115.29	112.37	99.52	94.73	105.11	105.29	119.60	127.53	137.25

∑(64)1...12 = 1411.15 (64)

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

	44.85	39.40	41.07	36.39	35.35	31.14	29.49	32.94	33.06	37.75	40.46	43.62 (65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	94.06	94.06	94.06	94.06	94.06	94.06	94.06	94.06	94.06	94.06	94.06	94.06	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	30.99	27.53	22.39	16.95	12.67	10.70	11.56	15.02	20.16	25.60	29.88	31.85	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	203.50	205.61	200.29	188.96	174.66	161.22	152.24	150.13	155.45	166.78	181.08	194.52	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	45.97	45.97	45.97	45.97	45.97	45.97	45.97	45.97	45.97	45.97	45.97	45.97	(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)	60.28	58.63	55.20	50.54	47.51	43.25	39.63	44.27	45.92	50.74	56.19	58.63	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	375.09	372.09	358.20	336.77	315.17	295.49	283.76	289.75	301.86	323.45	347.48	365.33	(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

	433.41	476.60	514.95	554.04	579.56	567.23	541.89	511.31	479.34	442.66	418.27	414.63 (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)	0.98	0.97	0.94	0.87	0.72	0.53	0.39	0.43	0.66	0.89	0.97	0.99	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.17	20.31	20.52	20.77	20.93	20.99	21.00	21.00	20.97	20.77	20.43	20.13	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)	20.01	20.02	20.02	20.03	20.03	20.04	20.04	20.05	20.04	20.03	20.03	20.02	(88)
Utilisation factor for gains for rest of dwelling n2,m	0.98	0.96	0.93	0.83	0.66	0.46	0.30	0.34	0.58	0.86	0.96	0.98	(89)

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

18.94	19.14	19.44	19.78	19.97	20.04	20.04	20.04	20.02	19.79	19.32	18.90

(90)

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

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

19.58	19.75	20.01	20.30	20.47	20.54	20.54	20.54	20.51	20.30	19.90	19.55

(92)

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

19.43	19.60	19.86	20.15	20.32	20.39	20.39	20.39	20.36	20.15	19.75	19.40

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.98	0.96	0.93	0.84	0.68	0.48	0.34	0.37	0.61	0.86	0.96	0.98	(94)
Useful gains, ηmGm, W (94)m x (84)m	422.96	457.69	476.35	464.45	395.96	274.90	181.88	190.77	292.58	381.77	399.95	406.33	(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]	750.46	727.44	659.37	548.60	419.44	277.91	182.21	191.35	302.40	464.65	618.49	746.40	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	243.66	181.27	136.17	60.58	17.47	0.00	0.00	0.00	0.00	61.66	157.35	253.01	

∑(98)1...5, 10...12 = 1111.18 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 24.26 (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 (%) — 92.90 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	262.28	195.13	146.57	65.21	18.81	0.00	0.00	0.00	0.00	66.37	169.38	272.34	

∑(211)1...5, 10...12 = 1196.10 (211)

Water heating

Efficiency of water heater

88.93	88.83	88.61	88.18	87.64	87.30	87.30	87.30	87.30	88.17	88.72	88.97

(217)

Water heating fuel, kWh/month

158.48	139.55	146.21	130.75	128.21	113.99	108.51	120.40	120.61	135.65	143.75	154.27

∑(219a)1...12 = 1600.39 (219)

Annual totals

Space heating fuel - main system 1 — 1196.10

Water heating fuel — 1600.39

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

mechanical ventilation fans - balanced, extract or positive input from outside	73.34	(230a)
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		148.34	(231)
Electricity for lighting (Appendix L)		218.93	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	3163.76	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	1196.10	x	3.48	x 0.01 =	41.62	(240)
Water heating	1600.39	x	3.48	x 0.01 =	55.69	(247)
Pumps and fans	148.34	x	13.19	x 0.01 =	19.57	(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) =		265.76	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.23	(257)
SAP value	82.85	
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	1196.10	x	0.216	=	258.36	(261)
Water heating	1600.39	x	0.216	=	345.68	(264)
Space and water heating			(261) + (262) + (263) + (264) =		604.04	(265)
Pumps and fans	148.34	x	0.519	=	76.99	(267)
Electricity for lighting	218.93	x	0.519	=	113.63	(268)
Total CO_2, kg/year				(265)...(271) =	794.66	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	17.35	(273)
EI value					88.27	
EI rating (section 14)					88	(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	1196.10	x	1.22	=	1459.24	(261)
Water heating	1600.39	x	1.22	=	1952.48	(264)
Space and water heating			(261) + (262) + (263) + (264) =		3411.72	(265)
Pumps and fans	148.34	x	3.07	=	455.40	(267)
Electricity for lighting	218.93	x	3.07	=	672.12	(268)
Primary energy kWh/year					4539.24	(272)
Dwelling primary energy rate kWh/m2/year					99.11	(273)

SAP 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		0	x 10 =	0	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.15	(18)
Number of sides on which the dwelling is sheltered	2	(19)
Shelter factor	1 - [0.075 x (19)] = 0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	77.35	(23c)

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

	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(24a)

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

	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(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	1.40	=	2.94			(26)
Window			12.10	x	1.24	=	14.95			(27)
External wall			88.80	x	0.20	=	17.76			(29a)
Roof			87.01	x	0.15	=	13.05			(30)
Total area of external elements ∑A, m²			190.01							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	48.70 (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		17.26 (36)
Total fabric heat loss	(33) + (36) =	65.96 (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	
18.00	17.79	17.58	16.54	16.33	15.29	15.29	15.09	15.71	16.33	16.75	17.17	(38)

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

83.96	83.75	83.55	82.51	82.30	81.26	81.26	81.05	81.67	82.30	82.71	83.13	

Average = ∑(39)1...12/12 = 82.45 (39)

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

1.06	1.06	1.06	1.04	1.04	1.03	1.03	1.02	1.03	1.04	1.05	1.05	

Average = ∑(40)1...12/12 = 1.04 (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

24.44	22.07	24.43	23.63	24.41	23.62	24.40	24.41	23.63	24.42	23.64	24.44	(61)

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

174.98	153.73	160.29	142.08	138.07	121.69	115.28	128.70	129.16	147.41	157.89	170.22	(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

174.98	153.73	160.29	142.08	138.07	121.69	115.28	128.70	129.16	147.41	157.89	170.22	

∑(64)1...12 = 1739.50 (64)

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

56.16	49.29	51.28	45.29	43.89	38.51	36.32	40.78	41.00	47.00	50.55	54.58	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	146.73	146.73	146.73	146.73	146.73	146.73	146.73	146.73	146.73	146.73	146.73	146.73	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	51.05	45.34	36.87	27.91	20.87	17.62	19.04	24.74	33.21	42.17	49.22	52.47	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	324.70	328.07	319.58	301.50	278.69	257.24	242.91	239.54	248.04	266.11	288.93	310.37	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	52.12	52.12	52.12	52.12	52.12	52.12	52.12	52.12	52.12	52.12	52.12	52.12	(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)	75.49	73.36	68.93	62.91	59.00	53.49	48.81	54.81	56.94	63.17	70.21	73.36	(72)

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

555.27	550.79	529.41	496.35	462.58	432.38	414.79	423.13	442.21	475.48	512.38	540.23	(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

653.59	723.82	780.88	832.62	861.75	838.57	802.28	762.17	722.81	670.68	631.16	623.73	(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	0.98	0.96	0.91	0.79	0.60	0.44	0.48	0.72	0.93	0.98	0.99	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.09	20.23	20.45	20.71	20.90	20.98	21.00	21.00	20.95	20.72	20.36	20.06	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	20.03	20.03	20.04	20.05	20.05	20.06	20.06	20.06	20.06	20.05	20.05	20.04	(88)
Utilisation factor for gains for rest of dwelling n2,m	0.99	0.98	0.95	0.88	0.74	0.52	0.35	0.39	0.65	0.90	0.98	0.99	(89)

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

18.84	19.05	19.35	19.72	19.96	20.05	20.06	20.06	20.02	19.74	19.24	18.80

(90)

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

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

19.38	19.56	19.83	20.15	20.37	20.46	20.47	20.47	20.43	20.17	19.73	19.35

(92)

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

19.23	19.41	19.68	20.00	20.22	20.31	20.32	20.32	20.28	20.02	19.58	19.20

(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.99	0.97	0.95	0.88	0.75	0.54	0.38	0.41	0.67	0.90	0.97	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	643.93	705.06	740.69	734.37	643.29	455.56	301.29	316.12	481.03	602.97	613.41	616.27	(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]	1253.95	1215.49	1101.14	915.98	700.94	463.67	302.16	317.61	504.53	774.98	1032.07	1247.08	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	453.86	343.01	268.18	130.76	42.90	0.00	0.00	0.00	0.00	127.98	301.44	469.32	

∑(98)1...5, 10...12 = 2137.44 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 27.02 (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 (%) — 92.90 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	488.55	369.23	288.67	140.75	46.18	0.00	0.00	0.00	0.00	137.76	324.47	505.19	

∑(211)1...5, 10...12 = 2300.80 (211)

Water heating

Efficiency of water heater	89.16	89.08	88.91	88.53	87.90	87.30	87.30	87.30	87.30	88.49	88.99	89.19	(217)
Water heating fuel, kWh/month	196.25	172.58	180.28	160.49	157.07	139.40	132.05	147.42	147.95	166.58	177.43	190.85	

∑(219a)1...12 = 1968.35 (219)

Annual totals

Space heating fuel - main system 1 — 2300.80

Water heating fuel — 1968.35

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

mechanical ventilation fans - balanced, extract or positive input from outside	150.78	(230a)
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		225.78	(231)
Electricity for lighting (Appendix L)		360.60	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	4855.53	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2300.80	x	3.48	x 0.01 =	80.07	(240)
Water heating	1968.35	x	3.48	x 0.01 =	68.50	(247)
Pumps and fans	225.78	x	13.19	x 0.01 =	29.78	(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) =	345.91	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.17	(257)
SAP value	83.67	
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	2300.80	x	0.216	=	496.97	(261)
Water heating	1968.35	x	0.216	=	425.16	(264)
Space and water heating			(261) + (262) + (263) + (264) =		922.14	(265)
Pumps and fans	225.78	x	0.519	=	117.18	(267)
Electricity for lighting	360.60	x	0.519	=	187.15	(268)
Total CO_2, kg/year				(265)...(271) =	1226.47	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	15.51	(273)
EI value					86.76	
EI rating (section 14)					87	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	2300.80	x	1.22	=	2806.97	(261)
Water heating	1968.35	x	1.22	=	2401.39	(264)
Space and water heating			(261) + (262) + (263) + (264) =		5208.36	(265)
Pumps and fans	225.78	x	3.07	=	693.16	(267)
Electricity for lighting	360.60	x	3.07	=	1107.04	(268)
Primary energy kWh/year					7008.56	(272)
Dwelling primary energy rate kWh/m2/year					88.60	(273)