Code for Sustainable Homes (November 2010)
Design - Draft

This report details the calculations and results for Ene 1, 2 and 7 of the Code For Sustainable Homes.

This Design Assessment has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed. Code calculations are from the Technical Guide (November 2010).

Assessor name	Mr Stuart Searle	Assessor number	2435
Client		Last modified	01/02/2013
Address	P01 4 St Augustines, London, NW1		

Building regulation assessment - criterion 1

	kg/m²/yr
DER	10.82
TER	17.77

Assessment of zero carbon home and low or zero carbon technologies

		Credits	Level
Dwelling emission rate (Ene 1)	CO_2 reduction = 39.1 %	4.2	4
Fabric Energy Efficiency	FEE = 48.1	No credits	
Low or zero carbon technologies (Ene 7)	CO_2 reduction = 14 %	1	

Ene 1 - dwelling emission rate

	%	kWh/m²	kgCO_2/m²/yr	
Assessment of Ene 1 (level 1-5)				
DER from SAP 2009 DER worksheet			10.82	
Additional allowable generation		0.00		
CO_2 emissions offset from generation			0.00	
CO_2 emissions offset from community biofuel CHP systems			0.00	
Total CO_2 emissions offset from SAP section 16 allowances			**0.00**	
DER accounting for SAP section 16 allowances			**10.82**	
CO_2 reduction compared to TER			6.95	
CO_2 reduction as % of TER	39.1			
Assessment of Ene 1 (level 6)				
DER from SAP 2009 DER worksheet			10.82	(ZC1)
CO_2 emissions from appliances (equation L14)			14.61	(ZC2)
CO_2 emissions from cooking (equation L16)			1.70	(ZC3)
Total CO_2 emissions			27.14	(ZC4)
Additional allowable generation and its CO_2 emissions offset		0.00		(ZC6)
CO_2 emissions offset from additional allowable generation			0.00	(ZC7)
CO_2 emissions offset from community biofuel CHP systems			0.00	(ZC5)
Net CO_2 emissions			**27.14**	(ZC8)

Ene 1 - dwelling emission rate - level 6

There is no Zero Carbon Home definition in the current technical guide

	Criterion	Value	Pass/Fail
FEE	<= 39	48.1	Fail
Net CO_2 emissions	<= 0.00	27.14	Fail

Result: Not level 6

Number of credits for Ene 1	**4.2**

Ene 2 - Fabric Energy Efficiency

FEE	48.1
Number of credits for Ene 2	**No credits**

Ene 7 - low or zero carbon technologies

	Emissions $kgCO_2/yr$	Reduction $kgCO_2/yr$
Standard case		
Space and water heating (265)	1543.43	
Mechanical cooling (266)	0.00	
Pumps and fans (267)	132.49	
Lighting (268)	220.41	
Appliances and cooking	1786.65	
Total CO_2	**1880.02**	
Actual case		
Space and water heating (265) or (376)	1543.43	
Space and water heating from LZCT considered in SAP 2009		0.00
Pumps and fans (267) or (378)	132.49	
Pumps and fans		0.00
Electricity generated by LZCT (269) + (380))		-540.37
Additional allowable electricity generation considered in SAP 2009 section 16		0.00
Offset from biofuel CHP [-1 x [(363)..(366) + (368)...(372)]]		0.00
LZCT electricity generation		-540.37
LZCT thermal generation		0
Total from specified LZCT		**-540.37**

	Emissions $kgCO_2/m^2/yr$	
Reduction in CO_2 Emissions		
Standard Case CO_2	33.64	
Actual Case CO_2	28.70	
% Reduction in CO_2	14	
Number of credits for Ene 7	**1**	

DRAFT

DER 2009 Worksheet
Design - Draft

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Assessor name	Mr Stuart Searle	Assessor number	2435
Client		Last modified	01/02/2013
Address	P01 4 St Augustines, London, NW1		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		109.50	(1a) x	2.60	(2a) =	284.70	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	109.50	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	284.70	(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	5.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.25	(18)

Air permeability value applies if a pressurisation test has been done, or a design or specified air permeability is being used

Number of sides on which dwelling is sheltered		1	(19)
Shelter factor	1 - [0.075 x (19)] =	0.92	(20)
Adjusted infiltration rate	(18) x (20) =	0.23	(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 7													
(22)m	5.40	5.10	5.10	4.50	4.10	3.90	3.70	3.70	4.20	4.50	4.80	5.10	
										∑(22)1...12 =		54.10	(22)
Wind Factor (22a)m = (22)m ÷ 4													
(22a)m	1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.20	1.27	
										∑(22a)1...12 =		13.52	(22a)
Adjusted infiltration rate (allowing for shelter and wind speed) = (21) × (22a)m													
(22b)m	0.31	0.29	0.29	0.26	0.24	0.23	0.21	0.21	0.24	0.26	0.28	0.29	
										∑(22b)1...12 =		3.13	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)), otherwise (23b) = (23a)	0.5	(23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = N/A (23c)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b)m + 0.5 x (23b)

(24c)m	0.56	0.54	0.54	0.51	0.50	0.50	0.50	0.50	0.50	0.51	0.53	0.54	(24c)

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

(25)m	0.56	0.54	0.54	0.51	0.50	0.50	0.50	0.50	0.50	0.51	0.53	0.54	(25)

3. Heat losses and heat loss parameter

The κ-value is the heat capacity per unit area, see Table 1e.

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	
Doors			2.10	x	1.60	=	3.36	N/A	N/A	(26)
Window*			8.68	x	1.15	=	9.94	N/A	N/A	(27)
Window*			18.23	x	1.33	=	24.17	N/A	N/A	(27)
Ground floor			109.50	x	0.12	=	13.14	N/A	N/A	(28a)
External wall			83.91	x	0.20	=	16.78	N/A	N/A	(29a)
Party Wall			34.19	x	0.00	=	0.00	N/A	N/A	(32)
Total area of external elements ∑A, m²			222.42	(31)						

** for windows and roof windows, effective window U-value is calculated using formula 1/[(1/UValue)+0.04] paragraph 3.2*

Fabric heat loss, W/K = ∑(A × U) (26)...(30) + (32) = 67.39 (33)

Heat capacity Cm = ∑(A x κ) (28)...(30) + (32) + (32a)...(32e) = N/A (34)

Thermal mass parameter (TMP) in kJ/m²K Calculated separately = 100.00 (35)

Thermal bridges: ∑(L x Ψ) calculated using Appendix K 17.55 (36)

if details of thermal bridging are not known then (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 84.94 (37)

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

(38)m	52.82	51.19	51.19	47.93	46.98	46.98	46.98	46.98	46.98	47.93	49.56	51.19	(38)

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

(39)m	137.75	136.12	136.12	132.86	131.91	131.91	131.91	131.91	131.91	132.86	134.49	136.12	

Average = ∑(39)1...12/12 = 133.83 (39)

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

(40)m	1.26	1.24	1.24	1.21	1.20	1.20	1.20	1.20	1.20	1.21	1.23	1.24	

Average = ∑(40)1...12/12 = 1.22 (40)

4. Water heating energy requirement

kWh/year

Assumed occupancy, N 2.81 (42)

If TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)

If TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 100.98 (43)

Annual average hot water usage has been reduced by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	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)													
(44)m	111.08	107.04	103.00	98.96	94.92	90.88	90.88	94.92	98.96	103.00	107.04	111.08	

∑(44)1...12 = 1211.76 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

(45)m	165.12	144.41	149.02	129.92	124.66	107.57	99.68	114.39	115.75	134.90	147.26	159.91	

∑(45)1...12 = 1592.61 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

For community heating include distribution loss whether or not hot water tank is present

Distribution loss 0.15 x (45)m

(46)m	24.77	21.66	22.35	19.49	18.70	16.14	14.95	17.16	17.36	20.24	22.09	23.99	(46)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):	1.85	(47)
Temperature factor from Table 2b	0.54	(48)
Energy lost from water storage, kWh/day (47) x (48)	1.00	(49)
Enter (49) or (54) in (55)	1.00	(55)

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

(56)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(56)

If cylinder contains dedicated solar storage, = (56)m x [(50) - (H11)] ÷ (50), else = (56)m where (H11) is from Appendix H

(57)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(57)

Primary circuit loss (annual) from Table 3: 360.00 (58)

Primary circuit loss for each month (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m	30.58	27.62	30.58	29.59	30.58	29.59	30.58	30.58	29.59	30.58	29.59	30.58	(59)

Combi loss for each month from Table 3a, 3b or 3c (enter '0' if not a combi boiler)

(61)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	(61)

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

(62)m	226.66	200.00	210.57	189.48	186.21	167.13	161.23	175.93	175.31	196.45	206.81	221.45	(62)

Solar DHW input calculated using Appendix H (negative quantity) ('0' entered if no solar contribution to water heating)

(63)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	

∑(63)1...12 = 0.00 (63)

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

(64)m	226.66	200.00	210.57	189.48	186.21	167.13	161.23	175.93	175.31	196.45	206.81	221.45	

∑(64)1...12 = 2317.25 (64)

if (64)m < 0 then set to 0

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

(65)m	104.14	92.49	98.79	90.85	90.69	83.42	82.38	87.27	86.14	94.09	96.61	102.41	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	140.59	140.59	140.59	140.59	140.59	140.59	140.59	140.59	140.59	140.59	140.59	140.59	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m	24.14	21.44	17.44	13.20	9.87	8.33	9.00	11.70	15.71	19.94	23.27	24.81	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m	270.84	273.65	266.56	251.49	232.45	214.57	202.62	199.81	206.89	221.97	241.00	258.89	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m	37.06	37.06	37.06	37.06	37.06	37.06	37.06	37.06	37.06	37.06	37.06	37.06	(69)
Pumps and fans gains (Table 5a)													
(70)m	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m	-112.47	-112.47	-112.47	-112.47	-112.47	-112.47	-112.47	-112.47	-112.47	-112.47	-112.47	-112.47	(71)
Water heating gains (Table 5)													
(72)m	139.97	137.63	132.78	126.18	121.89	115.86	110.73	117.30	119.63	126.47	134.18	137.64	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m	510.12	507.90	491.95	466.04	439.39	413.93	397.52	403.98	417.40	443.55	473.63	496.52	(73)

6. Solar gains

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Rows (74) to (82) are used 12 times, one for each month, repeating as needed if there is more than one window type.

Details for month of January and annual totals are shown below:

	Access factor Table 6d		Area m²		Solar flux W/m²		g Specific data or Table 6b		FF Specific data or Table 6c		Gains (W)	
West	0.54	x	8.68	x	19.87	x 0.9 x	0.63	x	0.80	=	42.25	(80)
South	0.54	x	18.23	x	47.32	x 0.9 x	0.63	x	0.80	=	211.29	(78)

Solar gains in watts, calculated for each month ∑(74)m...(82)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(83)m	253.54	426.51	551.69	663.67	721.12	732.95	717.84	672.25	602.93	480.55	302.87	217.42	(83)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(84)m	763.67	934.40	1043.64	1129.71	1160.51	1146.88	1115.36	1076.23	1020.34	924.10	776.50	713.94	(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, η1,m (see Table 9a)													
(86)m	0.95	0.93	0.89	0.83	0.74	0.60	0.44	0.45	0.66	0.84	0.93	0.96	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)													
(87)m	18.57	18.93	19.41	19.89	20.41	20.75	20.92	20.92	20.67	20.07	19.16	18.62	(87)
Temperature during heating periods in the living area from Table 9, Th2(°C)													
(88)m	19.88	19.89	19.89	19.91	19.92	19.92	19.92	19.92	19.92	19.91	19.90	19.89	(88)
Utilisation factor for gains for rest of dwelling η2,m (see Table 9a)													
(89)m	0.95	0.92	0.87	0.81	0.69	0.53	0.34	0.35	0.60	0.81	0.92	0.95	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)													
(90)m	16.66	17.18	17.87	18.56	19.26	19.70	19.87	19.87	19.61	18.82	17.53	16.74	(90)

Living area fraction fLA 24.00 ÷ (4) = 0.22 (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2													
(92)m	17.08	17.56	18.21	18.85	19.51	19.93	20.10	20.10	19.84	19.09	17.89	17.15	(92)
Apply adjustment to the mean internal temperature from Table 4e, where appropriate													
(93)m	16.93	17.41	18.06	18.70	19.36	19.78	19.95	19.95	19.69	18.94	17.74	17.00	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that tim = (93)m and recalculate the utilisation factor for gains using Table 9a)													
Utilisation factor for gains, ηm													
(94)m	0.92	0.88	0.83	0.77	0.67	0.52	0.34	0.35	0.58	0.77	0.89	0.93	(94)
Useful gains, ηmGm, W = (94)m x (84)m													
(95)m	702.49	824.96	870.31	872.02	773.08	594.70	382.83	380.88	591.46	711.94	691.05	660.58	(95)
Monthly average external temperature from Table 8													
(96)m	4.50	5.00	6.80	8.70	11.70	14.60	16.90	16.90	14.30	10.80	7.00	4.90	(96)
Heat loss rate for mean internal temperature, Lm, W													
(97)m	1712.49	1689.45	1532.10	1329.01	1010.65	682.96	402.79	402.28	710.95	1082.16	1443.96	1646.98	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m - (95)m] x (41)m													
(98)m	751.44	580.93	492.37	329.03	176.75	0.00	0.00	0.00	0.00	275.44	542.10	733.88	

Total per year (kWh/year) = ∑(98)1...5, 10...12 = 3881.95 (98)

Space heating requirement in kWh/m²/year (98) ÷ (4) = 35.45 (99)

9a. Energy Requirements - Individual heating systems including micro-CHP

Space heating:

Fraction of space heating from secondary/supplementary system (Table 11) 0.00 (201)

Fraction of space heating from main system(s) 1 - (201)	1.00	(202)
Fraction of main heating from main system 2	0.00	(203)
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 space heating system 1 (%)	93.00	(206)

(from database or Table 4a/4b, adjusted where appropriate by the amount shown in the 'space efficiency adjustment' column of Table 4c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement, kWh/month (as calculated above)												
(98)m	751.44	580.93	492.37	329.03	176.75	0.00	0.00	0.00	0.00	275.44	542.10	733.88
Space heating fuel (main heating system 1), kWh/month = (98)m x (204) x 100 ÷ (206)												
(211)m	808.00	624.66	529.43	353.80	190.05	0.00	0.00	0.00	0.00	296.17	582.90	789.12

Total per year (kWh/year) = ∑(211)1...5, 10...12 = 4174.14 (211)

Water heating:

Output from water heater, kWh/month (calculated above)												
(64)m	226.66	200.00	210.57	189.48	186.21	167.13	161.23	175.93	175.31	196.45	206.81	221.45

∑(64)1...12 = 2317.25 (64)

Efficiency of water heater per month												
(217)m	87.27	86.99	86.50	85.77	84.17	79.30	79.30	79.30	79.30	85.21	86.77	87.27
Fuel for water heating, kWh/month = (64)m x 100 ÷ (217)m												
(219)m	259.72	229.91	243.42	220.92	221.22	210.76	203.31	221.86	221.08	230.53	238.36	253.76

Total per year (kWh/year) = ∑(219)1...12 = 2754.84 (219)

Annual Totals Summary:	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		4174.14	(211)
Water heating fuel used		2754.84	(219)
Electricity for pumps, fans and electric keep-hot (Table 4f):			
mechanical ventilation fans - balanced, extract or positive input from outside	81.28		(230a)
warm air heating system fans	0.00		(230b)
central heating pump	130.00		(230c)
oil boiler pump	0.00		(230d)
boiler flue fan	45.00		(230e)
maintaining electric keep-hot facility for gas combi boiler	0.00		(230f)
pump for solar water heating	0.00		(230g)
Total electricity for the above	∑(230a)...(230g)	256.28	(231)
Electricity for lighting (calculated in Appendix L):		426.33	(232)
Energy saving/generation technologies (Appendices M, N and Q):			
Electricity generated by PVs (Appendix M) (negative quantity)		-1021.50	(233)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year		Emissions Factor		Emissions (kgCO2/year)	
Space heating - main system 1	4174.14	x	0.198	=	826.48	(261)
Water heating	2754.84	x	0.198	=	545.46	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1371.94	(265)
Pumps, fans and electric keep-hot	256.28	x	0.517	=	132.49	(267)
Lighting	426.33	x	0.517	=	220.41	(268)
Energy saving/generation technologies:						
PV emission savings (negative quantity)	-1021.50	x	0.529	=	-540.37	(269)
Total carbon dioxide emissions				∑(261)...(271) =	1184.47	(272)

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SAP 2009 Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Stuart Searle	Assessor number	2435
Client		Last modified	01/02/2013
Address	P01 4 St Augustines, London, NW1		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		109.50	(1a) x	2.60	(2a) =	284.70	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	109.50	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	284.70	(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	5.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.25	(18)

Air permeability value applies if a pressurisation test has been done, or a design or specified air permeability is being used

Number of sides on which dwelling is sheltered		1	(19)
Shelter factor	1 - [0.075 x (19)] =	0.92	(20)
Adjusted infiltration rate	(18) x (20) =	0.23	(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 7													
(22)m	5.40	5.10	5.10	4.50	4.10	3.90	3.70	3.70	4.20	4.50	4.80	5.10	
										∑(22)1...12 =		54.10	(22)
Wind Factor (22a)m = (22)m ÷ 4													
(22a)m	1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.20	1.27	
										∑(22a)1...12 =		13.52	(22a)
Adjusted infiltration rate (allowing for shelter and wind speed) = (21) × (22a)m													
(22b)m	0.31	0.29	0.29	0.26	0.24	0.23	0.21	0.21	0.24	0.26	0.28	0.29	
										∑(22b)1...12 =		3.13	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)), otherwise (23b) = (23a)	0.5	(23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = N/A (23c)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b)m + 0.5 x (23b)

(24c)m	0.56	0.54	0.54	0.51	0.50	0.50	0.50	0.50	0.50	0.51	0.53	0.54	(24c)

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

(25)m	0.56	0.54	0.54	0.51	0.50	0.50	0.50	0.50	0.50	0.51	0.53	0.54	(25)

3. Heat losses and heat loss parameter

The κ-value is the heat capacity per unit area, see Table 1e.

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	
Doors			2.10	x	1.60	=	3.36	N/A	N/A	(26)
Window*			8.68	x	1.15	=	9.94	N/A	N/A	(27)
Window*			18.23	x	1.33	=	24.17	N/A	N/A	(27)
Ground floor			109.50	x	0.12	=	13.14	N/A	N/A	(28a)
External wall			83.91	x	0.20	=	16.78	N/A	N/A	(29a)
Party Wall			34.19	x	0.00	=	0.00	N/A	N/A	(32)
Total area of external elements ∑A, m²			222.42	(31)						

** for windows and roof windows, effective window U-value is calculated using formula 1/[(1/UValue)+0.04] paragraph 3.2*

Fabric heat loss, W/K = ∑(A × U) (26)...(30) + (32) = 67.39 (33)

Heat capacity Cm = ∑(A x κ) (28)...(30) + (32) + (32a)...(32e) = N/A (34)

Thermal mass parameter (TMP) in kJ/m²K Calculated separately = 100.00 (35)

Thermal bridges: ∑(L x Ψ) calculated using Appendix K 17.55 (36)

if details of thermal bridging are not known then (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 84.94 (37)

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

(38)m	52.82	51.19	51.19	47.93	46.98	46.98	46.98	46.98	46.98	47.93	49.56	51.19	(38)

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

(39)m	137.75	136.12	136.12	132.86	131.91	131.91	131.91	131.91	131.91	132.86	134.49	136.12	

Average = ∑(39)1...12/12 = 133.83 (39)

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

(40)m	1.26	1.24	1.24	1.21	1.20	1.20	1.20	1.20	1.20	1.21	1.23	1.24	

Average = ∑(40)1...12/12 = 1.22 (40)

4. Water heating energy requirement

kWh/year

Assumed occupancy, N 2.81 (42)

If TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)

If TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 100.98 (43)

Annual average hot water usage has been reduced by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	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)													
(44)m	111.08	107.04	103.00	98.96	94.92	90.88	90.88	94.92	98.96	103.00	107.04	111.08	

∑(44)1...12 = 1211.76 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

(45)m	165.12	144.41	149.02	129.92	124.66	107.57	99.68	114.39	115.75	134.90	147.26	159.91	

∑(45)1...12 = 1592.61 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

For community heating include distribution loss whether or not hot water tank is present

Distribution loss 0.15 x (45)m

(46)m	24.77	21.66	22.35	19.49	18.70	16.14	14.95	17.16	17.36	20.24	22.09	23.99	(46)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):	1.85	(47)
Temperature factor from Table 2b	0.54	(48)
Energy lost from water storage, kWh/day (47) x (48)	1.00	(49)
Enter (49) or (54) in (55)	1.00	(55)

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

(56)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(56)

If cylinder contains dedicated solar storage, = (56)m x [(50) - (H11)] ÷ (50), else = (56)m where (H11) is from Appendix H

(57)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(57)

Primary circuit loss (annual) from Table 3: 360.00 (58)

Primary circuit loss for each month (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m	30.58	27.62	30.58	29.59	30.58	29.59	30.58	30.58	29.59	30.58	29.59	30.58	(59)

Combi loss for each month from Table 3a, 3b or 3c (enter '0' if not a combi boiler)

(61)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	(61)

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

(62)m	226.66	200.00	210.57	189.48	186.21	167.13	161.23	175.93	175.31	196.45	206.81	221.45	(62)

Solar DHW input calculated using Appendix H (negative quantity) ('0' entered if no solar contribution to water heating)

(63)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	

∑(63)1...12 = 0.00 (63)

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

(64)m	226.66	200.00	210.57	189.48	186.21	167.13	161.23	175.93	175.31	196.45	206.81	221.45	

∑(64)1...12 = 2317.25 (64)

if (64)m < 0 then set to 0

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

(65)m	104.14	92.49	98.79	90.85	90.69	83.42	82.38	87.27	86.14	94.09	96.61	102.41	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	168.71	168.71	168.71	168.71	168.71	168.71	168.71	168.71	168.71	168.71	168.71	168.71	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m	60.35	53.60	43.59	33.00	24.67	20.83	22.50	29.25	39.26	49.85	58.19	62.03	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m	404.23	408.43	397.86	375.35	346.95	320.25	302.41	298.22	308.79	331.29	359.70	386.40	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m	54.68	54.68	54.68	54.68	54.68	54.68	54.68	54.68	54.68	54.68	54.68	54.68	(69)
Pumps and fans gains (Table 5a)													
(70)m	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m	-112.47	-112.47	-112.47	-112.47	-112.47	-112.47	-112.47	-112.47	-112.47	-112.47	-112.47	-112.47	(71)
Water heating gains (Table 5)													
(72)m	139.97	137.63	132.78	126.18	121.89	115.86	110.73	117.30	119.63	126.47	134.18	137.64	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m	725.47	720.58	695.14	655.45	614.43	577.85	556.56	565.69	588.60	628.53	672.98	706.98	(73)

6. Solar gains

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Rows (74) to (82) are used 12 times, one for each month, repeating as needed if there is more than one window type.

Details for month of January and annual totals are shown below:

	Access factor Table 6d		Area m²		Solar flux W/m²		g Specific data or Table 6b		FF Specific data or Table 6c		Gains (W)	
West	0.54	x	8.68	x	19.87	x 0.9 x	0.63	x	0.80	=	42.25	(80)
South	0.54	x	18.23	x	47.32	x 0.9 x	0.63	x	0.80	=	211.29	(78)

Solar gains in watts, calculated for each month ∑(74)m...(82)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(83)m	253.54	426.51	551.69	663.67	721.12	732.95	717.84	672.25	602.93	480.55	302.87	217.42	(83)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(84)m	979.01	1147.09	1246.83	1319.12	1335.55	1310.80	1274.40	1237.94	1191.54	1109.08	975.85	924.41	(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, η1,m (see Table 9a)													
(86)m	0.93	0.89	0.85	0.79	0.69	0.55	0.40	0.41	0.60	0.78	0.90	0.93	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)													
(87)m	18.85	19.18	19.62	20.05	20.50	20.80	20.94	20.94	20.74	20.22	19.40	18.89	(87)
Temperature during heating periods in the living area from Table 9, Th2(°C)													
(88)m	19.88	19.89	19.89	19.91	19.92	19.92	19.92	19.92	19.92	19.91	19.90	19.89	(88)
Utilisation factor for gains for rest of dwelling η2,m (see Table 9a)													
(89)m	0.91	0.88	0.83	0.76	0.64	0.48	0.30	0.31	0.54	0.75	0.88	0.92	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)													
(90)m	17.06	17.53	18.15	18.77	19.38	19.74	19.88	19.88	19.68	19.02	17.86	17.13	(90)

Living area fraction fLA 24.00 ÷ (4) = 0.22 (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2													
(92)m	17.45	17.89	18.47	19.05	19.62	19.97	20.12	20.11	19.91	19.28	18.20	17.52	(92)
Apply adjustment to the mean internal temperature from Table 4e, where appropriate													
(93)m	17.30	17.74	18.32	18.90	19.47	19.82	19.97	19.96	19.76	19.13	18.05	17.37	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that tim = (93)m and recalculate the utilisation factor for gains using Table 9a)													
Utilisation factor for gains, ηm													
(94)m	0.88	0.84	0.79	0.73	0.62	0.47	0.31	0.31	0.52	0.72	0.84	0.89	(94)
Useful gains, ηmGm, W = (94)m x (84)m													
(95)m	862.21	965.34	984.76	957.66	824.96	617.88	389.17	387.91	624.64	793.85	824.57	819.01	(95)
Monthly average external temperature from Table 8													
(96)m	4.50	5.00	6.80	8.70	11.70	14.60	16.90	16.90	14.30	10.80	7.00	4.90	(96)
Heat loss rate for mean internal temperature, Lm, W													
(97)m	1763.47	1734.13	1568.31	1355.12	1025.59	689.18	404.44	404.11	720.11	1107.12	1486.15	1697.10	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m - (95)m] x (41)m													
(98)m	670.54	516.63	434.17	286.17	149.27	0.00	0.00	0.00	0.00	233.07	476.34	653.30	

Total per year (kWh/year) = ∑(98)1...5, 10...12 = 3419.49 (98)

Space heating requirement in kWh/m²/year (98) ÷ (4) 31.23 (99)

9a. Energy Requirements - Individual heating systems including micro-CHP

Space heating:

Fraction of space heating from secondary/supplementary system (Table 11) 0.00 (201)

Fraction of space heating from main system(s) 1 - (201)	1.00	(202)
Fraction of main heating from main system 2	0.00	(203)
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 space heating system 1 (%)	93.00	(206)

(from database or Table 4a/4b, adjusted where appropriate by the amount shown in the 'space efficiency adjustment' column of Table 4c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement, kWh/month (as calculated above)												
(98)m	670.54	516.63	434.17	286.17	149.27	0.00	0.00	0.00	0.00	233.07	476.34	653.30
Space heating fuel (main heating system 1), kWh/month = (98)m x (204) x 100 ÷ (206)												
(211)m	721.01	555.51	466.85	307.71	160.51	0.00	0.00	0.00	0.00	250.62	512.20	702.47

Total per year (kWh/year) = ∑(211)1...5, 10...12 = 3676.87 (211)

Water heating:

Output from water heater, kWh/month (calculated above)												
(64)m	226.66	200.00	210.57	189.48	186.21	167.13	161.23	175.93	175.31	196.45	206.81	221.45

∑(64)1...12 = 2317.25 (64)

Efficiency of water heater per month												
(217)m	87.03	86.73	86.20	85.41	83.73	79.30	79.30	79.30	79.30	84.77	86.47	87.03
Fuel for water heating, kWh/month = (64)m x 100 ÷ (217)m												
(219)m	260.43	230.59	244.27	221.85	222.39	210.76	203.31	221.86	221.08	231.74	239.18	254.47

Total per year (kWh/year) = ∑(219)1...12 = 2761.94 (219)

Annual Totals Summary:	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		3676.87	(211)
Water heating fuel used		2761.94	(219)
Electricity for pumps, fans and electric keep-hot (Table 4f):			
mechanical ventilation fans - balanced, extract or positive input from outside	81.28		(230a)
warm air heating system fans	0.00		(230b)
central heating pump	130.00		(230c)
oil boiler pump	0.00		(230d)
boiler flue fan	45.00		(230e)
maintaining electric keep-hot facility for gas combi boiler	0.00		(230f)
pump for solar water heating	0.00		(230g)
Total electricity for the above	∑(230a)...(230g)	256.28	(231)
Electricity for lighting (calculated in Appendix L):		426.33	(232)
Energy saving/generation technologies (Appendices M, N and Q):			
Electricity generated by PVs (Appendix M) (negative quantity)		-1021.50	(233)

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

	Fuel kWh/year		**Fuel price (Table 12)**		**Fuel cost £/year**	
Space heating - main system 1	3676.87	x	3.10	x 0.01 =	113.98	(240)
Water heating cost (other fuel)	2761.94	x	3.10	x 0.01 =	85.62	(247)
Pumps, fans and electric keep-hot	256.28	x	11.46	x 0.01 =	29.37	(249)
Energy for lighting	426.33	x	11.46	x 0.01 =	48.86	(250)
Additional standing charges (Table 12)					106.00	(251)
Energy saving/generation technologies (Appendices M, N and Q):						
PV savings (negative quantity)	-1021.50	x	11.46	x 0.01 =	-117.06	(252)
Total energy cost			(240)...(242) + (245)...(254)		266.77	(255)

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

Energy cost deflator (Table 12)		0.47	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	0.81	(257)
SAP value		88.68	
SAP rating		89	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year		Emissions Factor		Emissions (kgCO2/year)	
Space heating - main system 1	3676.87	x	0.198	=	728.02	(261)
Water heating	2761.94	x	0.198	=	546.86	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1274.89	(265)
Pumps, fans and electric keep-hot	256.28	x	0.517	=	132.49	(267)
Lighting	426.33	x	0.517	=	220.41	(268)
Energy saving/generation technologies:						
PV emission savings (negative quantity)	-1021.50	x	0.529	=	-540.37	(269)
Total carbon dioxide emissions			∑(261)...(271) =		1087.42	(272)
Dwelling carbon dioxide emissions rate			(272) ÷ (4) =		9.93	(273)
EI value					90.57	
EI rating (see section 14)					91	(274)
EI band					B	

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

	Energy kWh/year		Primary Energy Factor		Primary Energy	
Space heating - main system 1	3676.87	x	1.02	=	3750.41	(261*)
Water heating	2761.94	x	1.02	=	2817.18	(264*)
Space and water heating			(261*) + (262*) + (263*) + (264*) =		6567.59	(265*)
Pumps, fans and electric keep-hot	256.28	x	2.92	=	748.33	(267*)
Lighting	426.33	x	2.92	=	1244.88	(268*)
Energy saving/generation technologies:						
PV primary energy savings (negative quantity)	-1021.50	x	2.92	=	-2982.77	(269*)
Total primary energy kWh/year			∑(261*)...(271*) =		5578.03	(272*)
Primary energy kWh/m2/year			(272*) ÷ (4) =		50.94	(273*)

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Code for Sustainable Homes (November 2010)
Design - Draft

This report details the calculations and results for Ene 1, 2 and 7 of the Code For Sustainable Homes.

This Design Assessment has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed. Code calculations are from the Technical Guide (November 2010).

Assessor name	Mr Stuart Searle	Assessor number	2435
Client		Last modified	01/02/2013
Address	P02 4 St Augustines, London, NW1		

Building regulation assessment - criterion 1

	kg/m²/yr
DER	13.69
TER	18.82

Assessment of zero carbon home and low or zero carbon technologies

		Credits	Level
Dwelling emission rate (Ene 1)	CO_2 reduction = 27.3 %	3.2	4
Fabric Energy Efficiency	FEE = 53.8	No credits	
Low or zero carbon technologies (Ene 7)	CO_2 reduction = 12 %	1	

Ene 1 - dwelling emission rate

	%	kWh/m²	kgCO_2/m²/yr	
Assessment of Ene 1 (level 1-5)				
DER from SAP 2009 DER worksheet			13.69	
Additional allowable generation		0.00		
CO_2 emissions offset from generation			0.00	
CO_2 emissions offset from community biofuel CHP systems			0.00	
Total CO_2 emissions offset from SAP section 16 allowances			**0.00**	
DER accounting for SAP section 16 allowances			**13.69**	
CO_2 reduction compared to TER			5.13	
CO_2 reduction as % of TER	27.3			
Assessment of Ene 1 (level 6)				
DER from SAP 2009 DER worksheet			13.69	(ZC1)
CO_2 emissions from appliances (equation L14)			16.21	(ZC2)
CO_2 emissions from cooking (equation L16)			2.23	(ZC3)
Total CO_2 emissions			32.12	(ZC4)
Additional allowable generation and its CO_2 emissions offset		0.00		(ZC6)
CO_2 emissions offset from additional allowable generation			0.00	(ZC7)
CO_2 emissions offset from community biofuel CHP systems			0.00	(ZC5)
Net CO_2 emissions			**32.12**	(ZC8)

Ene 1 - dwelling emission rate - level 6

There is no Zero Carbon Home definition in the current technical guide

	Criterion	Value	Pass/Fail
FEE	<= 39	53.8	Fail
Net CO_2 emissions	<= 0.00	32.12	Fail

Result: Not level 6

Number of credits for Ene 1	**3.2**

Ene 2 - Fabric Energy Efficiency

FEE	53.8
Number of credits for Ene 2	**No credits**

Ene 7 - low or zero carbon technologies

	Emissions $kgCO_2/yr$	Reduction $kgCO_2/yr$
Standard case		
Space and water heating (265)	1320.98	
Mechanical cooling (266)	0.00	
Pumps and fans (267)	121.17	
Lighting (268)	178.62	
Appliances and cooking	1474.62	
Total CO_2	**3095.39**	
Actual case		
Space and water heating (265) or (376)	1320.98	
Space and water heating from LZCT considered in SAP 2009		0.00
Pumps and fans (267) or (378)	121.17	
Pumps and fans		0.00
Electricity generated by LZCT (269) + (380))		-395.06
Additional allowable electricity generation considered in SAP 2009 section 16		0.00
Offset from biofuel CHP [-1 x [(363)..(366) + (368)...(372)]]		0.00
LZCT electricity generation		-395.06
LZCT thermal generation		0
Total from specified LZCT		**-395.06**

	Emissions $kgCO_2/m^2/yr$	
Reduction in CO_2 Emissions		
Standard Case CO_2	38.69	
Actual Case CO_2	33.75	
% Reduction in CO_2	12	
Number of credits for Ene 7	**1**	

DRAFT

DER 2009 Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Stuart Searle	Assessor number	2435
Client		Last modified	01/02/2013
Address	P02 4 St Augustines, London, NW1		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		80.00	(1a) x	2.60	(2a) =	208.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	80.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	208.00	(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	5.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.25	(18)

Air permeability value applies if a pressurisation test has been done, or a design or specified air permeability is being used

Number of sides on which dwelling is sheltered		2	(19)
Shelter factor	1 - [0.075 x (19)] =	0.85	(20)
Adjusted infiltration rate	(18) x (20) =	0.21	(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 7													
(22)m	5.40	5.10	5.10	4.50	4.10	3.90	3.70	3.70	4.20	4.50	4.80	5.10	
										∑(22)1...12 =		54.10	(22)
Wind Factor (22a)m = (22)m ÷ 4													
(22a)m	1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.20	1.27	
										∑(22a)1...12 =		13.52	(22a)
Adjusted infiltration rate (allowing for shelter and wind speed) = (21) × (22a)m													
(22b)m	0.29	0.27	0.27	0.24	0.22	0.21	0.20	0.20	0.22	0.24	0.26	0.27	
										∑(22b)1...12 =		2.87	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)), otherwise (23b) = (23a)	0.5	(23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = N/A (23c)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b)m + 0.5 x (23b)

(24c)m	0.54	0.52	0.52	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.52	(24c)

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

(25)m	0.54	0.52	0.52	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.52	(25)

3. Heat losses and heat loss parameter

The κ-value is the heat capacity per unit area, see Table 1e.

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	
Doors			2.10	x	1.60	=	3.36	N/A	N/A	(26)
Window*			8.68	x	1.15	=	9.94	N/A	N/A	(27)
Window*			14.58	x	1.33	=	19.33	N/A	N/A	(27)
Ground floor			80.00	x	0.12	=	9.60	N/A	N/A	(28a)
External wall			50.20	x	0.20	=	10.04	N/A	N/A	(29a)
Party Wall			33.80	x	0.00	=	0.00	N/A	N/A	(32)

Total area of external elements ∑A, m² 155.56 (31)

** for windows and roof windows, effective window U-value is calculated using formula 1/[(1/UValue)+0.04] paragraph 3.2*

Fabric heat loss, W/K = ∑(A × U) (26)...(30) + (32) = 52.27 (33)

Heat capacity Cm = ∑(A x κ) (28)...(30) + (32) + (32a)...(32e) = N/A (34)

Thermal mass parameter (TMP) in kJ/m²K Calculated separately = 100.00 (35)

Thermal bridges: ∑(L x Ψ) calculated using Appendix K 13.72 (36)

if details of thermal bridging are not known then (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 65.99 (37)

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

(38)m	36.85	35.76	35.76	34.32	34.32	34.32	34.32	34.32	34.32	34.32	34.66	35.76	(38)

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

(39)m	102.84	101.75	101.75	100.31	100.31	100.31	100.31	100.31	100.31	100.31	100.65	101.75	

Average = ∑(39)1...12/12 = 100.91 (39)

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

(40)m	1.29	1.27	1.27	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.26	1.27	

Average = ∑(40)1...12/12 = 1.26 (40)

4. Water heating energy requirement

kWh/year

Assumed occupancy, N 2.46 (42)

If TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)

If TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 92.69 (43)

Annual average hot water usage has been reduced by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	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)													
(44)m	101.96	98.25	94.55	90.84	87.13	83.42	83.42	87.13	90.84	94.55	98.25	101.96	

∑(44)1...12 = 1112.32 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

(45)m	151.57	132.56	136.79	119.26	114.43	98.75	91.50	105.00	106.26	123.83	135.17	146.79	

∑(45)1...12 = 1461.91 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

For community heating include distribution loss whether or not hot water tank is present

Distribution loss 0.15 x (45)m

(46)m	22.74	19.88	20.52	17.89	17.16	14.81	13.73	15.75	15.94	18.57	20.28	22.02	(46)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):	1.85	(47)
Temperature factor from Table 2b	0.54	(48)
Energy lost from water storage, kWh/day (47) x (48)	1.00	(49)
Enter (49) or (54) in (55)	1.00	(55)

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

(56)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(56)

If cylinder contains dedicated solar storage, = (56)m x [(50) - (H11)] ÷ (50), else = (56)m where (H11) is from Appendix H

(57)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(57)

Primary circuit loss (annual) from Table 3: 360.00 (58)

Primary circuit loss for each month (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m	30.58	27.62	30.58	29.59	30.58	29.59	30.58	30.58	29.59	30.58	29.59	30.58	(59)

Combi loss for each month from Table 3a, 3b or 3c (enter '0' if not a combi boiler)

(61)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	(61)

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

(62)m	213.11	188.15	198.34	178.82	175.98	158.31	153.05	166.55	165.81	185.37	194.73	208.33	(62)

Solar DHW input calculated using Appendix H (negative quantity) ('0' entered if no solar contribution to water heating)

(63)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	

∑(63)1...12 = 0.00 (63)

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

(64)m	213.11	188.15	198.34	178.82	175.98	158.31	153.05	166.55	165.81	185.37	194.73	208.33	

∑(64)1...12 = 2186.55 (64)

if (64)m < 0 then set to 0

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

(65)m	99.63	88.55	94.72	87.30	87.28	80.48	79.66	84.15	82.98	90.41	92.59	98.04	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	123.14	123.14	123.14	123.14	123.14	123.14	123.14	123.14	123.14	123.14	123.14	123.14	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m	19.56	17.38	14.13	10.70	8.00	6.75	7.30	9.48	12.73	16.16	18.86	20.11	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m	219.44	221.72	215.98	203.76	188.34	173.85	164.17	161.89	167.63	179.84	195.27	209.76	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m	35.31	35.31	35.31	35.31	35.31	35.31	35.31	35.31	35.31	35.31	35.31	35.31	(69)
Pumps and fans gains (Table 5a)													
(70)m	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	(71)
Water heating gains (Table 5)													
(72)m	133.91	131.77	127.31	121.25	117.32	111.78	107.07	113.10	115.25	121.52	128.60	131.78	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m	442.86	440.80	427.36	405.66	383.60	362.32	348.48	354.42	365.54	387.47	412.67	431.58	(73)

6. Solar gains

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Rows (74) to (82) are used 12 times, one for each month, repeating as needed if there is more than one window type.

Details for month of January and annual totals are shown below:

	Access factor Table 6d		Area m²		Solar flux W/m²		g Specific data or Table 6b		FF Specific data or Table 6c		Gains (W)	
West	0.54	x	8.68	x	19.87	x 0.9 x	0.63	x	0.80	=	42.25	(80)
Northwest	0.54	x	14.58	x	11.51	x 0.9 x	0.63	x	0.80	=	41.11	(81)

Solar gains in watts, calculated for each month ∑(74)m...(82)m

(83)m	83.36	166.03	277.79	436.51	557.10	595.00	571.60	477.81	339.53	205.46	104.41	68.29	(83)

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

(84)m	526.22	606.83	705.16	842.17	940.70	957.33	920.07	832.23	705.07	592.92	517.08	499.87	(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, η1,m (see Table 9a)													
(86)m	0.96	0.94	0.90	0.83	0.71	0.56	0.41	0.45	0.70	0.87	0.95	0.96	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)													
(87)m	18.46	18.74	19.27	19.85	20.43	20.77	20.93	20.91	20.61	19.91	19.02	18.52	(87)
Temperature during heating periods in the living area from Table 9, Th2(°C)													
(88)m	19.85	19.87	19.87	19.88	19.88	19.88	19.88	19.88	19.88	19.88	19.88	19.87	(88)
Utilisation factor for gains for rest of dwelling η2,m (see Table 9a)													
(89)m	0.95	0.93	0.89	0.81	0.66	0.49	0.31	0.34	0.63	0.84	0.94	0.96	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)													
(90)m	16.49	16.90	17.66	18.48	19.26	19.68	19.84	19.83	19.51	18.59	17.32	16.59	(90)

Living area fraction fLA 31.30 ÷ (4) = 0.39 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2													
(92)m	17.26	17.62	18.29	19.02	19.71	20.11	20.27	20.25	19.94	19.10	17.98	17.34	(92)
Apply adjustment to the mean internal temperature from Table 4e, where appropriate													
(93)m	17.11	17.47	18.14	18.87	19.56	19.96	20.12	20.10	19.79	18.95	17.83	17.19	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that tim = (93)m and recalculate the utilisation factor for gains using Table 9a)													
Utilisation factor for gains, ηm													
(94)m	0.93	0.91	0.86	0.78	0.65	0.49	0.33	0.36	0.62	0.82	0.91	0.93	(94)
Useful gains, ηmGm, W = (94)m x (84)m													
(95)m	489.99	550.68	605.09	654.28	609.01	472.38	306.54	302.04	437.18	483.70	470.59	466.94	(95)
Monthly average external temperature from Table 8													
(96)m	4.50	5.00	6.80	8.70	11.70	14.60	16.90	16.90	14.30	10.80	7.00	4.90	(96)
Heat loss rate for mean internal temperature, Lm, W													
(97)m	1296.72	1268.45	1153.80	1019.88	788.87	537.60	322.57	321.44	550.47	817.82	1090.23	1250.71	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m - (95)m] x (41)m													
(98)m	600.21	482.34	408.23	263.23	133.82	0.00	0.00	0.00	0.00	248.59	446.14	583.13	

Total per year (kWh/year) = ∑(98)1...5, 10...12 = 3165.68 (98)

Space heating requirement in kWh/m²/year (98) ÷ (4) 39.57 (99)

9a. Energy Requirements - Individual heating systems including micro-CHP

Space heating:

Fraction of space heating from secondary/supplementary system (Table 11) 0.00 (201)

Fraction of space heating from main system(s) 1 - (201)	1.00	(202)
Fraction of main heating from main system 2	0.00	(203)
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 space heating system 1 (%)	93.00	(206)

(from database or Table 4a/4b, adjusted where appropriate by the amount shown in the 'space efficiency adjustment' column of Table 4c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement, kWh/month (as calculated above)												
(98)m	600.21	482.34	408.23	263.23	133.82	0.00	0.00	0.00	0.00	248.59	446.14	583.13
Space heating fuel (main heating system 1), kWh/month = (98)m x (204) x 100 ÷ (206)												
(211)m	645.38	518.64	438.96	283.04	143.89	0.00	0.00	0.00	0.00	267.30	479.72	627.02

Total per year (kWh/year) = ∑(211)1...5, 10...12 = 3403.96 (211)

Water heating:

Output from water heater, kWh/month (calculated above)												
(64)m	213.11	188.15	198.34	178.82	175.98	158.31	153.05	166.55	165.81	185.37	194.73	208.33

∑(64)1...12 = 2186.55 (64)

Efficiency of water heater per month												
(217)m	86.93	86.72	86.20	85.34	83.59	79.30	79.30	79.30	79.30	85.10	86.46	86.91
Fuel for water heating, kWh/month = (64)m x 100 ÷ (217)m												
(219)m	245.16	216.97	230.10	209.53	210.52	199.63	193.00	210.02	209.10	217.84	225.24	239.70

Total per year (kWh/year) = ∑(219)1...12 = 2606.81 (219)

Annual Totals Summary:	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		3403.96	(211)
Water heating fuel used		2606.81	(219)
Electricity for pumps, fans and electric keep-hot (Table 4f):			
mechanical ventilation fans - balanced, extract or positive input from outside	59.38		(230a)
warm air heating system fans	0.00		(230b)
central heating pump	130.00		(230c)
oil boiler pump	0.00		(230d)
boiler flue fan	45.00		(230e)
maintaining electric keep-hot facility for gas combi boiler	0.00		(230f)
pump for solar water heating	0.00		(230g)
Total electricity for the above	∑(230a)...(230g)	234.38	(231)
Electricity for lighting (calculated in Appendix L):		345.49	(232)
Energy saving/generation technologies (Appendices M, N and Q):			
Electricity generated by PVs (Appendix M) (negative quantity)		-746.81	(233)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year		Emissions Factor		Emissions (kgCO2/year)	
Space heating - main system 1	3403.96	x	0.198	=	673.98	(261)
Water heating	2606.81	x	0.198	=	516.15	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1190.13	(265)
Pumps, fans and electric keep-hot	234.38	x	0.517	=	121.17	(267)
Lighting	345.49	x	0.517	=	178.62	(268)
Energy saving/generation technologies:						
PV emission savings (negative quantity)	-746.81	x	0.529	=	-395.06	(269)
Total carbon dioxide emissions				∑(261)...(271) =	1094.87	(272)

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SAP 2009 Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Stuart Searle	Assessor number	2435
Client		Last modified	01/02/2013
Address	P02 4 St Augustines, London, NW1		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		80.00	(1a) x	2.60	(2a) =	208.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	80.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	208.00	(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	5.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.25	(18)

Air permeability value applies if a pressurisation test has been done, or a design or specified air permeability is being used

Number of sides on which dwelling is sheltered		2	(19)
Shelter factor	1 - [0.075 x (19)] =	0.85	(20)
Adjusted infiltration rate	(18) x (20) =	0.21	(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 7													
(22)m	5.40	5.10	5.10	4.50	4.10	3.90	3.70	3.70	4.20	4.50	4.80	5.10	
										∑(22)1...12 =		54.10	(22)
Wind Factor (22a)m = (22)m ÷ 4													
(22a)m	1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.20	1.27	
										∑(22a)1...12 =		13.52	(22a)
Adjusted infiltration rate (allowing for shelter and wind speed) = (21) × (22a)m													
(22b)m	0.29	0.27	0.27	0.24	0.22	0.21	0.20	0.20	0.22	0.24	0.26	0.27	
										∑(22b)1...12 =		2.87	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)), otherwise (23b) = (23a)	0.5	(23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = N/A (23c)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b)m + 0.5 x (23b)

(24c)m	0.54	0.52	0.52	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.52	(24c)

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

(25)m	0.54	0.52	0.52	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.52	(25)

3. Heat losses and heat loss parameter

The κ-value is the heat capacity per unit area, see Table 1e.

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	
Doors			2.10	x	1.60	=	3.36	N/A	N/A	(26)
Window*			8.68	x	1.15	=	9.94	N/A	N/A	(27)
Window*			14.58	x	1.33	=	19.33	N/A	N/A	(27)
Ground floor			80.00	x	0.12	=	9.60	N/A	N/A	(28a)
External wall			50.20	x	0.20	=	10.04	N/A	N/A	(29a)
Party Wall			33.80	x	0.00	=	0.00	N/A	N/A	(32)

Total area of external elements ∑A, m² 155.56 (31)

** for windows and roof windows, effective window U-value is calculated using formula 1/[(1/UValue)+0.04] paragraph 3.2*

Fabric heat loss, W/K = ∑(A × U) (26)...(30) + (32) = 52.27 (33)

Heat capacity Cm = ∑(A x κ) (28)...(30) + (32) + (32a)...(32e) = N/A (34)

Thermal mass parameter (TMP) in kJ/m²K Calculated separately = 100.00 (35)

Thermal bridges: ∑(L x Ψ) calculated using Appendix K 13.72 (36)

if details of thermal bridging are not known then (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 65.99 (37)

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

(38)m	36.85	35.76	35.76	34.32	34.32	34.32	34.32	34.32	34.32	34.32	34.66	35.76	(38)

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

(39)m	102.84	101.75	101.75	100.31	100.31	100.31	100.31	100.31	100.31	100.31	100.65	101.75	

Average = ∑(39)1...12/12 = 100.91 (39)

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

(40)m	1.29	1.27	1.27	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.26	1.27	

Average = ∑(40)1...12/12 = 1.26 (40)

4. Water heating energy requirement

kWh/year

Assumed occupancy, N 2.46 (42)

If TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)

If TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 92.69 (43)

Annual average hot water usage has been reduced by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	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)													
(44)m	101.96	98.25	94.55	90.84	87.13	83.42	83.42	87.13	90.84	94.55	98.25	101.96	

∑(44)1...12 = 1112.32 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

(45)m	151.57	132.56	136.79	119.26	114.43	98.75	91.50	105.00	106.26	123.83	135.17	146.79	

∑(45)1...12 = 1461.91 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

For community heating include distribution loss whether or not hot water tank is present

Distribution loss 0.15 x (45)m

(46)m	22.74	19.88	20.52	17.89	17.16	14.81	13.73	15.75	15.94	18.57	20.28	22.02	(46)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):	1.85	(47)
Temperature factor from Table 2b	0.54	(48)
Energy lost from water storage, kWh/day (47) x (48)	1.00	(49)
Enter (49) or (54) in (55)	1.00	(55)

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

(56)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(56)

If cylinder contains dedicated solar storage, = (56)m x [(50) - (H11)] ÷ (50), else = (56)m where (H11) is from Appendix H

(57)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(57)

Primary circuit loss (annual) from Table 3: 360.00 (58)

Primary circuit loss for each month (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m	30.58	27.62	30.58	29.59	30.58	29.59	30.58	30.58	29.59	30.58	29.59	30.58	(59)

Combi loss for each month from Table 3a, 3b or 3c (enter '0' if not a combi boiler)

(61)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	(61)

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

(62)m	213.11	188.15	198.34	178.82	175.98	158.31	153.05	166.55	165.81	185.37	194.73	208.33	(62)

Solar DHW input calculated using Appendix H (negative quantity) ('0' entered if no solar contribution to water heating)

(63)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	

∑(63)1...12 = 0.00 (63)

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

(64)m	213.11	188.15	198.34	178.82	175.98	158.31	153.05	166.55	165.81	185.37	194.73	208.33	

∑(64)1...12 = 2186.55 (64)

if (64)m < 0 then set to 0

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

(65)m	99.63	88.55	94.72	87.30	87.28	80.48	79.66	84.15	82.98	90.41	92.59	98.04	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	147.77	147.77	147.77	147.77	147.77	147.77	147.77	147.77	147.77	147.77	147.77	147.77	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m	48.91	43.44	35.33	26.75	19.99	16.88	18.24	23.71	31.82	40.40	47.15	50.27	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m	327.52	330.92	322.36	304.12	281.11	259.48	245.03	241.63	250.19	268.42	291.44	313.07	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m	52.24	52.24	52.24	52.24	52.24	52.24	52.24	52.24	52.24	52.24	52.24	52.24	(69)
Pumps and fans gains (Table 5a)													
(70)m	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	(71)
Water heating gains (Table 5)													
(72)m	133.91	131.77	127.31	121.25	117.32	111.78	107.07	113.10	115.25	121.52	128.60	131.78	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m	621.84	617.63	596.49	563.62	529.92	499.63	481.83	489.93	508.75	541.84	578.69	606.61	(73)

6. Solar gains

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Rows (74) to (82) are used 12 times, one for each month, repeating as needed if there is more than one window type.

Details for month of January and annual totals are shown below:

	Access factor Table 6d		Area m²		Solar flux W/m²		g Specific data or Table 6b		FF Specific data or Table 6c		Gains (W)	
West	0.54	x	8.68	x	19.87	x 0.9 x	0.63	x	0.80	=	42.25	(80)
Northwest	0.54	x	14.58	x	11.51	x 0.9 x	0.63	x	0.80	=	41.11	(81)

Solar gains in watts, calculated for each month ∑(74)m...(82)m

(83)m	83.36	166.03	277.79	436.51	557.10	595.00	571.60	477.81	339.53	205.46	104.41	68.29	(83)

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

(84)m	705.21	783.66	874.29	1000.13	1087.01	1094.63	1053.43	967.75	848.28	747.30	683.10	674.90	(84)

7. Mean internal temperature (heating season)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area, η1,m (see Table 9a)													
(86)m	0.93	0.91	0.86	0.78	0.66	0.51	0.37	0.39	0.63	0.81	0.91	0.93	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)													
(87)m	18.78	19.03	19.52	20.03	20.53	20.82	20.95	20.94	20.70	20.11	19.30	18.84	(87)
Temperature during heating periods in the living area from Table 9, Th2(°C)													
(88)m	19.85	19.87	19.87	19.88	19.88	19.88	19.88	19.88	19.88	19.88	19.88	19.87	(88)
Utilisation factor for gains for rest of dwelling η2,m (see Table 9a)													
(89)m	0.92	0.89	0.84	0.75	0.61	0.44	0.27	0.30	0.55	0.78	0.89	0.92	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)													
(90)m	16.94	17.32	18.00	18.71	19.37	19.72	19.85	19.84	19.60	18.84	17.71	17.03	(90)

Living area fraction fLA 31.30 ÷ (4) = 0.39 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2													
(92)m	17.66	17.99	18.59	19.23	19.82	20.15	20.28	20.27	20.03	19.34	18.33	17.74	(92)
Apply adjustment to the mean internal temperature from Table 4e, where appropriate													
(93)m	17.51	17.84	18.44	19.08	19.67	20.00	20.13	20.12	19.88	19.19	18.18	17.59	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that tim = (93)m and recalculate the utilisation factor for gains using Table 9a)													
Utilisation factor for gains, ηm													
(94)m	0.89	0.86	0.81	0.73	0.60	0.45	0.30	0.32	0.55	0.75	0.86	0.89	(94)
Useful gains, ηmGm, W = (94)m x (84)m													
(95)m	626.66	675.82	707.18	726.59	649.15	489.42	311.55	308.54	470.66	562.87	588.18	601.64	(95)
Monthly average external temperature from Table 8													
(96)m	4.50	5.00	6.80	8.70	11.70	14.60	16.90	16.90	14.30	10.80	7.00	4.90	(96)
Heat loss rate for mean internal temperature, Lm, W													
(97)m	1337.96	1306.18	1184.56	1040.97	799.87	541.94	323.82	323.08	559.52	841.21	1125.44	1291.07	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m - (95)m] x (41)m													
(98)m	529.21	423.60	355.17	226.35	112.13	0.00	0.00	0.00	0.00	207.08	386.83	512.94	

Total per year (kWh/year) = ∑(98)1...5, 10...12 = 2753.31 (98)

Space heating requirement in kWh/m²/year (98) ÷ (4) 34.42 (99)

9a. Energy Requirements - Individual heating systems including micro-CHP

Space heating:

Fraction of space heating from secondary/supplementary system (Table 11) 0.00 (201)

Fraction of space heating from main system(s) 1 - (201)	1.00	(202)
Fraction of main heating from main system 2	0.00	(203)
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 space heating system 1 (%)	93.00	(206)

(from database or Table 4a/4b, adjusted where appropriate by the amount shown in the 'space efficiency adjustment' column of Table 4c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement, kWh/month (as calculated above)												
(98)m	529.21	423.60	355.17	226.35	112.13	0.00	0.00	0.00	0.00	207.08	386.83	512.94
Space heating fuel (main heating system 1), kWh/month = (98)m x (204) x 100 ÷ (206)												
(211)m	569.05	455.49	381.91	243.38	120.57	0.00	0.00	0.00	0.00	222.67	415.94	551.54

Total per year (kWh/year) = ∑(211)1...5, 10...12 = 2960.54 (211)

Water heating:

Output from water heater, kWh/month (calculated above)												
(64)m	213.11	188.15	198.34	178.82	175.98	158.31	153.05	166.55	165.81	185.37	194.73	208.33

∑(64)1...12 = 2186.55 (64)

Efficiency of water heater per month												
(217)m	86.64	86.41	85.85	84.94	83.15	79.30	79.30	79.30	79.30	84.61	86.11	86.62
Fuel for water heating, kWh/month = (64)m x 100 ÷ (217)m												
(219)m	245.97	217.73	231.03	210.52	211.64	199.63	193.00	210.02	209.10	219.10	226.14	240.50

Total per year (kWh/year) = ∑(219)1...12 = 2614.38 (219)

Annual Totals Summary:	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		2960.54	(211)
Water heating fuel used		2614.38	(219)
Electricity for pumps, fans and electric keep-hot (Table 4f):			
mechanical ventilation fans - balanced, extract or positive input from outside	59.38		(230a)
warm air heating system fans	0.00		(230b)
central heating pump	130.00		(230c)
oil boiler pump	0.00		(230d)
boiler flue fan	45.00		(230e)
maintaining electric keep-hot facility for gas combi boiler	0.00		(230f)
pump for solar water heating	0.00		(230g)
Total electricity for the above	∑(230a)...(230g)	234.38	(231)
Electricity for lighting (calculated in Appendix L):		345.49	(232)
Energy saving/generation technologies (Appendices M, N and Q):			
Electricity generated by PVs (Appendix M) (negative quantity)		-746.81	(233)

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

	Fuel kWh/year		Fuel price (Table 12)		Fuel cost £/year	
Space heating - main system 1	2960.54	x	3.10	x 0.01 =	91.78	(240)
Water heating cost (other fuel)	2614.38	x	3.10	x 0.01 =	81.05	(247)
Pumps, fans and electric keep-hot	234.38	x	11.46	x 0.01 =	26.86	(249)
Energy for lighting	345.49	x	11.46	x 0.01 =	39.59	(250)
Additional standing charges (Table 12)					106.00	(251)
Energy saving/generation technologies (Appendices M, N and Q):						
PV savings (negative quantity)	-746.81	x	11.46	x 0.01 =	-85.58	(252)
Total energy cost			(240)...(242) + (245)...(254)		259.69	(255)

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

Energy cost deflator (Table 12)		0.47	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	0.98	(257)
SAP value		86.38	
SAP rating		86	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year		Emissions Factor		Emissions (kgCO2/year)	
Space heating - main system 1	2960.54	x	0.198	=	586.19	(261)
Water heating	2614.38	x	0.198	=	517.65	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1103.83	(265)
Pumps, fans and electric keep-hot	234.38	x	0.517	=	121.17	(267)
Lighting	345.49	x	0.517	=	178.62	(268)
Energy saving/generation technologies:						
PV emission savings (negative quantity)	-746.81	x	0.529	=	-395.06	(269)
Total carbon dioxide emissions			∑(261)...(271) =		1008.57	(272)
Dwelling carbon dioxide emissions rate			(272) ÷ (4) =		12.61	(273)
EI value					89.19	
EI rating (see section 14)					89	(274)
EI band					B	

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

	Energy kWh/year		Primary Energy Factor		Primary Energy	
Space heating - main system 1	2960.54	x	1.02	=	3019.75	(261*)
Water heating	2614.38	x	1.02	=	2666.66	(264*)
Space and water heating			(261*) + (262*) + (263*) + (264*) =		5686.42	(265*)
Pumps, fans and electric keep-hot	234.38	x	2.92	=	684.39	(267*)
Lighting	345.49	x	2.92	=	1008.84	(268*)
Energy saving/generation technologies:						
PV primary energy savings (negative quantity)	-746.81	x	2.92	=	-2180.68	(269*)
Total primary energy kWh/year			∑(261*)...(271*) =		5198.97	(272*)
Primary energy kWh/m2/year			(272*) ÷ (4) =		64.99	(273*)

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Code for Sustainable Homes (November 2010)
Design - Draft

This report details the calculations and results for Ene 1, 2 and 7 of the Code For Sustainable Homes.

This Design Assessment has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed. Code calculations are from the Technical Guide (November 2010).

Assessor name	Mr Stuart Searle	Assessor number	2435
Client		Last modified	01/02/2013
Address	P03 4 St Augustines, London, NW1		

Building regulation assessment - criterion 1

	kg/m²/yr
DER	9.57
TER	14.98

Assessment of zero carbon home and low or zero carbon technologies

		Credits	Level
Dwelling emission rate (Ene 1)	CO_2 reduction = 36.1 %	4	4
Fabric Energy Efficiency	FEE = 40.8	6.1	
Low or zero carbon technologies (Ene 7)	CO_2 reduction = 15 %	2	

Ene 1 - dwelling emission rate

	%	kWh/m²	kgCO_2/m²/yr	
Assessment of Ene 1 (level 1-5)				
DER from SAP 2009 DER worksheet			9.57	
Additional allowable generation		0.00		
CO_2 emissions offset from generation			0.00	
CO_2 emissions offset from community biofuel CHP systems			0.00	
Total CO_2 emissions offset from SAP section 16 allowances			**0.00**	
DER accounting for SAP section 16 allowances			**9.57**	
CO_2 reduction compared to TER			5.41	
CO_2 reduction as % of TER	36.1			
Assessment of Ene 1 (level 6)				
DER from SAP 2009 DER worksheet			9.57	(ZC1)
CO_2 emissions from appliances (equation L14)			14.75	(ZC2)
CO_2 emissions from cooking (equation L16)			1.74	(ZC3)
Total CO_2 emissions			26.06	(ZC4)
Additional allowable generation and its CO_2 emissions offset		0.00		(ZC6)
CO_2 emissions offset from additional allowable generation			0.00	(ZC7)
CO_2 emissions offset from community biofuel CHP systems			0.00	(ZC5)
Net CO_2 emissions			**26.06**	(ZC8)

Ene 1 - dwelling emission rate - level 6

There is no Zero Carbon Home definition in the current technical guide

	Criterion	Value	Pass/Fail
FEE	<= 39	40.8	Fail
Net CO_2 emissions	<= 0.00	26.06	Fail

Result: Not level 6

Number of credits for Ene 1	**4**

Ene 2 - Fabric Energy Efficiency

FEE	40.8
Number of credits for Ene 2	**6.1**

Ene 7 - low or zero carbon technologies

	Emissions $kgCO_2/yr$	Reduction $kgCO_2/yr$
Standard case		
Space and water heating (265)	1338.74	
Mechanical cooling (266)	0.00	
Pumps and fans (267)	131.54	
Lighting (268)	217.44	
Appliances and cooking	1764.63	
Total CO_2	**3452.34**	
Actual case		
Space and water heating (265) or (376)	1338.74	
Space and water heating from LZCT considered in SAP 2009		0.00
Pumps and fans (267) or (378)	131.54	
Pumps and fans		0.00
Electricity generated by LZCT (269) + (380))		-528.11
Additional allowable electricity generation considered in SAP 2009 section 16		0.00
Offset from biofuel CHP [-1 x [(363)..(366) + (368)...(372)]]		0.00
LZCT electricity generation		-528.11
LZCT thermal generation		0
Total from specified LZCT		**-528.11**

	Emissions $kgCO_2/m^2/yr$	
Reduction in CO_2 Emissions		
Standard Case CO_2	32.26	
Actual Case CO_2	27.33	
% Reduction in CO_2	15	
Number of credits for Ene 7	**2**	

DRAFT

DER 2009 Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Stuart Searle	Assessor number	2435
Client		Last modified	01/02/2013
Address	P03 4 St Augustines, London, NW1		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		107.00	(1a) x	2.60	(2a) =	278.20	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	107.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	278.20	(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	5.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.25	(18)

Air permeability value applies if a pressurisation test has been done, or a design or specified air permeability is being used

Number of sides on which dwelling is sheltered		1	(19)
Shelter factor	1 - [0.075 x (19)] =	0.92	(20)
Adjusted infiltration rate	(18) x (20) =	0.23	(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 7													
(22)m	5.40	5.10	5.10	4.50	4.10	3.90	3.70	3.70	4.20	4.50	4.80	5.10	
										∑(22)1...12 =		54.10	(22)
Wind Factor (22a)m = (22)m ÷ 4													
(22a)m	1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.20	1.27	
										∑(22a)1...12 =		13.52	(22a)
Adjusted infiltration rate (allowing for shelter and wind speed) = (21) × (22a)m													
(22b)m	0.31	0.29	0.29	0.26	0.24	0.23	0.21	0.21	0.24	0.26	0.28	0.29	
										∑(22b)1...12 =		3.13	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)), otherwise (23b) = (23a)	0.5	(23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = N/A (23c)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b)m + 0.5 x (23b)

(24c)m	0.56	0.54	0.54	0.51	0.50	0.50	0.50	0.50	0.50	0.51	0.53	0.54	(24c)

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

(25)m	0.56	0.54	0.54	0.51	0.50	0.50	0.50	0.50	0.50	0.51	0.53	0.54	(25)

3. Heat losses and heat loss parameter

The κ-value is the heat capacity per unit area, see Table 1e.

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	
Doors			2.10	x	1.60	=	3.36	N/A	N/A	(26)
Window*			8.68	x	1.15	=	9.94	N/A	N/A	(27)
Window*			17.49	x	1.33	=	23.19	N/A	N/A	(27)
External wall			84.65	x	0.20	=	16.93	N/A	N/A	(29a)
Party Wall			34.19	x	0.00	=	0.00	N/A	N/A	(32)

Total area of external elements ∑A, m² 112.92 (31)

** for windows and roof windows, effective window U-value is calculated using formula 1/[(1/UValue)+0.04] paragraph 3.2*

Fabric heat loss, W/K = ∑(A × U) (26)...(30) + (32) = 53.42 (33)

Heat capacity Cm = ∑(A x κ) (28)...(30) + (32) + (32a)...(32e) = N/A (34)

Thermal mass parameter (TMP) in kJ/m²K Calculated separately = 100.00 (35)

Thermal bridges: ∑(L x Ψ) calculated using Appendix K 12.54 (36)

if details of thermal bridging are not known then (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 65.96 (37)

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

(38)m	51.61	50.02	50.02	46.84	45.90	45.90	45.90	45.90	45.90	46.84	48.43	50.02	(38)

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

(39)m	117.57	115.98	115.98	112.79	111.86	111.86	111.86	111.86	111.86	112.79	114.38	115.98	

Average = ∑(39)1...12/12 = 113.73 (39)

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

(40)m	1.10	1.08	1.08	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.07	1.08	

Average = ∑(40)1...12/12 = 1.06 (40)

4. Water heating energy requirement

kWh/year

Assumed occupancy, N 2.80 (42)

If TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)

If TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 100.59 (43)

Annual average hot water usage has been reduced by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	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)													
(44)m	110.65	106.63	102.61	98.58	94.56	90.54	90.54	94.56	98.58	102.61	106.63	110.65	

∑(44)1...12 = 1207.14 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

(45)m	164.49	143.86	148.45	129.43	124.19	107.16	99.30	113.95	115.31	134.39	146.69	159.30	

∑(45)1...12 = 1586.53 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

For community heating include distribution loss whether or not hot water tank is present

Distribution loss 0.15 x (45)m

(46)m	24.67	21.58	22.27	19.41	18.63	16.07	14.90	17.09	17.30	20.16	22.00	23.89	(46)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):	1.85	(47)
Temperature factor from Table 2b	0.54	(48)
Energy lost from water storage, kWh/day (47) x (48)	1.00	(49)
Enter (49) or (54) in (55)	1.00	(55)

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

(56)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(56)

If cylinder contains dedicated solar storage, = (56)m x [(50) - (H11)] ÷ (50), else = (56)m where (H11) is from Appendix H

(57)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(57)

Primary circuit loss (annual) from Table 3 360.00 (58)

Primary circuit loss for each month (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m	30.58	27.62	30.58	29.59	30.58	29.59	30.58	30.58	29.59	30.58	29.59	30.58	(59)

Combi loss for each month from Table 3a, 3b or 3c (enter '0' if not a combi boiler)

(61)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	(61)

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

(62)m	226.03	199.45	210.00	188.99	185.73	166.72	160.85	175.50	174.87	195.93	206.25	220.84	(62)

Solar DHW input calculated using Appendix H (negative quantity) ('0' entered if no solar contribution to water heating)

(63)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	

∑(63)1...12 = 0.00 (63)

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

(64)m	226.03	199.45	210.00	188.99	185.73	166.72	160.85	175.50	174.87	195.93	206.25	220.84	

∑(64)1...12 = 2311.17 (64)

if (64)m < 0 then set to 0

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

(65)m	103.93	92.31	98.60	90.68	90.53	83.28	82.25	87.12	85.99	93.92	96.42	102.20	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	139.78	139.78	139.78	139.78	139.78	139.78	139.78	139.78	139.78	139.78	139.78	139.78	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m	23.81	21.15	17.20	13.02	9.73	8.22	8.88	11.54	15.49	19.67	22.96	24.48	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m	267.17	269.95	262.96	248.09	229.31	211.67	199.88	197.10	204.09	218.96	237.74	255.38	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	36.98	(69)
Pumps and fans gains (Table 5a)													
(70)m	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m	-111.82	-111.82	-111.82	-111.82	-111.82	-111.82	-111.82	-111.82	-111.82	-111.82	-111.82	-111.82	(71)
Water heating gains (Table 5)													
(72)m	139.69	137.36	132.52	125.95	121.68	115.67	110.56	117.10	119.43	126.24	133.92	137.37	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m	505.61	503.39	487.62	461.99	435.66	410.48	394.25	400.68	413.95	439.81	469.55	492.16	(73)

6. Solar gains

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Rows (74) to (82) are used 12 times, one for each month, repeating as needed if there is more than one window type.

Details for month of January and annual totals are shown below:

	Access factor Table 6d		Area m²		Solar flux W/m²		g Specific data or Table 6b		FF Specific data or Table 6c		Gains (W)	
West	0.54	x	8.68	x	19.87	x 0.9 x	0.63	x	0.80	=	42.25	(80)
South	0.54	x	17.49	x	47.32	x 0.9 x	0.63	x	0.80	=	202.77	(78)

Solar gains in watts, calculated for each month ∑(74)m...(82)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(83)m	245.02	412.61	534.72	644.74	701.58	713.35	698.55	653.55	584.93	465.19	292.78	210.06	(83)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(84)m	750.63	916.00	1022.34	1106.73	1137.24	1123.83	1092.80	1054.23	998.88	905.00	762.33	702.22	(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, η1,m (see Table 9a)													
(86)m	0.95	0.92	0.87	0.81	0.70	0.56	0.40	0.41	0.62	0.81	0.93	0.95	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)													
(87)m	18.92	19.27	19.71	20.15	20.58	20.84	20.96	20.95	20.78	20.29	19.46	18.95	(87)
Temperature during heating periods in the living area from Table 9, Th2(˚C)													
(88)m	20.00	20.02	20.02	20.04	20.05	20.05	20.05	20.05	20.05	20.04	20.03	20.02	(88)
Utilisation factor for gains for rest of dwelling η2,m (see Table 9a)													
(89)m	0.94	0.91	0.86	0.78	0.66	0.49	0.31	0.32	0.56	0.78	0.91	0.95	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)													
(90)m	17.23	17.74	18.37	19.00	19.58	19.90	20.02	20.02	19.84	19.20	18.03	17.29	(90)

Living area fraction fLA 24.00 ÷ (4) = 0.22 (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2													
(92)m	17.61	18.08	18.67	19.26	19.80	20.11	20.23	20.23	20.05	19.44	18.35	17.67	(92)
Apply adjustment to the mean internal temperature from Table 4e, where appropriate													
(93)m	17.46	17.93	18.52	19.11	19.65	19.96	20.08	20.08	19.90	19.29	18.20	17.52	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that tim = (93)m and recalculate the utilisation factor for gains using Table 9a)													
Utilisation factor for gains, ηm													
(94)m	0.92	0.88	0.82	0.76	0.64	0.49	0.32	0.33	0.55	0.75	0.89	0.92	(94)
Useful gains, ηmGm, W = (94)m x (84)m													
(95)m	689.19	804.28	842.81	835.69	727.26	545.80	344.94	343.73	548.81	682.59	675.06	648.71	(95)
Monthly average external temperature from Table 8													
(96)m	4.50	5.00	6.80	8.70	11.70	14.60	16.90	16.90	14.30	10.80	7.00	4.90	(96)
Heat loss rate for mean internal temperature, Lm, W													
(97)m	1523.38	1499.87	1359.62	1174.08	889.71	600.01	355.80	355.51	626.12	957.76	1281.53	1463.25	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m - (95)m] x (41)m													
(98)m	620.63	467.44	384.50	243.64	120.86	0.00	0.00	0.00	0.00	204.73	436.66	606.02	

Total per year (kWh/year) = ∑(98)1...5, 10...12 = 3084.49 (98)

Space heating requirement in kWh/m²/year (98) ÷ (4) 28.83 (99)

9a. Energy Requirements - Individual heating systems including micro-CHP

Space heating:

Fraction of space heating from secondary/supplementary system (Table 11) 0.00 (201)

Fraction of space heating from main system(s) 1 - (201) 1.00 (202)

Fraction of main heating from main system 2 0.00 (203)

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 space heating system 1 (%)	93.00	(206)

(from database or Table 4a/4b, adjusted where appropriate by the amount shown in the 'space efficiency adjustment' column of Table 4c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement, kWh/month (as calculated above)												
(98)m	620.63	467.44	384.50	243.64	120.86	0.00	0.00	0.00	0.00	204.73	436.66	606.02
Space heating fuel (main heating system 1), kWh/month = (98)m x (204) x 100 ÷ (206)												
(211)m	667.35	502.63	413.45	261.98	129.96	0.00	0.00	0.00	0.00	220.14	469.53	651.63

Total per year (kWh/year) = ∑(211)1...5, 10...12 = 3316.65 (211)

Water heating:

Output from water heater, kWh/month (calculated above)												
(64)m	226.03	199.45	210.00	188.99	185.73	166.72	160.85	175.50	174.87	195.93	206.25	220.84

∑(64)1...12 = 2311.17 (64)

Efficiency of water heater per month												
(217)m	86.87	86.51	85.91	84.99	83.20	79.30	79.30	79.30	79.30	84.43	86.27	86.87
Fuel for water heating, kWh/month = (64)m x 100 ÷ (217)m												
(219)m	260.20	230.56	244.45	222.36	223.24	210.24	202.83	221.31	220.52	232.07	239.09	254.23

Total per year (kWh/year) = ∑(219)1...12 = 2761.09 (219)

Annual Totals Summary:	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		3316.65	(211)
Water heating fuel used		2761.09	(219)
Electricity for pumps, fans and electric keep-hot (Table 4f):			
mechanical ventilation fans - balanced, extract or positive input from outside	79.42		(230a)
warm air heating system fans	0.00		(230b)
central heating pump	130.00		(230c)
oil boiler pump	0.00		(230d)
boiler flue fan	45.00		(230e)
maintaining electric keep-hot facility for gas combi boiler	0.00		(230f)
pump for solar water heating	0.00		(230g)
Total electricity for the above	∑(230a)...(230g)	254.42	(231)
Electricity for lighting (calculated in Appendix L):		420.57	(232)
Energy saving/generation technologies (Appendices M, N and Q):			
Electricity generated by PVs (Appendix M) (negative quantity)		-998.32	(233)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year		Emissions Factor		Emissions (kgCO2/year)	
Space heating - main system 1	3316.65	x	0.198	=	656.70	(261)
Water heating	2761.09	x	0.198	=	546.70	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1203.39	(265)
Pumps, fans and electric keep-hot	254.42	x	0.517	=	131.54	(267)
Lighting	420.57	x	0.517	=	217.44	(268)
Energy saving/generation technologies:						
PV emission savings (negative quantity)	-998.32	x	0.529	=	-528.11	(269)
Total carbon dioxide emissions				∑(261)...(271) =	1024.25	(272)
Dwelling Carbon Dioxide Emissions Rate (DER)					9.57	(273)

SAP 2009 Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Stuart Searle	Assessor number	2435
Client		Last modified	01/02/2013
Address	P03 4 St Augustines, London, NW1		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		107.00	(1a) x	2.60	(2a) =	278.20	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	107.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	278.20	(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	5.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.25	(18)

Air permeability value applies if a pressurisation test has been done, or a design or specified air permeability is being used

Number of sides on which dwelling is sheltered		1	(19)
Shelter factor	1 - [0.075 x (19)] =	0.92	(20)
Adjusted infiltration rate	(18) x (20) =	0.23	(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 7													
(22)m	5.40	5.10	5.10	4.50	4.10	3.90	3.70	3.70	4.20	4.50	4.80	5.10	
										∑(22)1...12 =		54.10	(22)
Wind Factor (22a)m = (22)m ÷ 4													
(22a)m	1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.20	1.27	
										∑(22a)1...12 =		13.52	(22a)
Adjusted infiltration rate (allowing for shelter and wind speed) = (21) × (22a)m													
(22b)m	0.31	0.29	0.29	0.26	0.24	0.23	0.21	0.21	0.24	0.26	0.28	0.29	
										∑(22b)1...12 =		3.13	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)), otherwise (23b) = (23a)	0.5	(23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = N/A (23c)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b)m + 0.5 x (23b)

(24c)m	0.56	0.54	0.54	0.51	0.50	0.50	0.50	0.50	0.50	0.51	0.53	0.54	(24c)

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

(25)m	0.56	0.54	0.54	0.51	0.50	0.50	0.50	0.50	0.50	0.51	0.53	0.54	(25)

3. Heat losses and heat loss parameter

The κ-value is the heat capacity per unit area, see Table 1e.

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	
Doors			2.10	x	1.60	=	3.36	N/A	N/A	(26)
Window*			8.68	x	1.15	=	9.94	N/A	N/A	(27)
Window*			17.49	x	1.33	=	23.19	N/A	N/A	(27)
External wall			84.65	x	0.20	=	16.93	N/A	N/A	(29a)
Party Wall			34.19	x	0.00	=	0.00	N/A	N/A	(32)

Total area of external elements ∑A, m² 112.92 (31)

** for windows and roof windows, effective window U-value is calculated using formula 1/[(1/UValue)+0.04] paragraph 3.2*

Fabric heat loss, W/K = ∑(A × U) (26)...(30) + (32) = 53.42 (33)

Heat capacity Cm = ∑(A x κ) (28)...(30) + (32) + (32a)...(32e) = N/A (34)

Thermal mass parameter (TMP) in kJ/m²K Calculated separately = 100.00 (35)

Thermal bridges: ∑(L x Ψ) calculated using Appendix K 12.54 (36)

if details of thermal bridging are not known then (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 65.96 (37)

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

(38)m	51.61	50.02	50.02	46.84	45.90	45.90	45.90	45.90	45.90	46.84	48.43	50.02	(38)

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

(39)m	117.57	115.98	115.98	112.79	111.86	111.86	111.86	111.86	111.86	112.79	114.38	115.98	

Average = ∑(39)1...12/12 = 113.73 (39)

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

(40)m	1.10	1.08	1.08	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.07	1.08	

Average = ∑(40)1...12/12 = 1.06 (40)

4. Water heating energy requirement

kWh/year

Assumed occupancy, N 2.80 (42)

If TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)

If TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 100.59 (43)

Annual average hot water usage has been reduced by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	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)													
(44)m	110.65	106.63	102.61	98.58	94.56	90.54	90.54	94.56	98.58	102.61	106.63	110.65	

∑(44)1...12 = 1207.14 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

(45)m	164.49	143.86	148.45	129.43	124.19	107.16	99.30	113.95	115.31	134.39	146.69	159.30	

∑(45)1...12 = 1586.53 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

For community heating include distribution loss whether or not hot water tank is present

Distribution loss 0.15 x (45)m

(46)m	24.67	21.58	22.27	19.41	18.63	16.07	14.90	17.09	17.30	20.16	22.00	23.89	(46)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):	1.85	(47)
Temperature factor from Table 2b	0.54	(48)
Energy lost from water storage, kWh/day (47) x (48)	1.00	(49)
Enter (49) or (54) in (55)	1.00	(55)

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

(56)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(56)

If cylinder contains dedicated solar storage, = (56)m x [(50) - (H11)] ÷ (50), else = (56)m where (H11) is from Appendix H

(57)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(57)

Primary circuit loss (annual) from Table 3: 360.00 (58)

Primary circuit loss for each month (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m	30.58	27.62	30.58	29.59	30.58	29.59	30.58	30.58	29.59	30.58	29.59	30.58	(59)

Combi loss for each month from Table 3a, 3b or 3c (enter '0' if not a combi boiler)

(61)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	(61)

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

(62)m	226.03	199.45	210.00	188.99	185.73	166.72	160.85	175.50	174.87	195.93	206.25	220.84	(62)

Solar DHW input calculated using Appendix H (negative quantity) ('0' entered if no solar contribution to water heating)

(63)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	

∑(63)1...12 = 0.00 (63)

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

(64)m	226.03	199.45	210.00	188.99	185.73	166.72	160.85	175.50	174.87	195.93	206.25	220.84	

∑(64)1...12 = 2311.17 (64)

if (64)m < 0 then set to 0

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

(65)m	103.93	92.31	98.60	90.68	90.53	83.28	82.25	87.12	85.99	93.92	96.42	102.20	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	167.73	167.73	167.73	167.73	167.73	167.73	167.73	167.73	167.73	167.73	167.73	167.73	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m	59.54	52.88	43.00	32.56	24.34	20.55	22.20	28.86	38.73	49.18	57.40	61.19	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m	398.77	402.90	392.48	370.28	342.26	315.92	298.32	294.19	304.61	326.81	354.83	381.17	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m	54.57	54.57	54.57	54.57	54.57	54.57	54.57	54.57	54.57	54.57	54.57	54.57	(69)
Pumps and fans gains (Table 5a)													
(70)m	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m	-111.82	-111.82	-111.82	-111.82	-111.82	-111.82	-111.82	-111.82	-111.82	-111.82	-111.82	-111.82	(71)
Water heating gains (Table 5)													
(72)m	139.69	137.36	132.52	125.95	121.68	115.67	110.56	117.10	119.43	126.24	133.92	137.37	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m	718.47	713.62	688.48	649.26	608.75	572.61	551.56	560.63	583.26	622.71	666.64	700.21	(73)

6. Solar gains

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Rows (74) to (82) are used 12 times, one for each month, repeating as needed if there is more than one window type.

Details for month of January and annual totals are shown below:

	Access factor Table 6d		Area m²		Solar flux W/m²		g Specific data or Table 6b		FF Specific data or Table 6c		Gains (W)	
West	0.54	x	8.68	x	19.87	x 0.9 x	0.63	x	0.80	=	42.25	(80)
South	0.54	x	17.49	x	47.32	x 0.9 x	0.63	x	0.80	=	202.77	(78)

Solar gains in watts, calculated for each month ∑(74)m...(82)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(83)m	245.02	412.61	534.72	644.74	701.58	713.35	698.55	653.55	584.93	465.19	292.78	210.06	(83)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(84)m	963.49	1126.23	1223.20	1294.00	1310.33	1285.96	1250.11	1214.18	1168.19	1087.90	959.41	910.27	(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, η1,m (see Table 9a)													
(86)m	0.92	0.88	0.83	0.76	0.65	0.50	0.35	0.36	0.56	0.75	0.88	0.92	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)													
(87)m	19.20	19.52	19.92	20.30	20.66	20.88	20.97	20.97	20.83	20.43	19.71	19.24	(87)
Temperature during heating periods in the living area from Table 9, Th2(˚C)													
(88)m	20.00	20.02	20.02	20.04	20.05	20.05	20.05	20.05	20.05	20.04	20.03	20.02	(88)
Utilisation factor for gains for rest of dwelling η2,m (see Table 9a)													
(89)m	0.91	0.86	0.81	0.73	0.60	0.44	0.28	0.28	0.50	0.72	0.87	0.91	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)													
(90)m	17.64	18.09	18.65	19.19	19.68	19.94	20.03	20.03	19.89	19.38	18.37	17.70	(90)

Living area fraction fLA 24.00 ÷ (4) = 0.22 (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2													
(92)m	17.99	18.41	18.93	19.44	19.90	20.15	20.24	20.24	20.10	19.62	18.67	18.05	(92)
Apply adjustment to the mean internal temperature from Table 4e, where appropriate													
(93)m	17.84	18.26	18.78	19.29	19.75	20.00	20.09	20.09	19.95	19.47	18.52	17.90	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that tim = (93)m and recalculate the utilisation factor for gains using Table 9a)													
Utilisation factor for gains, ηm													
(94)m	0.88	0.83	0.78	0.70	0.59	0.44	0.28	0.29	0.49	0.69	0.84	0.88	(94)
Useful gains, ηmGm, W = (94)m x (84)m													
(95)m	843.08	937.07	948.13	910.77	768.86	562.08	348.76	348.02	573.53	754.32	801.51	801.56	(95)
Monthly average external temperature from Table 8													
(96)m	4.50	5.00	6.80	8.70	11.70	14.60	16.90	16.90	14.30	10.80	7.00	4.90	(96)
Heat loss rate for mean internal temperature, Lm, W													
(97)m	1568.36	1538.38	1389.79	1194.59	900.38	603.94	356.72	356.54	632.24	977.35	1317.89	1507.50	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m - (95)m] x (41)m													
(98)m	539.61	404.08	328.60	204.35	97.86	0.00	0.00	0.00	0.00	165.94	371.79	525.22	

Total per year (kWh/year) = ∑(98)1...5, 10...12 = 2637.44 (98)

Space heating requirement in kWh/m²/year (98) ÷ (4) = 24.65 (99)

9a. Energy Requirements - Individual heating systems including micro-CHP

Space heating:

Fraction of space heating from secondary/supplementary system (Table 11) 0.00 (201)

Fraction of space heating from main system(s) 1 - (201) 1.00 (202)

Fraction of main heating from main system 2 0.00 (203)

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 space heating system 1 (%)	93.00	(206)

(from database or Table 4a/4b, adjusted where appropriate by the amount shown in the 'space efficiency adjustment' column of Table 4c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement, kWh/month (as calculated above)												
(98)m	539.61	404.08	328.60	204.35	97.86	0.00	0.00	0.00	0.00	165.94	371.79	525.22
Space heating fuel (main heating system 1), kWh/month = (98)m x (204) x 100 ÷ (206)												
(211)m	580.23	434.49	353.33	219.73	105.22	0.00	0.00	0.00	0.00	178.43	399.78	564.75

Total per year (kWh/year) = ∑(211)1...5, 10...12 = 2835.96 (211)

Water heating:

Output from water heater, kWh/month (calculated above)												
(64)m	226.03	199.45	210.00	188.99	185.73	166.72	160.85	175.50	174.87	195.93	206.25	220.84

∑(64)1...12 = 2311.17 (64)

Efficiency of water heater per month												
(217)m	86.55	86.16	85.50	84.52	82.69	79.30	79.30	79.30	79.30	83.87	85.87	86.54
Fuel for water heating, kWh/month = (64)m x 100 ÷ (217)m												
(219)m	261.15	231.50	245.61	223.60	224.61	210.24	202.83	221.31	220.52	233.61	240.20	255.18

Total per year (kWh/year) = ∑(219)1...12 = 2770.35 (219)

Annual Totals Summary:	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		2835.96	(211)
Water heating fuel used		2770.35	(219)
Electricity for pumps, fans and electric keep-hot (Table 4f):			
mechanical ventilation fans - balanced, extract or positive input from outside	79.42		(230a)
warm air heating system fans	0.00		(230b)
central heating pump	130.00		(230c)
oil boiler pump	0.00		(230d)
boiler flue fan	45.00		(230e)
maintaining electric keep-hot facility for gas combi boiler	0.00		(230f)
pump for solar water heating	0.00		(230g)
Total electricity for the above	∑(230a)...(230g)	254.42	(231)
Electricity for lighting (calculated in Appendix L):		420.57	(232)
Energy saving/generation technologies (Appendices M, N and Q):			
Electricity generated by PVs (Appendix M) (negative quantity)		-998.32	(233)

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

	Fuel kWh/year		Fuel price (Table 12)		Fuel cost £/year	
Space heating - main system 1	2835.96	x	3.10	x 0.01 =	87.91	(240)
Water heating cost (other fuel)	2770.35	x	3.10	x 0.01 =	85.88	(247)
Pumps, fans and electric keep-hot	254.42	x	11.46	x 0.01 =	29.16	(249)
Energy for lighting	420.57	x	11.46	x 0.01 =	48.20	(250)
Additional standing charges (Table 12)					106.00	(251)
Energy saving/generation technologies (Appendices M, N and Q):						
PV savings (negative quantity)	-998.32	x	11.46	x 0.01 =	-114.41	(252)
Total energy cost			(240)...(242) + (245)...(254)		242.74	(255)

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

Energy cost deflator (Table 12)	0.47	(256)

Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	0.75	(257)
SAP value		89.53	
SAP rating		90	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year		Emissions Factor		Emissions (kgCO2/year)	
Space heating - main system 1	2835.96	x	0.198	=	561.52	(261)
Water heating	2770.35	x	0.198	=	548.53	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1110.05	(265)
Pumps, fans and electric keep-hot	254.42	x	0.517	=	131.54	(267)
Lighting	420.57	x	0.517	=	217.44	(268)
Energy saving/generation technologies:						
PV emission savings (negative quantity)	-998.32	x	0.529	=	-528.11	(269)
Total carbon dioxide emissions			∑(261)...(271) =		930.91	(272)
Dwelling carbon dioxide emissions rate			(272) ÷ (4) =		8.70	(273)
EI value					91.79	
EI rating (see section 14)					92	(274)
EI band					A	

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

	Energy kWh/year		Primary Energy Factor		Primary Energy	
Space heating - main system 1	2835.96	x	1.02	=	2892.68	(261*)
Water heating	2770.35	x	1.02	=	2825.76	(264*)
Space and water heating			(261*) + (262*) + (263*) + (264*) =		5718.44	(265*)
Pumps, fans and electric keep-hot	254.42	x	2.92	=	742.91	(267*)
Lighting	420.57	x	2.92	=	1228.08	(268*)
Energy saving/generation technologies:						
PV primary energy savings (negative quantity)	-998.32	x	2.92	=	-2915.09	(269*)
Total primary energy kWh/year			∑(261*)...(271*) =		4774.33	(272*)
Primary energy kWh/m2/year			(272*) ÷ (4) =		44.62	(273*)

DRAFT

Code for Sustainable Homes (November 2010)
Design - Draft

This report details the calculations and results for Ene 1, 2 and 7 of the Code For Sustainable Homes.

This Design Assessment has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed. Code calculations are from the Technical Guide (November 2010).

Assessor name	Mr Stuart Searle	Assessor number	2435
Client		Last modified	01/02/2013
Address	P04 4 St Augustines, London, NW1		

Building regulation assessment - criterion 1

	kg/m²/yr
DER	12.12
TER	15.73

Assessment of zero carbon home and low or zero carbon technologies

		Credits	Level
Dwelling emission rate (Ene 1)	CO_2 reduction = 22.9 %	2.7	3
Fabric Energy Efficiency	FEE = 45.6	3.7	
Low or zero carbon technologies (Ene 7)	CO_2 reduction = 13 %	1	

Ene 1 - dwelling emission rate

	%	kWh/m²	kgCO_2/m²/yr	
Assessment of Ene 1 (level 1-5)				
DER from SAP 2009 DER worksheet			12.12	
Additional allowable generation		0.00		
CO_2 emissions offset from generation			0.00	
CO_2 emissions offset from community biofuel CHP systems			0.00	
Total CO_2 emissions offset from SAP section 16 allowances			**0.00**	
DER accounting for SAP section 16 allowances			**12.12**	
CO_2 reduction compared to TER			3.61	
CO_2 reduction as % of TER	22.9			
Assessment of Ene 1 (level 6)				
DER from SAP 2009 DER worksheet			12.12	(ZC1)
CO_2 emissions from appliances (equation L14)			16.21	(ZC2)
CO_2 emissions from cooking (equation L16)			2.23	(ZC3)
Total CO_2 emissions			30.55	(ZC4)
Additional allowable generation and its CO_2 emissions offset		0.00		(ZC6)
CO_2 emissions offset from additional allowable generation			0.00	(ZC7)
CO_2 emissions offset from community biofuel CHP systems			0.00	(ZC5)
Net CO_2 emissions			**30.55**	(ZC8)

Ene 1 - dwelling emission rate - level 6

There is no Zero Carbon Home definition in the current technical guide

	Criterion	Value	Pass/Fail
FEE	<= 39	45.6	Fail
Net CO_2 emissions	<= 0.00	30.55	Fail

Result: Not level 6

Number of credits for Ene 1	**2.7**

Ene 2 - Fabric Energy Efficiency

FEE	45.6
Number of credits for Ene 2	**3.7**

Ene 7 - low or zero carbon technologies

	Emissions $kgCO_2/yr$	Reduction $kgCO_2/yr$
Standard case		
Space and water heating (265)	1172.98	
Mechanical cooling (266)	0.00	
Pumps and fans (267)	121.17	
Lighting (268)	178.62	
Appliances and cooking	1474.62	
Total CO_2	**2947.40**	
Actual case		
Space and water heating (265) or (376)	1172.98	
Space and water heating from LZCT considered in SAP 2009		0.00
Pumps and fans (267) or (378)	121.17	
Pumps and fans		0.00
Electricity generated by LZCT (269) + (380))		-395.06
Additional allowable electricity generation considered in SAP 2009 section 16		0.00
Offset from biofuel CHP [-1 x [(363)..(366) + (368)...(372)]]		0.00
LZCT electricity generation		-395.06
LZCT thermal generation		0
Total from specified LZCT		**-395.06**

	Emissions $kgCO_2/m^2/yr$	
Reduction in CO_2 Emissions		
Standard Case CO_2	36.84	
Actual Case CO_2	31.90	
% Reduction in CO_2	13	
Number of credits for Ene 7	**1**	

DRAFT

DER 2009 Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Stuart Searle	Assessor number	2435
Client		Last modified	01/02/2013
Address	P04 4 St Augustines, London, NW1		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		80.00	(1a) x	2.60	(2a) =	208.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	80.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	208.00	(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	5.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.25	(18)

Air permeability value applies if a pressurisation test has been done, or a design or specified air permeability is being used

Number of sides on which dwelling is sheltered		2	(19)
Shelter factor	1 - [0.075 x (19)] =	0.85	(20)
Adjusted infiltration rate	(18) x (20) =	0.21	(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 7													
(22)m	5.40	5.10	5.10	4.50	4.10	3.90	3.70	3.70	4.20	4.50	4.80	5.10	
										∑(22)1...12 =		54.10	(22)
Wind Factor (22a)m = (22)m ÷ 4													
(22a)m	1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.20	1.27	
										∑(22a)1...12 =		13.52	(22a)
Adjusted infiltration rate (allowing for shelter and wind speed) = (21) × (22a)m													
(22b)m	0.29	0.27	0.27	0.24	0.22	0.21	0.20	0.20	0.22	0.24	0.26	0.27	
										∑(22b)1...12 =		2.87	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)), otherwise (23b) = (23a)	0.5	(23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = N/A (23c)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b)m + 0.5 x (23b)

(24c)m	0.54	0.52	0.52	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.52	(24c)

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

(25)m	0.54	0.52	0.52	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.52	(25)

3. Heat losses and heat loss parameter

The κ-value is the heat capacity per unit area, see Table 1e.

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	
Doors			2.10	x	1.60	=	3.36	N/A	N/A	(26)
Window*			8.68	x	1.15	=	9.94	N/A	N/A	(27)
Window*			13.99	x	1.33	=	18.55	N/A	N/A	(27)
External wall			50.79	x	0.20	=	10.16	N/A	N/A	(29a)
Party Wall			33.80	x	0.00	=	0.00	N/A	N/A	(32)

Total area of external elements ∑A, m² 75.56 (31)

** for windows and roof windows, effective window U-value is calculated using formula 1/[(1/UValue)+0.04] paragraph 3.2*

Fabric heat loss, W/K = ∑(A × U) (26)...(30) + (32) = 42.01 (33)

Heat capacity Cm = ∑(A x κ) (28)...(30) + (32) + (32a)...(32e) = N/A (34)

Thermal mass parameter (TMP) in kJ/m²K Calculated separately = 100.00 (35)

Thermal bridges: ∑(L x Ψ) calculated using Appendix K 10.02 (36)

if details of thermal bridging are not known then (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 52.03 (37)

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

(38)m	36.85	35.76	35.76	34.32	34.32	34.32	34.32	34.32	34.32	34.32	34.66	35.76	(38)

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

(39)m	88.88	87.79	87.79	86.35	86.35	86.35	86.35	86.35	86.35	86.35	86.69	87.79	

Average = ∑(39)1...12/12 = 86.95 (39)

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

(40)m	1.11	1.10	1.10	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.10	

Average = ∑(40)1...12/12 = 1.09 (40)

4. Water heating energy requirement

kWh/year

Assumed occupancy, N 2.46 (42)

If TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)

If TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 92.69 (43)

Annual average hot water usage has been reduced by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	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)													
(44)m	101.96	98.25	94.55	90.84	87.13	83.42	83.42	87.13	90.84	94.55	98.25	101.96	

∑(44)1...12 = 1112.32 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

(45)m	151.57	132.56	136.79	119.26	114.43	98.75	91.50	105.00	106.26	123.83	135.17	146.79	

∑(45)1...12 = 1461.91 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

For community heating include distribution loss whether or not hot water tank is present

Distribution loss 0.15 x (45)m

(46)m	22.74	19.88	20.52	17.89	17.16	14.81	13.73	15.75	15.94	18.57	20.28	22.02	(46)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):	1.85	(47)
Temperature factor from Table 2b	0.54	(48)
Energy lost from water storage, kWh/day (47) x (48)	1.00	(49)
Enter (49) or (54) in (55)	1.00	(55)

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

(56)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(56)

If cylinder contains dedicated solar storage, = (56)m x [(50) - (H11)] ÷ (50), else = (56)m where (H11) is from Appendix H

(57)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(57)

Primary circuit loss (annual) from Table 3: 360.00 (58)

Primary circuit loss for each month (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m	30.58	27.62	30.58	29.59	30.58	29.59	30.58	30.58	29.59	30.58	29.59	30.58	(59)

Combi loss for each month from Table 3a, 3b or 3c (enter '0' if not a combi boiler)

(61)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	(61)

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

(62)m	213.11	188.15	198.34	178.82	175.98	158.31	153.05	166.55	165.81	185.37	194.73	208.33	(62)

Solar DHW input calculated using Appendix H (negative quantity) ('0' entered if no solar contribution to water heating)

(63)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	

∑(63)1...12 = 0.00 (63)

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

(64)m	213.11	188.15	198.34	178.82	175.98	158.31	153.05	166.55	165.81	185.37	194.73	208.33	

∑(64)1...12 = 2186.55 (64)

if (64)m < 0 then set to 0

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

(65)m	99.63	88.55	94.72	87.30	87.28	80.48	79.66	84.15	82.98	90.41	92.59	98.04	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	123.14	123.14	123.14	123.14	123.14	123.14	123.14	123.14	123.14	123.14	123.14	123.14	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m	19.56	17.38	14.13	10.70	8.00	6.75	7.30	9.48	12.73	16.16	18.86	20.11	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m	219.44	221.72	215.98	203.76	188.34	173.85	164.17	161.89	167.63	179.84	195.27	209.76	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m	35.31	35.31	35.31	35.31	35.31	35.31	35.31	35.31	35.31	35.31	35.31	35.31	(69)
Pumps and fans gains (Table 5a)													
(70)m	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	(71)
Water heating gains (Table 5)													
(72)m	133.91	131.77	127.31	121.25	117.32	111.78	107.07	113.10	115.25	121.52	128.60	131.78	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m	442.86	440.80	427.36	405.66	383.60	362.32	348.48	354.42	365.54	387.47	412.67	431.58	(73)

6. Solar gains

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Rows (74) to (82) are used 12 times, one for each month, repeating as needed if there is more than one window type.

Details for month of January and annual totals are shown below:

	Access factor Table 6d		Area m²		Solar flux W/m²		g Specific data or Table 6b		FF Specific data or Table 6c		Gains (W)	
West	0.54	x	8.68	x	19.87	x 0.9 x	0.63	x	0.80	=	42.25	(80)
Northwest	0.54	x	13.99	x	11.51	x 0.9 x	0.63	x	0.80	=	39.45	(81)

Solar gains in watts, calculated for each month ∑(74)m...(82)m

(83)m	81.70	162.64	271.87	426.75	544.17	580.96	558.21	466.95	332.15	201.19	102.32	66.94	(83)

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

(84)m	524.57	603.44	699.23	832.40	927.77	943.28	906.68	821.37	697.69	588.66	514.99	498.52	(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, η1,m (see Table 9a)													
(86)m	0.96	0.94	0.89	0.81	0.68	0.52	0.37	0.40	0.66	0.86	0.94	0.96	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)													
(87)m	18.82	19.09	19.59	20.12	20.60	20.86	20.96	20.95	20.73	20.14	19.33	18.87	(87)
Temperature during heating periods in the living area from Table 9, Th2(˚C)													
(88)m	19.99	20.01	20.01	20.02	20.02	20.02	20.02	20.02	20.02	20.02	20.02	20.01	(88)
Utilisation factor for gains for rest of dwelling η2,m (see Table 9a)													
(89)m	0.95	0.93	0.88	0.79	0.63	0.46	0.29	0.32	0.60	0.83	0.93	0.95	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)													
(90)m	17.08	17.49	18.19	18.94	19.58	19.89	20.00	19.99	19.76	18.99	17.84	17.17	(90)

Living area fraction fLA 31.30 ÷ (4) = 0.39 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2													
(92)m	17.76	18.11	18.74	19.40	19.98	20.27	20.37	20.37	20.14	19.44	18.43	17.84	(92)
Apply adjustment to the mean internal temperature from Table 4e, where appropriate													
(93)m	17.61	17.96	18.59	19.25	19.83	20.12	20.22	20.22	19.99	19.29	18.28	17.69	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that tim = (93)m and recalculate the utilisation factor for gains using Table 9a)													
Utilisation factor for gains, ηm													
(94)m	0.93	0.91	0.85	0.76	0.62	0.46	0.31	0.34	0.59	0.81	0.91	0.93	(94)
Useful gains, ηmGm, W = (94)m x (84)m													
(95)m	488.30	546.43	595.78	635.04	577.69	436.55	278.22	275.45	414.22	473.98	467.66	465.59	(95)
Monthly average external temperature from Table 8													
(96)m	4.50	5.00	6.80	8.70	11.70	14.60	16.90	16.90	14.30	10.80	7.00	4.90	(96)
Heat loss rate for mean internal temperature, Lm, W													
(97)m	1165.36	1138.11	1034.80	910.93	701.73	476.67	286.96	286.33	491.14	732.96	977.64	1122.56	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m - (95)m] x (41)m													
(98)m	503.73	397.61	326.63	198.64	92.29	0.00	0.00	0.00	0.00	192.68	367.18	488.78	

Total per year (kWh/year) = ∑(98)1...5, 10...12 = 2567.54 (98)

Space heating requirement in kWh/m²/year (98) ÷ (4) 32.09 (99)

9a. Energy Requirements - Individual heating systems including micro-CHP

Space heating:

Fraction of space heating from secondary/supplementary system (Table 11) 0.00 (201)

Fraction of space heating from main system(s) 1 - (201) 1.00 (202)

Fraction of main heating from main system 2 0.00 (203)

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 space heating system 1 (%)	93.00	(206)

(from database or Table 4a/4b, adjusted where appropriate by the amount shown in the 'space efficiency adjustment' column of Table 4c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement, kWh/month (as calculated above)												
(98)m	503.73	397.61	326.63	198.64	92.29	0.00	0.00	0.00	0.00	192.68	367.18	488.78
Space heating fuel (main heating system 1), kWh/month = (98)m x (204) x 100 ÷ (206)												
(211)m	541.65	427.54	351.22	213.59	99.23	0.00	0.00	0.00	0.00	207.18	394.82	525.57

Total per year (kWh/year) = ∑(211)1...5, 10...12 = 2760.80 (211)

Water heating:

Output from water heater, kWh/month (calculated above)												
(64)m	213.11	188.15	198.34	178.82	175.98	158.31	153.05	166.55	165.81	185.37	194.73	208.33

∑(64)1...12 = 2186.55 (64)

Efficiency of water heater per month												
(217)m	86.53	86.26	85.63	84.59	82.68	79.30	79.30	79.30	79.30	84.41	85.98	86.51
Fuel for water heating, kWh/month = (64)m x 100 ÷ (217)m												
(219)m	246.29	218.12	231.61	211.39	212.84	199.63	193.00	210.02	209.10	219.60	226.48	240.81

Total per year (kWh/year) = ∑(219)1...12 = 2618.88 (219)

Annual Totals Summary:	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		2760.80	(211)
Water heating fuel used		2618.88	(219)
Electricity for pumps, fans and electric keep-hot (Table 4f):			
mechanical ventilation fans - balanced, extract or positive input from outside	59.38		(230a)
warm air heating system fans	0.00		(230b)
central heating pump	130.00		(230c)
oil boiler pump	0.00		(230d)
boiler flue fan	45.00		(230e)
maintaining electric keep-hot facility for gas combi boiler	0.00		(230f)
pump for solar water heating	0.00		(230g)
Total electricity for the above	∑(230a)...(230g)	234.38	(231)
Electricity for lighting (calculated in Appendix L):		345.49	(232)
Energy saving/generation technologies (Appendices M, N and Q):			
Electricity generated by PVs (Appendix M) (negative quantity)		-746.81	(233)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year		Emissions Factor		Emissions (kgCO2/year)	
Space heating - main system 1	2760.80	x	0.198	=	546.64	(261)
Water heating	2618.88	x	0.198	=	518.54	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1065.18	(265)
Pumps, fans and electric keep-hot	234.38	x	0.517	=	121.17	(267)
Lighting	345.49	x	0.517	=	178.62	(268)
Energy saving/generation technologies:						
PV emission savings (negative quantity)	-746.81	x	0.529	=	-395.06	(269)
Total carbon dioxide emissions				∑(261)...(271) =	969.91	(272)
Dwelling Carbon Dioxide Emissions Rate (DER)					12.12	(273)

SAP 2009 Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Stuart Searle	Assessor number	2435
Client		Last modified	01/02/2013
Address	P04 4 St Augustines, London, NW1		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		80.00	(1a) x	2.60	(2a) =	208.00	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	80.00	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	208.00	(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	5.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.25	(18)

Air permeability value applies if a pressurisation test has been done, or a design or specified air permeability is being used

Number of sides on which dwelling is sheltered		2	(19)
Shelter factor	1 - [0.075 x (19)] =	0.85	(20)
Adjusted infiltration rate	(18) x (20) =	0.21	(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 7													
(22)m	5.40	5.10	5.10	4.50	4.10	3.90	3.70	3.70	4.20	4.50	4.80	5.10	
										∑(22)1...12 =		54.10	(22)
Wind Factor (22a)m = (22)m ÷ 4													
(22a)m	1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.20	1.27	
										∑(22a)1...12 =		13.52	(22a)
Adjusted infiltration rate (allowing for shelter and wind speed) = (21) × (22a)m													
(22b)m	0.29	0.27	0.27	0.24	0.22	0.21	0.20	0.20	0.22	0.24	0.26	0.27	
										∑(22b)1...12 =		2.87	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)), otherwise (23b) = (23a)	0.5	(23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = N/A (23c)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b)m + 0.5 x (23b)

(24c)m	0.54	0.52	0.52	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.52	(24c)

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

(25)m	0.54	0.52	0.52	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.52	(25)

3. Heat losses and heat loss parameter

The κ-value is the heat capacity per unit area, see Table 1e.

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	
Doors			2.10	x	1.60	=	3.36	N/A	N/A	(26)
Window*			8.68	x	1.15	=	9.94	N/A	N/A	(27)
Window*			13.99	x	1.33	=	18.55	N/A	N/A	(27)
External wall			50.79	x	0.20	=	10.16	N/A	N/A	(29a)
Party Wall			33.80	x	0.00	=	0.00	N/A	N/A	(32)

Total area of external elements ∑A, m² 75.56 (31)

** for windows and roof windows, effective window U-value is calculated using formula 1/[(1/UValue)+0.04] paragraph 3.2*

Fabric heat loss, W/K = ∑(A × U) (26)...(30) + (32) = 42.01 (33)

Heat capacity Cm = ∑(A x κ) (28)...(30) + (32) + (32a)...(32e) = N/A (34)

Thermal mass parameter (TMP) in kJ/m²K Calculated separately = 100.00 (35)

Thermal bridges: ∑(L x Ψ) calculated using Appendix K 10.02 (36)

if details of thermal bridging are not known then (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 52.03 (37)

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

(38)m	36.85	35.76	35.76	34.32	34.32	34.32	34.32	34.32	34.32	34.32	34.66	35.76	(38)

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

(39)m	88.88	87.79	87.79	86.35	86.35	86.35	86.35	86.35	86.35	86.35	86.69	87.79	

Average = ∑(39)1...12/12 = 86.95 (39)

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

(40)m	1.11	1.10	1.10	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.08	1.10	

Average = ∑(40)1...12/12 = 1.09 (40)

4. Water heating energy requirement

kWh/year

Assumed occupancy, N 2.46 (42)

If TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)

If TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 92.69 (43)

Annual average hot water usage has been reduced by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	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)													
(44)m	101.96	98.25	94.55	90.84	87.13	83.42	83.42	87.13	90.84	94.55	98.25	101.96	

∑(44)1...12 = 1112.32 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

(45)m	151.57	132.56	136.79	119.26	114.43	98.75	91.50	105.00	106.26	123.83	135.17	146.79	

∑(45)1...12 = 1461.91 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

For community heating include distribution loss whether or not hot water tank is present

Distribution loss 0.15 x (45)m

(46)m	22.74	19.88	20.52	17.89	17.16	14.81	13.73	15.75	15.94	18.57	20.28	22.02	(46)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):	1.85	(47)
Temperature factor from Table 2b	0.54	(48)
Energy lost from water storage, kWh/day (47) x (48)	1.00	(49)
Enter (49) or (54) in (55)	1.00	(55)

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

(56)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(56)

If cylinder contains dedicated solar storage, = (56)m x [(50) - (H11)] ÷ (50), else = (56)m where (H11) is from Appendix H

(57)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(57)

Primary circuit loss (annual) from Table 3: 360.00 (58)

Primary circuit loss for each month (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m	30.58	27.62	30.58	29.59	30.58	29.59	30.58	30.58	29.59	30.58	29.59	30.58	(59)

Combi loss for each month from Table 3a, 3b or 3c (enter '0' if not a combi boiler)

(61)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	(61)

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

(62)m	213.11	188.15	198.34	178.82	175.98	158.31	153.05	166.55	165.81	185.37	194.73	208.33	(62)

Solar DHW input calculated using Appendix H (negative quantity) ('0' entered if no solar contribution to water heating)

(63)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	

∑(63)1...12 = 0.00 (63)

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

(64)m	213.11	188.15	198.34	178.82	175.98	158.31	153.05	166.55	165.81	185.37	194.73	208.33	

∑(64)1...12 = 2186.55 (64)

if (64)m < 0 then set to 0

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

(65)m	99.63	88.55	94.72	87.30	87.28	80.48	79.66	84.15	82.98	90.41	92.59	98.04	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	147.77	147.77	147.77	147.77	147.77	147.77	147.77	147.77	147.77	147.77	147.77	147.77	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m	48.91	43.44	35.33	26.75	19.99	16.88	18.24	23.71	31.82	40.40	47.15	50.27	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m	327.52	330.92	322.36	304.12	281.11	259.48	245.03	241.63	250.19	268.42	291.44	313.07	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m	52.24	52.24	52.24	52.24	52.24	52.24	52.24	52.24	52.24	52.24	52.24	52.24	(69)
Pumps and fans gains (Table 5a)													
(70)m	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	-98.51	(71)
Water heating gains (Table 5)													
(72)m	133.91	131.77	127.31	121.25	117.32	111.78	107.07	113.10	115.25	121.52	128.60	131.78	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m	621.84	617.63	596.49	563.62	529.92	499.63	481.83	489.93	508.75	541.84	578.69	606.61	(73)

6. Solar gains

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Rows (74) to (82) are used 12 times, one for each month, repeating as needed if there is more than one window type.

Details for month of January and annual totals are shown below:

	Access factor Table 6d		Area m²		Solar flux W/m²		g Specific data or Table 6b		FF Specific data or Table 6c		Gains (W)	
West	0.54	x	8.68	x	19.87	x 0.9 x	0.63	x	0.80	=	42.25	(80)
Northwest	0.54	x	13.99	x	11.51	x 0.9 x	0.63	x	0.80	=	39.45	(81)

Solar gains in watts, calculated for each month ∑(74)m...(82)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(83)m	81.70	162.64	271.87	426.75	544.17	580.96	558.21	466.95	332.15	201.19	102.32	66.94	(83)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(84)m	703.55	780.26	868.36	990.37	1074.09	1080.59	1040.04	956.89	840.90	743.03	681.01	673.55	(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, η1,m (see Table 9a)													
(86)m	0.92	0.90	0.84	0.76	0.62	0.47	0.33	0.35	0.58	0.79	0.90	0.92	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)													
(87)m	19.15	19.40	19.83	20.28	20.68	20.89	20.97	20.96	20.80	20.33	19.62	19.20	(87)
Temperature during heating periods in the living area from Table 9, Th2(˚C)													
(88)m	19.99	20.01	20.01	20.02	20.02	20.02	20.02	20.02	20.02	20.02	20.02	20.01	(88)
Utilisation factor for gains for rest of dwelling η2,m (see Table 9a)													
(89)m	0.91	0.88	0.82	0.73	0.57	0.41	0.25	0.27	0.52	0.76	0.88	0.91	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)													
(90)m	17.55	17.91	18.53	19.15	19.67	19.92	20.00	20.00	19.83	19.23	18.25	17.64	(90)

Living area fraction fLA 31.30 ÷ (4) = 0.39 (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2													
(92)m	18.18	18.49	19.04	19.59	20.07	20.30	20.38	20.38	20.21	19.66	18.78	18.25	(92)
Apply adjustment to the mean internal temperature from Table 4e, where appropriate													
(93)m	18.03	18.34	18.89	19.44	19.92	20.15	20.23	20.23	20.06	19.51	18.63	18.10	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that tim = (93)m and recalculate the utilisation factor for gains using Table 9a)													
Utilisation factor for gains, ηm													
(94)m	0.88	0.86	0.80	0.71	0.57	0.42	0.27	0.29	0.52	0.74	0.85	0.89	(94)
Useful gains, ηmGm, W = (94)m x (84)m													
(95)m	622.23	667.68	692.22	699.81	610.21	448.58	281.26	279.52	440.56	546.37	581.48	597.65	(95)
Monthly average external temperature from Table 8													
(96)m	4.50	5.00	6.80	8.70	11.70	14.60	16.90	16.90	14.30	10.80	7.00	4.90	(96)
Heat loss rate for mean internal temperature, Lm, W													
(97)m	1202.27	1171.36	1061.10	927.84	709.67	479.43	287.66	287.26	497.50	752.18	1008.60	1158.64	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m - (95)m] x (41)m													
(98)m	431.54	338.48	274.45	164.18	74.00	0.00	0.00	0.00	0.00	153.12	307.53	417.38	

Total per year (kWh/year) = ∑(98)1...5, 10...12 = 2160.68 (98)

Space heating requirement in kWh/m²/year (98) ÷ (4) 27.01 (99)

9a. Energy Requirements - Individual heating systems including micro-CHP

Space heating:

Fraction of space heating from secondary/supplementary system (Table 11) 0.00 (201)

Fraction of space heating from main system(s) 1 - (201) 1.00 (202)

Fraction of main heating from main system 2 0.00 (203)

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 space heating system 1 (%)	93.00	(206)

(from database or Table 4a/4b, adjusted where appropriate by the amount shown in the 'space efficiency adjustment' column of Table 4c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement, kWh/month (as calculated above)												
(98)m	431.54	338.48	274.45	164.18	74.00	0.00	0.00	0.00	0.00	153.12	307.53	417.38
Space heating fuel (main heating system 1), kWh/month = (98)m x (204) x 100 ÷ (206)												
(211)m	464.03	363.96	295.10	176.54	79.57	0.00	0.00	0.00	0.00	164.65	330.67	448.79

Total per year (kWh/year) = ∑(211)1...5, 10...12 = 2323.31 (211)

Water heating:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Output from water heater, kWh/month (calculated above)												
(64)m	213.11	188.15	198.34	178.82	175.98	158.31	153.05	166.55	165.81	185.37	194.73	208.33
Efficiency of water heater per month												
(217)m	86.16	85.86	85.18	84.09	82.19	79.30	79.30	79.30	79.30	83.81	85.53	86.13
Fuel for water heating, kWh/month = (64)m x 100 ÷ (217)m												
(219)m	247.35	219.14	232.85	212.66	214.10	199.63	193.00	210.02	209.10	221.19	227.68	241.88

∑(64)1...12 = 2186.55 (64)

Total per year (kWh/year) = ∑(219)1...12 = 2628.60 (219)

Annual Totals Summary:	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		2323.31	(211)
Water heating fuel used		2628.60	(219)
Electricity for pumps, fans and electric keep-hot (Table 4f):			
mechanical ventilation fans - balanced, extract or positive input from outside	59.38		(230a)
warm air heating system fans	0.00		(230b)
central heating pump	130.00		(230c)
oil boiler pump	0.00		(230d)
boiler flue fan	45.00		(230e)
maintaining electric keep-hot facility for gas combi boiler	0.00		(230f)
pump for solar water heating	0.00		(230g)
Total electricity for the above	∑(230a)...(230g)	234.38	(231)
Electricity for lighting (calculated in Appendix L):		345.49	(232)
Energy saving/generation technologies (Appendices M, N and Q):			
Electricity generated by PVs (Appendix M) (negative quantity)		-746.81	(233)

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

	Fuel kWh/year		Fuel price (Table 12)		Fuel cost £/year	
Space heating - main system 1	2323.31	x	3.10	x 0.01 =	72.02	(240)
Water heating cost (other fuel)	2628.60	x	3.10	x 0.01 =	81.49	(247)
Pumps, fans and electric keep-hot	234.38	x	11.46	x 0.01 =	26.86	(249)
Energy for lighting	345.49	x	11.46	x 0.01 =	39.59	(250)
Additional standing charges (Table 12)					106.00	(251)
Energy saving/generation technologies (Appendices M, N and Q):						
PV savings (negative quantity)	-746.81	x	11.46	x 0.01 =	-85.58	(252)
Total energy cost			(240)...(242) + (245)...(254)		240.38	(255)

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

Energy cost deflator (Table 12)	0.47	(256)

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Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	0.90	(257)
SAP value		87.39	
SAP rating		87	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year		Emissions Factor		Emissions (kgCO2/year)	
Space heating - main system 1	2323.31	x	0.198	=	460.02	(261)
Water heating	2628.60	x	0.198	=	520.46	(264)
Space and water heating			(261) + (262) + (263) + (264) =		980.48	(265)
Pumps, fans and electric keep-hot	234.38	x	0.517	=	121.17	(267)
Lighting	345.49	x	0.517	=	178.62	(268)
Energy saving/generation technologies:						
PV emission savings (negative quantity)	-746.81	x	0.529	=	-395.06	(269)
Total carbon dioxide emissions			∑(261)...(271) =		885.21	(272)
Dwelling carbon dioxide emissions rate			(272) ÷ (4) =		11.07	(273)
EI value					90.51	
EI rating (see section 14)					91	(274)
EI band					B	

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

	Energy kWh/year		Primary Energy Factor		Primary Energy	
Space heating - main system 1	2323.31	x	1.02	=	2369.78	(261*)
Water heating	2628.60	x	1.02	=	2681.18	(264*)
Space and water heating			(261*) + (262*) + (263*) + (264*) =		5050.96	(265*)
Pumps, fans and electric keep-hot	234.38	x	2.92	=	684.39	(267*)
Lighting	345.49	x	2.92	=	1008.84	(268*)
Energy saving/generation technologies:						
PV primary energy savings (negative quantity)	-746.81	x	2.92	=	-2180.68	(269*)
Total primary energy kWh/year			∑(261*)...(271*) =		4563.51	(272*)
Primary energy kWh/m2/year			(272*) ÷ (4) =		57.04	(273*)

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Code for Sustainable Homes (November 2010)
Design - Draft

This report details the calculations and results for Ene 1, 2 and 7 of the Code For Sustainable Homes.

This Design Assessment has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed. Code calculations are from the Technical Guide (November 2010).

Assessor name	Mr Stuart Searle	Assessor number	2435
Client		Last modified	01/02/2013
Address	P05 4 St Augustines, London, NW1		

Building regulation assessment - criterion 1

	kg/m²/yr
DER	9.58
TER	15.02

Assessment of zero carbon home and low or zero carbon technologies

		Credits	Level
Dwelling emission rate (Ene 1)	CO_2 reduction = 36.2 %	4	4
Fabric Energy Efficiency	FEE = 40.4	6.3	
Low or zero carbon technologies (Ene 7)	CO_2 reduction = 15 %	2	

Ene 1 - dwelling emission rate

	%	kWh/m²	kgCO_2/m²/yr	
Assessment of Ene 1 (level 1-5)				
DER from SAP 2009 DER worksheet			9.58	
Additional allowable generation		0.00		
CO_2 emissions offset from generation			0.00	
CO_2 emissions offset from community biofuel CHP systems			0.00	
Total CO_2 emissions offset from SAP section 16 allowances			**0.00**	
DER accounting for SAP section 16 allowances			**9.58**	
CO_2 reduction compared to TER			5.44	
CO_2 reduction as % of TER	36.2			
Assessment of Ene 1 (level 6)				
DER from SAP 2009 DER worksheet			9.58	(ZC1)
CO_2 emissions from appliances (equation L14)			14.78	(ZC2)
CO_2 emissions from cooking (equation L16)			1.75	(ZC3)
Total CO_2 emissions			26.11	(ZC4)
Additional allowable generation and its CO_2 emissions offset		0.00		(ZC6)
CO_2 emissions offset from additional allowable generation			0.00	(ZC7)
CO_2 emissions offset from community biofuel CHP systems			0.00	(ZC5)
Net CO_2 emissions			**26.11**	(ZC8)

Ene 1 - dwelling emission rate - level 6

There is no Zero Carbon Home definition in the current technical guide

	Criterion	Value	Pass/Fail
FEE	<= 39	40.4	Fail
Net CO_2 emissions	<= 0.00	26.11	Fail

Result: Not level 6

Number of credits for Ene 1	**4**

Ene 2 - Fabric Energy Efficiency

FEE	40.4
Number of credits for Ene 2	**6.3**

Ene 7 - low or zero carbon technologies

	Emissions $kgCO_2/yr$	Reduction $kgCO_2/yr$
Standard case		
Space and water heating (265)	1329.90	
Mechanical cooling (266)	0.00	
Pumps and fans (267)	131.34	
Lighting (268)	218.06	
Appliances and cooking	1760.14	
Total CO_2	**1662.77**	
Actual case		
Space and water heating (265) or (376)	1329.90	
Space and water heating from LZCT considered in SAP 2009		0.00
Pumps and fans (267) or (378)	131.34	
Pumps and fans		0.00
Electricity generated by LZCT (269) + (380))		-525.84
Additional allowable electricity generation considered in SAP 2009 section 16		0.00
Offset from biofuel CHP [-1 x [(363)..(366) + (368)...(372)]]		0.00
LZCT electricity generation		-525.84
LZCT thermal generation		0
Total from specified LZCT		**-525.84**

	Emissions $kgCO_2/m^2/yr$	
Reduction in CO_2 Emissions		
Standard Case CO_2	32.30	
Actual Case CO_2	27.36	
% Reduction in CO_2	15	
Number of credits for Ene 7	**2**	

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DER 2009 Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Stuart Searle	Assessor number	2435
Client		Last modified	01/02/2013
Address	P05 4 St Augustines, London, NW1		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		106.50	(1a) x	2.60	(2a) =	276.90	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	106.50	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	276.90	(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	5.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.25	(18)

Air permeability value applies if a pressurisation test has been done, or a design or specified air permeability is being used

Number of sides on which dwelling is sheltered		1	(19)
Shelter factor	1 - [0.075 x (19)] =	0.92	(20)
Adjusted infiltration rate	(18) x (20) =	0.23	(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 7													
(22)m	5.40	5.10	5.10	4.50	4.10	3.90	3.70	3.70	4.20	4.50	4.80	5.10	
										∑(22)1...12 =		54.10	(22)
Wind Factor (22a)m = (22)m ÷ 4													
(22a)m	1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.20	1.27	
										∑(22a)1...12 =		13.52	(22a)
Adjusted infiltration rate (allowing for shelter and wind speed) = (21) × (22a)m													
(22b)m	0.31	0.29	0.29	0.26	0.24	0.23	0.21	0.21	0.24	0.26	0.28	0.29	
										∑(22b)1...12 =		3.13	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)), otherwise (23b) = (23a)	0.5	(23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = N/A (23c)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b)m + 0.5 x (23b)

(24c)m	0.56	0.54	0.54	0.51	0.50	0.50	0.50	0.50	0.50	0.51	0.53	0.54	(24c)

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

(25)m	0.56	0.54	0.54	0.51	0.50	0.50	0.50	0.50	0.50	0.51	0.53	0.54	(25)

3. Heat losses and heat loss parameter

The κ-value is the heat capacity per unit area, see Table 1e.

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	
Doors			2.10	x	1.60	=	3.36	N/A	N/A	(26)
Window*			8.68	x	1.15	=	9.94	N/A	N/A	(27)
Window*			14.77	x	1.33	=	19.59	N/A	N/A	(27)
External wall			87.37	x	0.20	=	17.47	N/A	N/A	(29a)
Party Wall			34.19	x	0.00	=	0.00	N/A	N/A	(32)

Total area of external elements ∑A, m² 112.92 (31)

** for windows and roof windows, effective window U-value is calculated using formula 1/[(1/UValue)+0.04] paragraph 3.2*

Fabric heat loss, W/K = ∑(A × U) (26)...(30) + (32) = 50.36 (33)

Heat capacity Cm = ∑(A x κ) (28)...(30) + (32) + (32a)...(32e) = N/A (34)

Thermal mass parameter (TMP) in kJ/m²K Calculated separately = 100.00 (35)

Thermal bridges: ∑(L x Ψ) calculated using Appendix K 12.35 (36)

if details of thermal bridging are not known then (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 62.71 (37)

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

(38)m	51.37	49.79	49.79	46.62	45.69	45.69	45.69	45.69	45.69	46.62	48.20	49.79	(38)

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

(39)m	114.08	112.50	112.50	109.33	108.40	108.40	108.40	108.40	108.40	109.33	110.91	112.50	

Average = ∑(39)1...12/12 = 110.26 (39)

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

(40)m	1.07	1.06	1.06	1.03	1.02	1.02	1.02	1.02	1.02	1.03	1.04	1.06	

Average = ∑(40)1...12/12 = 1.04 (40)

4. Water heating energy requirement

kWh/year

Assumed occupancy, N 2.79 (42)

If TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)

If TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 100.51 (43)

Annual average hot water usage has been reduced by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	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)													
(44)m	110.56	106.54	102.52	98.50	94.48	90.46	90.46	94.48	98.50	102.52	106.54	110.56	

∑(44)1...12 = 1206.15 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

(45)m	164.36	143.75	148.33	129.32	124.09	107.08	99.22	113.86	115.22	134.28	146.57	159.17	

∑(45)1...12 = 1585.24 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

For community heating include distribution loss whether or not hot water tank is present

Distribution loss 0.15 x (45)m

(46)m	24.65	21.56	22.25	19.40	18.61	16.06	14.88	17.08	17.28	20.14	21.99	23.88	(46)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):	1.85	(47)
Temperature factor from Table 2b	0.54	(48)
Energy lost from water storage, kWh/day (47) x (48)	1.00	(49)
Enter (49) or (54) in (55)	1.00	(55)

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

(56)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(56)

If cylinder contains dedicated solar storage, = (56)m x [(50) - (H11)] ÷ (50), else = (56)m where (H11) is from Appendix H

(57)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(57)

Primary circuit loss (annual) from Table 3: 360.00 (58)

Primary circuit loss for each month (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m	30.58	27.62	30.58	29.59	30.58	29.59	30.58	30.58	29.59	30.58	29.59	30.58	(59)

Combi loss for each month from Table 3a, 3b or 3c (enter '0' if not a combi boiler)

(61)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	(61)

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

(62)m	225.90	199.33	209.88	188.88	185.63	166.64	160.77	175.40	174.78	195.82	206.13	220.71	(62)

Solar DHW input calculated using Appendix H (negative quantity) ('0' entered if no solar contribution to water heating)

(63)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	

∑(63)1...12 = 0.00 (63)

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

(64)m	225.90	199.33	209.88	188.88	185.63	166.64	160.77	175.40	174.78	195.82	206.13	220.71	

∑(64)1...12 = 2309.87 (64)

if (64)m < 0 then set to 0

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

(65)m	103.88	92.27	98.56	90.65	90.49	83.25	82.23	87.09	85.96	93.88	96.38	102.16	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	139.61	139.61	139.61	139.61	139.61	139.61	139.61	139.61	139.61	139.61	139.61	139.61	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m	23.88	21.21	17.25	13.06	9.76	8.24	8.91	11.58	15.54	19.73	23.03	24.55	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m	266.43	269.19	262.23	247.39	228.67	211.08	199.32	196.56	203.52	218.35	237.08	254.67	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m	36.96	36.96	36.96	36.96	36.96	36.96	36.96	36.96	36.96	36.96	36.96	36.96	(69)
Pumps and fans gains (Table 5a)													
(70)m	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	(71)
Water heating gains (Table 5)													
(72)m	139.63	137.30	132.47	125.90	121.63	115.63	110.52	117.06	119.39	126.19	133.87	137.31	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m	504.82	502.59	486.83	461.23	434.95	409.82	393.63	400.07	413.33	439.15	468.85	491.41	(73)

6. Solar gains

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Rows (74) to (82) are used 12 times, one for each month, repeating as needed if there is more than one window type.

Details for month of January and annual totals are shown below:

	Access factor Table 6d		Area m²		Solar flux W/m²		g Specific data or Table 6b		FF Specific data or Table 6c		Gains (W)	
West	0.54	x	8.68	x	19.87	x 0.9 x	0.63	x	0.80	=	42.25	(80)
South	0.54	x	14.77	x	47.32	x 0.9 x	0.63	x	0.80	=	171.25	(78)

Solar gains in watts, calculated for each month ∑(74)m...(82)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(83)m	213.50	361.20	471.94	574.72	629.27	640.81	627.19	584.35	518.33	408.38	255.43	182.82	(83)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(84)m	718.32	863.78	958.77	1035.96	1064.22	1050.63	1020.81	984.42	931.65	847.53	724.27	674.23	(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, η1,m (see Table 9a)													
(86)m	0.95	0.93	0.89	0.82	0.72	0.57	0.41	0.42	0.64	0.83	0.93	0.96	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)													
(87)m	18.94	19.27	19.70	20.14	20.57	20.84	20.96	20.95	20.77	20.28	19.47	18.98	(87)
Temperature during heating periods in the living area from Table 9, Th2(˚C)													
(88)m	20.03	20.04	20.04	20.06	20.07	20.07	20.07	20.07	20.07	20.06	20.05	20.04	(88)
Utilisation factor for gains for rest of dwelling η2,m (see Table 9a)													
(89)m	0.95	0.92	0.87	0.80	0.68	0.51	0.33	0.34	0.58	0.80	0.92	0.95	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)													
(90)m	17.27	17.75	18.37	19.00	19.59	19.92	20.04	20.04	19.85	19.20	18.06	17.34	(90)

Living area fraction fLA 24.00 ÷ (4) = 0.23 (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2													
(92)m	17.65	18.09	18.67	19.26	19.81	20.13	20.25	20.25	20.06	19.44	18.38	17.71	(92)
Apply adjustment to the mean internal temperature from Table 4e, where appropriate													
(93)m	17.50	17.94	18.52	19.11	19.66	19.98	20.10	20.10	19.91	19.29	18.23	17.56	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that tim = (93)m and recalculate the utilisation factor for gains using Table 9a)													
Utilisation factor for gains, ηm													
(94)m	0.92	0.89	0.84	0.77	0.66	0.50	0.33	0.34	0.57	0.77	0.89	0.93	(94)
Useful gains, ηmGm, W = (94)m x (84)m													
(95)m	663.38	766.66	802.81	798.37	698.88	527.82	335.62	334.36	529.08	652.42	647.07	626.03	(95)
Monthly average external temperature from Table 8													
(96)m	4.50	5.00	6.80	8.70	11.70	14.60	16.90	16.90	14.30	10.80	7.00	4.90	(96)
Heat loss rate for mean internal temperature, Lm, W													
(97)m	1482.66	1456.12	1318.66	1137.88	862.85	582.92	346.70	346.40	607.90	928.57	1245.19	1424.37	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m - (95)m] x (41)m													
(98)m	609.54	463.32	383.80	244.45	121.99	0.00	0.00	0.00	0.00	205.46	430.65	593.97	

Total per year (kWh/year) = ∑(98)1...5, 10...12 = 3053.18 (98)

Space heating requirement in kWh/m²/year (98) ÷ (4) 28.67 (99)

9a. Energy Requirements - Individual heating systems including micro-CHP

Space heating:

Fraction of space heating from secondary/supplementary system (Table 11) 0.00 (201)

Fraction of space heating from main system(s) 1 - (201) 1.00 (202)

Fraction of main heating from main system 2 0.00 (203)

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 space heating system 1 (%)	93.00	(206)

(from database or Table 4a/4b, adjusted where appropriate by the amount shown in the 'space efficiency adjustment' column of Table 4c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement, kWh/month (as calculated above)												
(98)m	609.54	463.32	383.80	244.45	121.99	0.00	0.00	0.00	0.00	205.46	430.65	593.97
Space heating fuel (main heating system 1), kWh/month = (98)m x (204) x 100 ÷ (206)												
(211)m	655.42	498.19	412.68	262.85	131.18	0.00	0.00	0.00	0.00	220.93	463.06	638.68

Total per year (kWh/year) = ∑(211)1...5, 10...12 = 3282.99 (211)

Water heating:

Output from water heater, kWh/month (calculated above)												
(64)m	225.90	199.33	209.88	188.88	185.63	166.64	160.77	175.40	174.78	195.82	206.13	220.71

∑(64)1...12 = 2309.87 (64)

Efficiency of water heater per month												
(217)m	86.83	86.49	85.90	85.00	83.22	79.30	79.30	79.30	79.30	84.44	86.23	86.83
Fuel for water heating, kWh/month = (64)m x 100 ÷ (217)m												
(219)m	260.16	230.47	244.32	222.21	223.05	210.13	202.73	221.19	220.40	231.91	239.04	254.20

Total per year (kWh/year) = ∑(219)1...12 = 2759.81 (219)

Annual Totals Summary:	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		3282.99	(211)
Water heating fuel used		2759.81	(219)
Electricity for pumps, fans and electric keep-hot (Table 4f):			
mechanical ventilation fans - balanced, extract or positive input from outside	79.05		(230a)
warm air heating system fans	0.00		(230b)
central heating pump	130.00		(230c)
oil boiler pump	0.00		(230d)
boiler flue fan	45.00		(230e)
maintaining electric keep-hot facility for gas combi boiler	0.00		(230f)
pump for solar water heating	0.00		(230g)
Total electricity for the above	∑(230a)...(230g)	254.05	(231)
Electricity for lighting (calculated in Appendix L):		421.77	(232)
Energy saving/generation technologies (Appendices M, N and Q):			
Electricity generated by PVs (Appendix M) (negative quantity)		-994.03	(233)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year		Emissions Factor		Emissions (kgCO2/year)	
Space heating - main system 1	3282.99	x	0.198	=	650.03	(261)
Water heating	2759.81	x	0.198	=	546.44	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1196.47	(265)
Pumps, fans and electric keep-hot	254.05	x	0.517	=	131.34	(267)
Lighting	421.77	x	0.517	=	218.06	(268)
Energy saving/generation technologies:						
PV emission savings (negative quantity)	-994.03	x	0.529	=	-525.84	(269)
Total carbon dioxide emissions				∑(261)...(271) =	1020.03	(272)
Dwelling Carbon Dioxide Emissions Rate (DER)					9.58	(273)

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Assessor name	Mr Stuart Searle	Assessor number	2435
Client		Last modified	01/02/2013
Address	P05 4 St Augustines, London, NW1		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		106.50	(1a) x	2.60	(2a) =	276.90	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	106.50	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	276.90	(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	5.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.25	(18)

Air permeability value applies if a pressurisation test has been done, or a design or specified air permeability is being used

Number of sides on which dwelling is sheltered		1	(19)
Shelter factor	1 - [0.075 x (19)] =	0.92	(20)
Adjusted infiltration rate	(18) x (20) =	0.23	(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 7													
(22)m	5.40	5.10	5.10	4.50	4.10	3.90	3.70	3.70	4.20	4.50	4.80	5.10	
										∑(22)1...12 =		54.10	(22)
Wind Factor (22a)m = (22)m ÷ 4													
(22a)m	1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.20	1.27	
										∑(22a)1...12 =		13.52	(22a)
Adjusted infiltration rate (allowing for shelter and wind speed) = (21) × (22a)m													
(22b)m	0.31	0.29	0.29	0.26	0.24	0.23	0.21	0.21	0.24	0.26	0.28	0.29	
										∑(22b)1...12 =		3.13	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)), otherwise (23b) = (23a)	0.5	(23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = N/A (23c)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b)m + 0.5 x (23b)

(24c)m	0.56	0.54	0.54	0.51	0.50	0.50	0.50	0.50	0.50	0.51	0.53	0.54	(24c)

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

(25)m	0.56	0.54	0.54	0.51	0.50	0.50	0.50	0.50	0.50	0.51	0.53	0.54	(25)

3. Heat losses and heat loss parameter

The κ-value is the heat capacity per unit area, see Table 1e.

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	
Doors			2.10	x	1.60	=	3.36	N/A	N/A	(26)
Window*			8.68	x	1.15	=	9.94	N/A	N/A	(27)
Window*			14.77	x	1.33	=	19.59	N/A	N/A	(27)
External wall			87.37	x	0.20	=	17.47	N/A	N/A	(29a)
Party Wall			34.19	x	0.00	=	0.00	N/A	N/A	(32)

Total area of external elements ∑A, m² 112.92 (31)

** for windows and roof windows, effective window U-value is calculated using formula 1/[(1/UValue)+0.04] paragraph 3.2*

Fabric heat loss, W/K = ∑(A × U) (26)...(30) + (32) = 50.36 (33)

Heat capacity Cm = ∑(A x κ) (28)...(30) + (32) + (32a)...(32e) = N/A (34)

Thermal mass parameter (TMP) in kJ/m²K Calculated separately = 100.00 (35)

Thermal bridges: ∑(L x Ψ) calculated using Appendix K 12.35 (36)

if details of thermal bridging are not known then (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 62.71 (37)

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

(38)m	51.37	49.79	49.79	46.62	45.69	45.69	45.69	45.69	45.69	46.62	48.20	49.79	(38)

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

(39)m	114.08	112.50	112.50	109.33	108.40	108.40	108.40	108.40	108.40	109.33	110.91	112.50	

Average = ∑(39)1...12/12 = 110.26 (39)

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

(40)m	1.07	1.06	1.06	1.03	1.02	1.02	1.02	1.02	1.02	1.03	1.04	1.06	

Average = ∑(40)1...12/12 = 1.04 (40)

4. Water heating energy requirement

kWh/year

Assumed occupancy, N 2.79 (42)

If TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)

If TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 100.51 (43)

Annual average hot water usage has been reduced by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	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)													
(44)m	110.56	106.54	102.52	98.50	94.48	90.46	90.46	94.48	98.50	102.52	106.54	110.56	

∑(44)1...12 = 1206.15 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

(45)m	164.36	143.75	148.33	129.32	124.09	107.08	99.22	113.86	115.22	134.28	146.57	159.17	

∑(45)1...12 = 1585.24 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

For community heating include distribution loss whether or not hot water tank is present

Distribution loss 0.15 x (45)m

(46)m	24.65	21.56	22.25	19.40	18.61	16.06	14.88	17.08	17.28	20.14	21.99	23.88 (46)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.85 (47)

Temperature factor from Table 2b 0.54 (48)

Energy lost from water storage, kWh/day (47) x (48) 1.00 (49)

Enter (49) or (54) in (55) 1.00 (55)

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

(56)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97 (56)

If cylinder contains dedicated solar storage, = (56)m x [(50) - (H11)] ÷ (50), else = (56)m where (H11) is from Appendix H

(57)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97 (57)

Primary circuit loss (annual) from Table 3 360.00 (58)

Primary circuit loss for each month (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m	30.58	27.62	30.58	29.59	30.58	29.59	30.58	30.58	29.59	30.58	29.59	30.58 (59)

Combi loss for each month from Table 3a, 3b or 3c (enter '0' if not a combi boiler)

(61)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 (61)

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

(62)m	225.90	199.33	209.88	188.88	185.63	166.64	160.77	175.40	174.78	195.82	206.13	220.71 (62)

Solar DHW input calculated using Appendix H (negative quantity) ('0' entered if no solar contribution to water heating)

(63)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

∑(63)1...12 = 0.00 (63)

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

(64)m	225.90	199.33	209.88	188.88	185.63	166.64	160.77	175.40	174.78	195.82	206.13	220.71

∑(64)1...12 = 2309.87 (64)

if (64)m < 0 then set to 0

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

(65)m	103.88	92.27	98.56	90.65	90.49	83.25	82.23	87.09	85.96	93.88	96.38	102.16 (65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	167.53	167.53	167.53	167.53	167.53	167.53	167.53	167.53	167.53	167.53	167.53	167.53	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m	59.71	53.03	43.13	32.65	24.41	20.60	22.26	28.94	38.84	49.32	57.56	61.37	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m	397.65	401.78	391.38	369.25	341.30	315.04	297.49	293.37	303.76	325.90	353.85	380.11	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m	54.54	54.54	54.54	54.54	54.54	54.54	54.54	54.54	54.54	54.54	54.54	54.54	(69)
Pumps and fans gains (Table 5a)													
(70)m	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	(71)
Water heating gains (Table 5)													
(72)m	139.63	137.30	132.47	125.90	121.63	115.63	110.52	117.06	119.39	126.19	133.87	137.31	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m	717.38	712.50	687.36	648.18	607.73	571.65	550.66	559.75	582.38	621.79	665.66	699.17	(73)

6. Solar gains

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Rows (74) to (82) are used 12 times, one for each month, repeating as needed if there is more than one window type.

Details for month of January and annual totals are shown below:

	Access factor Table 6d		Area m²		Solar flux W/m²		g Specific data or Table 6b		FF Specific data or Table 6c		Gains (W)	
West	0.54	x	8.68	x	19.87	x 0.9 x	0.63	x	0.80	=	42.25	(80)
South	0.54	x	14.77	x	47.32	x 0.9 x	0.63	x	0.80	=	171.25	(78)

Solar gains in watts, calculated for each month ∑(74)m...(82)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(83)m	213.50	361.20	471.94	574.72	629.27	640.81	627.19	584.35	518.33	408.38	255.43	182.82	(83)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(84)m	930.87	1073.69	1159.30	1222.90	1237.00	1212.46	1177.85	1144.10	1100.70	1030.17	921.09	881.99	(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, η1,m (see Table 9a)													
(86)m	0.92	0.89	0.84	0.77	0.66	0.51	0.36	0.37	0.57	0.77	0.89	0.92	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)													
(87)m	19.23	19.53	19.91	20.30	20.66	20.88	20.97	20.97	20.83	20.43	19.72	19.27	(87)
Temperature during heating periods in the living area from Table 9, Th2(˚C)													
(88)m	20.03	20.04	20.04	20.06	20.07	20.07	20.07	20.07	20.07	20.06	20.05	20.04	(88)
Utilisation factor for gains for rest of dwelling η2,m (see Table 9a)													
(89)m	0.91	0.87	0.82	0.74	0.62	0.45	0.29	0.29	0.51	0.73	0.87	0.91	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)													
(90)m	17.69	18.12	18.66	19.21	19.70	19.96	20.05	20.05	19.91	19.40	18.41	17.76	(90)

Living area fraction fLA 24.00 ÷ (4) = 0.23 (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2													
(92)m	18.04	18.44	18.95	19.45	19.91	20.17	20.26	20.26	20.12	19.63	18.70	18.10	(92)
Apply adjustment to the mean internal temperature from Table 4e, where appropriate													
(93)m	17.89	18.29	18.80	19.30	19.76	20.02	20.11	20.11	19.97	19.48	18.55	17.95	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that tim = (93)m and recalculate the utilisation factor for gains using Table 9a)													
Utilisation factor for gains, ηm													
(94)m	0.88	0.84	0.79	0.72	0.60	0.45	0.29	0.30	0.50	0.71	0.84	0.88	(94)
Useful gains, ηmGm, W = (94)m x (84)m													
(95)m	819.11	902.67	911.81	876.88	742.91	545.29	339.74	339.00	555.60	727.39	775.91	780.42	(95)
Monthly average external temperature from Table 8													
(96)m	4.50	5.00	6.80	8.70	11.70	14.60	16.90	16.90	14.30	10.80	7.00	4.90	(96)
Heat loss rate for mean internal temperature, Lm, W													
(97)m	1527.37	1494.88	1349.44	1159.06	874.03	587.10	347.67	347.50	614.39	948.80	1281.58	1468.26	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m - (95)m] x (41)m													
(98)m	526.94	397.96	325.59	203.17	97.56	0.00	0.00	0.00	0.00	164.73	364.08	511.75	

Total per year (kWh/year) = ∑(98)1...5, 10...12 = 2591.78 (98)

Space heating requirement in kWh/m²/year (98) ÷ (4) 24.34 (99)

9a. Energy Requirements - Individual heating systems including micro-CHP

Space heating:

Fraction of space heating from secondary/supplementary system (Table 11) 0.00 (201)

Fraction of space heating from main system(s) 1 - (201) 1.00 (202)

Fraction of main heating from main system 2 0.00 (203)

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 space heating system 1 (%)	93.00	(206)

(from database or Table 4a/4b, adjusted where appropriate by the amount shown in the 'space efficiency adjustment' column of Table 4c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement, kWh/month (as calculated above)												
(98)m	526.94	397.96	325.59	203.17	97.56	0.00	0.00	0.00	0.00	164.73	364.08	511.75
Space heating fuel (main heating system 1), kWh/month = (98)m x (204) x 100 ÷ (206)												
(211)m	566.61	427.92	350.10	218.46	104.90	0.00	0.00	0.00	0.00	177.12	391.49	550.27

Total per year (kWh/year) = ∑(211)1...5, 10...12 = 2786.86 (211)

Water heating:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Output from water heater, kWh/month (calculated above)												
(64)m	225.90	199.33	209.88	188.88	185.63	166.64	160.77	175.40	174.78	195.82	206.13	220.71

∑(64)1...12 = 2309.87 (64)

Efficiency of water heater per month												
(217)m	86.50	86.12	85.48	84.51	82.69	79.30	79.30	79.30	79.30	83.85	85.81	86.48
Fuel for water heating, kWh/month = (64)m x 100 ÷ (217)m												
(219)m	261.16	231.46	245.53	223.51	224.50	210.13	202.73	221.19	220.40	233.52	240.21	255.21

Total per year (kWh/year) = ∑(219)1...12 = 2769.55 (219)

Annual Totals Summary:	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		2786.86	(211)
Water heating fuel used		2769.55	(219)
Electricity for pumps, fans and electric keep-hot (Table 4f):			
mechanical ventilation fans - balanced, extract or positive input from outside	79.05		(230a)
warm air heating system fans	0.00		(230b)
central heating pump	130.00		(230c)
oil boiler pump	0.00		(230d)
boiler flue fan	45.00		(230e)
maintaining electric keep-hot facility for gas combi boiler	0.00		(230f)
pump for solar water heating	0.00		(230g)
Total electricity for the above	∑(230a)...(230g)	254.05	(231)
Electricity for lighting (calculated in Appendix L):		421.77	(232)
Energy saving/generation technologies (Appendices M, N and Q):			
Electricity generated by PVs (Appendix M) (negative quantity)		-994.03	(233)

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

	Fuel kWh/year		Fuel price (Table 12)		Fuel cost £/year	
Space heating - main system 1	2786.86	x	3.10	x 0.01 =	86.39	(240)
Water heating cost (other fuel)	2769.55	x	3.10	x 0.01 =	85.86	(247)
Pumps, fans and electric keep-hot	254.05	x	11.46	x 0.01 =	29.11	(249)
Energy for lighting	421.77	x	11.46	x 0.01 =	48.33	(250)
Additional standing charges (Table 12)					106.00	(251)
Energy saving/generation technologies (Appendices M, N and Q):						
PV savings (negative quantity)	-994.03	x	11.46	x 0.01 =	-113.92	(252)
Total energy cost			(240)...(242) + (245)...(254)		241.78	(255)

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

Energy cost deflator (Table 12)	0.47	(256)

Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	0.75	(257)
SAP value		89.54	
SAP rating		90	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year		Emissions Factor		Emissions (kgCO2/year)	
Space heating - main system 1	2786.86	x	0.198	=	551.80	(261)
Water heating	2769.55	x	0.198	=	548.37	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1100.17	(265)
Pumps, fans and electric keep-hot	254.05	x	0.517	=	131.34	(267)
Lighting	421.77	x	0.517	=	218.06	(268)
Energy saving/generation technologies:						
PV emission savings (negative quantity)	-994.03	x	0.529	=	-525.84	(269)
Total carbon dioxide emissions			∑(261)...(271) =		923.73	(272)
Dwelling carbon dioxide emissions rate			(272) ÷ (4) =		8.67	(273)
EI value					91.83	
EI rating (see section 14)					92	(274)
EI band					A	

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

	Energy kWh/year		Primary Energy Factor		Primary Energy	
Space heating - main system 1	2786.86	x	1.02	=	2842.60	(261*)
Water heating	2769.55	x	1.02	=	2824.94	(264*)
Space and water heating			(261*) + (262*) + (263*) + (264*) =		5667.54	(265*)
Pumps, fans and electric keep-hot	254.05	x	2.92	=	741.82	(267*)
Lighting	421.77	x	2.92	=	1231.57	(268*)
Energy saving/generation technologies:						
PV primary energy savings (negative quantity)	-994.03	x	2.92	=	-2902.56	(269*)
Total primary energy kWh/year			∑(261*)...(271*) =		4738.37	(272*)
Primary energy kWh/m2/year			(272*) ÷ (4) =		44.49	(273*)

DRAFT

Code for Sustainable Homes (November 2010)
Design - Draft

This report details the calculations and results for Ene 1, 2 and 7 of the Code For Sustainable Homes.

This Design Assessment has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed. Code calculations are from the Technical Guide (November 2010).

Assessor name	Mr Stuart Searle	Assessor number	2435
Client		Last modified	01/02/2013
Address	P06 4 St Augustines, London, NW1		

Building regulation assessment - criterion 1

	kg/m²/yr
DER	10.53
TER	15.03

Assessment of zero carbon home and low or zero carbon technologies

		Credits	Level
Dwelling emission rate (Ene 1)	CO_2 reduction = 29.9 %	3.4	4
Fabric Energy Efficiency	FEE = 41.7	5.6	
Low or zero carbon technologies (Ene 7)	CO_2 reduction = 14 %	1	

Ene 1 - dwelling emission rate

	%	kWh/m²	kgCO_2/m²/yr	
Assessment of Ene 1 (level 1-5)				
DER from SAP 2009 DER worksheet			10.53	
Additional allowable generation		0.00		
CO_2 emissions offset from generation			0.00	
CO_2 emissions offset from community biofuel CHP systems			0.00	
Total CO_2 emissions offset from SAP section 16 allowances			**0.00**	
DER accounting for SAP section 16 allowances			**10.53**	
CO_2 reduction compared to TER			4.50	
CO_2 reduction as % of TER	29.9			
Assessment of Ene 1 (level 6)				
DER from SAP 2009 DER worksheet			10.53	(ZC1)
CO_2 emissions from appliances (equation L14)			15.39	(ZC2)
CO_2 emissions from cooking (equation L16)			1.92	(ZC3)
Total CO_2 emissions			27.85	(ZC4)
Additional allowable generation and its CO_2 emissions offset		0.00		(ZC6)
CO_2 emissions offset from additional allowable generation			0.00	(ZC7)
CO_2 emissions offset from community biofuel CHP systems			0.00	(ZC5)
Net CO_2 emissions			**27.85**	(ZC8)

Ene 1 - dwelling emission rate - level 6

There is no Zero Carbon Home definition in the current technical guide

	Criterion	Value	Pass/Fail
FEE	<= 39	41.7	Fail
Net CO_2 emissions	<= 0.00	27.85	Fail

Result: Not level 6

Number of credits for Ene 1	**3.4**

Ene 2 - Fabric Energy Efficiency

FEE	41.7
Number of credits for Ene 2	**5.6**

Ene 7 - low or zero carbon technologies

	Emissions $kgCO_2/yr$	Reduction $kgCO_2/yr$
Standard case		
Space and water heating (265)	1264.06	
Mechanical cooling (266)	0.00	
Pumps and fans (267)	127.12	
Lighting (268)	204.20	
Appliances and cooking	1653.87	
Total CO_2	**1578.06**	
Actual case		
Space and water heating (265) or (376)	1264.06	
Space and water heating from LZCT considered in SAP 2009		0.00
Pumps and fans (267) or (378)	127.12	
Pumps and fans		0.00
Electricity generated by LZCT (269) + (380))		-471.35
Additional allowable electricity generation considered in SAP 2009 section 16		0.00
Offset from biofuel CHP [-1 x [(363)..(366) + (368)...(372)]]		0.00
LZCT electricity generation		-471.35
LZCT thermal generation		0
Total from specified LZCT		**-471.35**

	Emissions $kgCO_2/m^2/yr$	
Reduction in CO_2 Emissions		
Standard Case CO_2	34.03	
Actual Case CO_2	29.09	
% Reduction in CO_2	14	
Number of credits for Ene 7	**1**	

DRAFT

DER 2009 Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Stuart Searle	Assessor number	2435
Client		Last modified	01/02/2013
Address	P06 4 St Augustines, London, NW1		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		95.50	(1a) x	2.60	(2a) =	248.30	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	95.50	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	248.30	(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	5.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.25	(18)

Air permeability value applies if a pressurisation test has been done, or a design or specified air permeability is being used

Number of sides on which dwelling is sheltered		2	(19)
Shelter factor	1 - [0.075 x (19)] =	0.85	(20)
Adjusted infiltration rate	(18) x (20) =	0.21	(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 7													
(22)m	5.40	5.10	5.10	4.50	4.10	3.90	3.70	3.70	4.20	4.50	4.80	5.10	
										∑(22)1...12 =		54.10	(22)
Wind Factor (22a)m = (22)m ÷ 4													
(22a)m	1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.20	1.27	
										∑(22a)1...12 =		13.52	(22a)
Adjusted infiltration rate (allowing for shelter and wind speed) = (21) × (22a)m													
(22b)m	0.29	0.27	0.27	0.24	0.22	0.21	0.20	0.20	0.22	0.24	0.26	0.27	
										∑(22b)1...12 =		2.87	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)), otherwise (23b) = (23a)	0.5	(23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = N/A (23c)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b)m + 0.5 x (23b)

(24c)m	0.54	0.52	0.52	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.52	(24c)

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

(25)m	0.54	0.52	0.52	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.52	(25)

3. Heat losses and heat loss parameter

The κ-value is the heat capacity per unit area, see Table 1e.

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	
Doors			2.10	x	1.60	=	3.36	N/A	N/A	(26)
Window*			8.68	x	1.15	=	9.94	N/A	N/A	(27)
Window*			11.82	x	1.33	=	15.67	N/A	N/A	(27)
Exposed floor			15.50	x	0.20	=	3.10	N/A	N/A	(28b)
External wall			52.96	x	0.20	=	10.59	N/A	N/A	(29a)
Party Wall			33.80	x	0.00	=	0.00	N/A	N/A	(32)

Total area of external elements ∑A, m² 91.06 (31)

** for windows and roof windows, effective window U-value is calculated using formula 1/[(1/UValue)+0.04] paragraph 3.2*

Fabric heat loss, W/K = ∑(A × U) (26)...(30) + (32) = 42.66 (33)

Heat capacity Cm = ∑(A x κ) (28)...(30) + (32) + (32a)...(32e) = N/A (34)

Thermal mass parameter (TMP) in kJ/m²K Calculated separately = 100.00 (35)

Thermal bridges: ∑(L x Ψ) calculated using Appendix K 9.87 (36)

if details of thermal bridging are not known then (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 52.53 (37)

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

(38)m	43.99	42.69	42.69	40.97	40.97	40.97	40.97	40.97	40.97	40.97	41.38	42.69	(38)

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

(39)m	96.53	95.22	95.22	93.50	93.50	93.50	93.50	93.50	93.50	93.50	93.91	95.22	

Average = ∑(39)1...12/12 = 94.22 (39)

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

(40)m	1.01	1.00	1.00	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	1.00	

Average = ∑(40)1...12/12 = 0.99 (40)

4. Water heating energy requirement

kWh/year

Assumed occupancy, N 2.69 (42)

If TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)

If TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 98.18 (43)

Annual average hot water usage has been reduced by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	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)													
(44)m	108.00	104.07	100.14	96.21	92.29	88.36	88.36	92.29	96.21	100.14	104.07	108.00	

∑(44)1...12 = 1178.13 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

(45)m	160.54	140.41	144.89	126.32	121.20	104.59	96.92	111.21	112.54	131.16	143.17	155.47	

∑(45)1...12 = 1548.41 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

For community heating include distribution loss whether or not hot water tank is present

Distribution loss 0.15 x (45)m

(46)m	24.08	21.06	21.73	18.95	18.18	15.69	14.54	16.68	16.88	19.67	21.48	23.32	(46)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):	1.85	(47)
Temperature factor from Table 2b	0.54	(48)
Energy lost from water storage, kWh/day (47) x (48)	1.00	(49)
Enter (49) or (54) in (55)	1.00	(55)

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

(56)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(56)

If cylinder contains dedicated solar storage, = (56)m x [(50) - (H11)] ÷ (50), else = (56)m where (H11) is from Appendix H

(57)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(57)

Primary circuit loss (annual) from Table 3: 360.00 (58)

Primary circuit loss for each month (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m	30.58	27.62	30.58	29.59	30.58	29.59	30.58	30.58	29.59	30.58	29.59	30.58	(59)

Combi loss for each month from Table 3a, 3b or 3c (enter '0' if not a combi boiler)

(61)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	(61)

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

(62)m	222.08	195.99	206.43	185.87	182.75	164.15	158.46	172.76	172.10	192.70	202.73	217.02	(62)

Solar DHW input calculated using Appendix H (negative quantity) ('0' entered if no solar contribution to water heating)

(63)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	

∑(63)1...12 = 0.00 (63)

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

(64)m	222.08	195.99	206.43	185.87	182.75	164.15	158.46	172.76	172.10	192.70	202.73	217.02	

∑(64)1...12 = 2273.04 (64)

if (64)m < 0 then set to 0

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

(65)m	102.61	91.16	97.41	89.65	89.54	82.42	81.46	86.21	85.07	92.85	95.25	100.93	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	134.69	134.69	134.69	134.69	134.69	134.69	134.69	134.69	134.69	134.69	134.69	134.69	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m	22.36	19.86	16.15	12.23	9.14	7.72	8.34	10.84	14.55	18.47	21.56	22.99	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m	248.84	251.42	244.92	231.06	213.58	197.14	186.16	183.58	190.09	203.94	221.43	237.86	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m	36.47	36.47	36.47	36.47	36.47	36.47	36.47	36.47	36.47	36.47	36.47	36.47	(69)
Pumps and fans gains (Table 5a)													
(70)m	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	(71)
Water heating gains (Table 5)													
(72)m	137.92	135.65	130.93	124.51	120.34	114.48	109.49	115.88	118.15	124.79	132.29	135.66	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m	482.53	480.34	465.41	441.21	416.47	392.74	377.40	383.71	396.19	420.61	448.69	469.91	(73)

6. Solar gains

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Rows (74) to (82) are used 12 times, one for each month, repeating as needed if there is more than one window type.

Details for month of January and annual totals are shown below:

	Access factor Table 6d		Area m²		Solar flux W/m²		g Specific data or Table 6b		FF Specific data or Table 6c		Gains (W)	
West	0.54	x	8.68	x	19.87	x 0.9 x	0.63	x	0.80	=	42.25	(80)
Northwest	0.54	x	11.82	x	11.51	x 0.9 x	0.63	x	0.80	=	33.32	(81)

Solar gains in watts, calculated for each month ∑(74)m...(82)m

(83)m	75.57	150.08	249.95	390.62	496.33	529.00	508.66	426.76	304.84	185.42	94.58	61.95	(83)

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

(84)m	558.11	630.43	715.36	831.83	912.80	921.74	886.06	810.47	701.03	606.03	543.27	531.86	(84)

7. Mean internal temperature (heating season)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area, η1,m (see Table 9a)													
(86)m	0.97	0.95	0.92	0.85	0.72	0.57	0.41	0.44	0.70	0.88	0.95	0.97	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)													
(87)m	18.93	19.18	19.62	20.12	20.59	20.85	20.96	20.95	20.73	20.17	19.42	18.99	(87)
Temperature during heating periods in the living area from Table 9, Th2(°C)													
(88)m	20.08	20.09	20.09	20.10	20.10	20.10	20.10	20.10	20.10	20.10	20.10	20.09	(88)
Utilisation factor for gains for rest of dwelling η2,m (see Table 9a)													
(89)m	0.96	0.94	0.90	0.83	0.68	0.51	0.33	0.36	0.64	0.86	0.94	0.96	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)													
(90)m	17.29	17.65	18.30	19.00	19.64	19.97	20.08	20.07	19.83	19.08	18.01	17.39	(90)

Living area fraction fLA 31.30 ÷ (4) = 0.33 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2													
(92)m	17.83	18.15	18.73	19.37	19.95	20.26	20.37	20.36	20.13	19.44	18.47	17.91	(92)
Apply adjustment to the mean internal temperature from Table 4e, where appropriate													
(93)m	17.68	18.00	18.58	19.22	19.80	20.11	20.22	20.21	19.98	19.29	18.32	17.76	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that tim = (93)m and recalculate the utilisation factor for gains using Table 9a)													
Utilisation factor for gains, ηm													
(94)m	0.94	0.92	0.88	0.80	0.67	0.51	0.34	0.37	0.63	0.83	0.92	0.95	(94)
Useful gains, ηmGm, W = (94)m x (84)m													
(95)m	526.38	581.85	628.37	666.73	611.65	467.79	300.25	297.33	443.58	504.99	501.90	502.94	(95)
Monthly average external temperature from Table 8													
(96)m	4.50	5.00	6.80	8.70	11.70	14.60	16.90	16.90	14.30	10.80	7.00	4.90	(96)
Heat loss rate for mean internal temperature, Lm, W													
(97)m	1272.07	1238.05	1121.94	983.31	757.09	514.87	310.10	309.44	530.79	793.75	1063.47	1224.57	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m - (95)m] x (41)m													
(98)m	554.79	440.97	367.21	227.94	108.21	0.00	0.00	0.00	0.00	214.84	404.33	536.90	

Total per year (kWh/year) = ∑(98)1...5, 10...12 = 2855.20 (98)

Space heating requirement in kWh/m²/year (98) ÷ (4) 29.90 (99)

9a. Energy Requirements - Individual heating systems including micro-CHP

Space heating:

Fraction of space heating from secondary/supplementary system (Table 11) 0.00 (201)

Fraction of space heating from main system(s) 1 - (201)	1.00	(202)
Fraction of main heating from main system 2	0.00	(203)
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 space heating system 1 (%)	93.00	(206)

(from database or Table 4a/4b, adjusted where appropriate by the amount shown in the 'space efficiency adjustment' column of Table 4c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement, kWh/month (as calculated above)												
(98)m	554.79	440.97	367.21	227.94	108.21	0.00	0.00	0.00	0.00	214.84	404.33	536.90
Space heating fuel (main heating system 1), kWh/month = (98)m x (204) x 100 ÷ (206)												
(211)m	596.55	474.16	394.85	245.10	116.36	0.00	0.00	0.00	0.00	231.01	434.77	577.31

Total per year (kWh/year) = ∑(211)1...5, 10...12 = 3070.10 (211)

Water heating:

Output from water heater, kWh/month (calculated above)												
(64)m	222.08	195.99	206.43	185.87	182.75	164.15	158.46	172.76	172.10	192.70	202.73	217.02

∑(64)1...12 = 2273.04 (64)

Efficiency of water heater per month												
(217)m	86.66	86.41	85.83	84.86	82.97	79.30	79.30	79.30	79.30	84.60	86.12	86.64
Fuel for water heating, kWh/month = (64)m x 100 ÷ (217)m												
(219)m	256.27	226.81	240.51	219.04	220.26	207.00	199.83	217.85	217.03	227.77	235.40	250.49

Total per year (kWh/year) = ∑(219)1...12 = 2718.27 (219)

Annual Totals Summary:	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		3070.10	(211)
Water heating fuel used		2718.27	(219)
Electricity for pumps, fans and electric keep-hot (Table 4f):			
mechanical ventilation fans - balanced, extract or positive input from outside	70.88		(230a)
warm air heating system fans	0.00		(230b)
central heating pump	130.00		(230c)
oil boiler pump	0.00		(230d)
boiler flue fan	45.00		(230e)
maintaining electric keep-hot facility for gas combi boiler	0.00		(230f)
pump for solar water heating	0.00		(230g)
Total electricity for the above	∑(230a)...(230g)	245.88	(231)
Electricity for lighting (calculated in Appendix L):		394.96	(232)
Energy saving/generation technologies (Appendices M, N and Q):			
Electricity generated by PVs (Appendix M) (negative quantity)		-891.02	(233)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year		Emissions Factor		Emissions (kgCO2/year)	
Space heating - main system 1	3070.10	x	0.198	=	607.88	(261)
Water heating	2718.27	x	0.198	=	538.22	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1146.10	(265)
Pumps, fans and electric keep-hot	245.88	x	0.517	=	127.12	(267)
Lighting	394.96	x	0.517	=	204.20	(268)
Energy saving/generation technologies:						
PV emission savings (negative quantity)	-891.02	x	0.529	=	-471.35	(269)
Total carbon dioxide emissions				∑(261)...(271) =	1006.07	(272)

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SAP 2009 Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Stuart Searle	Assessor number	2435
Client		Last modified	01/02/2013
Address	P06 4 St Augustines, London, NW1		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		95.50	(1a) x	2.60	(2a) =	248.30	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	95.50	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	248.30	(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	5.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.25	(18)

Air permeability value applies if a pressurisation test has been done, or a design or specified air permeability is being used

Number of sides on which dwelling is sheltered		2	(19)
Shelter factor	1 - [0.075 x (19)] =	0.85	(20)
Adjusted infiltration rate	(18) x (20) =	0.21	(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 7													
(22)m	5.40	5.10	5.10	4.50	4.10	3.90	3.70	3.70	4.20	4.50	4.80	5.10	
										∑(22)1...12 =		54.10	(22)
Wind Factor (22a)m = (22)m ÷ 4													
(22a)m	1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.20	1.27	
										∑(22a)1...12 =		13.52	(22a)
Adjusted infiltration rate (allowing for shelter and wind speed) = (21) × (22a)m													
(22b)m	0.29	0.27	0.27	0.24	0.22	0.21	0.20	0.20	0.22	0.24	0.26	0.27	
										∑(22b)1...12 =		2.87	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)), otherwise (23b) = (23a)	0.5	(23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = N/A (23c)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b)m + 0.5 x (23b)

(24c)m	0.54	0.52	0.52	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.52	(24c)

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

(25)m	0.54	0.52	0.52	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.52	(25)

3. Heat losses and heat loss parameter

The κ-value is the heat capacity per unit area, see Table 1e.

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	
Doors			2.10	x	1.60	=	3.36	N/A	N/A	(26)
Window*			8.68	x	1.15	=	9.94	N/A	N/A	(27)
Window*			11.82	x	1.33	=	15.67	N/A	N/A	(27)
Exposed floor			15.50	x	0.20	=	3.10	N/A	N/A	(28b)
External wall			52.96	x	0.20	=	10.59	N/A	N/A	(29a)
Party Wall			33.80	x	0.00	=	0.00	N/A	N/A	(32)

Total area of external elements ∑A, m² 91.06 (31)

** for windows and roof windows, effective window U-value is calculated using formula 1/[(1/UValue)+0.04] paragraph 3.2*

Fabric heat loss, W/K = ∑(A × U) (26)...(30) + (32) = 42.66 (33)

Heat capacity Cm = ∑(A x κ) (28)...(30) + (32) + (32a)...(32e) = N/A (34)

Thermal mass parameter (TMP) in kJ/m²K Calculated separately = 100.00 (35)

Thermal bridges: ∑(L x Ψ) calculated using Appendix K 9.87 (36)

if details of thermal bridging are not known then (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 52.53 (37)

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

(38)m	43.99	42.69	42.69	40.97	40.97	40.97	40.97	40.97	40.97	40.97	41.38	42.69	(38)

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

(39)m	96.53	95.22	95.22	93.50	93.50	93.50	93.50	93.50	93.50	93.50	93.91	95.22	

Average = ∑(39)1...12/12 = 94.22 (39)

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

(40)m	1.01	1.00	1.00	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	1.00	

Average = ∑(40)1...12/12 = 0.99 (40)

4. Water heating energy requirement

kWh/year

Assumed occupancy, N 2.69 (42)

If TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)

If TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 98.18 (43)

Annual average hot water usage has been reduced by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	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)													
(44)m	108.00	104.07	100.14	96.21	92.29	88.36	88.36	92.29	96.21	100.14	104.07	108.00	

∑(44)1...12 = 1178.13 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

(45)m	160.54	140.41	144.89	126.32	121.20	104.59	96.92	111.21	112.54	131.16	143.17	155.47	

∑(45)1...12 = 1548.41 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

For community heating include distribution loss whether or not hot water tank is present

Distribution loss 0.15 x (45)m

(46)m	24.08	21.06	21.73	18.95	18.18	15.69	14.54	16.68	16.88	19.67	21.48	23.32	(46)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):	1.85	(47)
Temperature factor from Table 2b	0.54	(48)
Energy lost from water storage, kWh/day (47) x (48)	1.00	(49)
Enter (49) or (54) in (55)	1.00	(55)

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

(56)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(56)

If cylinder contains dedicated solar storage, = (56)m x [(50) - (H11)] ÷ (50), else = (56)m where (H11) is from Appendix H

(57)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(57)

Primary circuit loss (annual) from Table 3: 360.00 (58)

Primary circuit loss for each month (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m	30.58	27.62	30.58	29.59	30.58	29.59	30.58	30.58	29.59	30.58	29.59	30.58	(59)

Combi loss for each month from Table 3a, 3b or 3c (enter '0' if not a combi boiler)

(61)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	(61)

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

(62)m	222.08	195.99	206.43	185.87	182.75	164.15	158.46	172.76	172.10	192.70	202.73	217.02	(62)

Solar DHW input calculated using Appendix H (negative quantity) ('0' entered if no solar contribution to water heating)

(63)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	

∑(63)1...12 = 0.00 (63)

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

(64)m	222.08	195.99	206.43	185.87	182.75	164.15	158.46	172.76	172.10	192.70	202.73	217.02	

∑(64)1...12 = 2273.04 (64)

if (64)m < 0 then set to 0

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

(65)m	102.61	91.16	97.41	89.65	89.54	82.42	81.46	86.21	85.07	92.85	95.25	100.93	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	161.63	161.63	161.63	161.63	161.63	161.63	161.63	161.63	161.63	161.63	161.63	161.63	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m	55.91	49.66	40.39	30.57	22.86	19.30	20.85	27.10	36.37	46.19	53.91	57.47	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m	371.40	375.26	365.55	344.87	318.77	294.24	277.85	274.00	283.71	304.39	330.49	355.02	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m	53.86	53.86	53.86	53.86	53.86	53.86	53.86	53.86	53.86	53.86	53.86	53.86	(69)
Pumps and fans gains (Table 5a)													
(70)m	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	(71)
Water heating gains (Table 5)													
(72)m	137.92	135.65	130.93	124.51	120.34	114.48	109.49	115.88	118.15	124.79	132.29	135.66	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m	682.97	678.30	654.59	617.69	579.70	545.75	525.93	534.71	555.97	593.10	634.42	665.87	(73)

6. Solar gains

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Rows (74) to (82) are used 12 times, one for each month, repeating as needed if there is more than one window type.

Details for month of January and annual totals are shown below:

	Access factor Table 6d		Area m²		Solar flux W/m²		g Specific data or Table 6b		FF Specific data or Table 6c		Gains (W)	
West	0.54	x	8.68	x	19.87	x 0.9 x	0.63	x	0.80	=	42.25	(80)
Northwest	0.54	x	11.82	x	11.51	x 0.9 x	0.63	x	0.80	=	33.32	(81)

Solar gains in watts, calculated for each month ∑(74)m...(82)m

(83)m	75.57	150.08	249.95	390.62	496.33	529.00	508.66	426.76	304.84	185.42	94.58	61.95	(83)

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

(84)m	758.54	828.38	904.55	1008.31	1076.04	1074.75	1034.58	961.47	860.81	778.52	729.00	727.82	(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, η1,m (see Table 9a)													
(86)m	0.93	0.91	0.87	0.79	0.66	0.51	0.36	0.38	0.62	0.81	0.91	0.93	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)													
(87)m	19.26	19.48	19.88	20.30	20.68	20.89	20.97	20.97	20.81	20.36	19.71	19.31	(87)
Temperature during heating periods in the living area from Table 9, Th2(°C)													
(88)m	20.08	20.09	20.09	20.10	20.10	20.10	20.10	20.10	20.10	20.10	20.10	20.09	(88)
Utilisation factor for gains for rest of dwelling η2,m (see Table 9a)													
(89)m	0.92	0.90	0.85	0.76	0.62	0.45	0.28	0.30	0.56	0.78	0.90	0.92	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)													
(90)m	17.76	18.09	18.65	19.24	19.75	20.00	20.09	20.08	19.92	19.34	18.42	17.85	(90)

Living area fraction fLA 31.30 ÷ (4) = 0.33 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2													
(92)m	18.25	18.55	19.05	19.59	20.06	20.29	20.38	20.37	20.21	19.68	18.84	18.33	(92)
Apply adjustment to the mean internal temperature from Table 4e, where appropriate													
(93)m	18.10	18.40	18.90	19.44	19.91	20.14	20.23	20.22	20.06	19.53	18.69	18.18	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that tim = (93)m and recalculate the utilisation factor for gains using Table 9a)													
Utilisation factor for gains, ηm													
(94)m	0.90	0.87	0.82	0.74	0.61	0.45	0.29	0.31	0.55	0.76	0.87	0.90	(94)
Useful gains, ηmGm, W = (94)m x (84)m													
(95)m	681.41	724.04	744.12	747.52	654.10	483.83	304.18	302.48	476.64	591.86	634.54	655.51	(95)
Monthly average external temperature from Table 8													
(96)m	4.50	5.00	6.80	8.70	11.70	14.60	16.90	16.90	14.30	10.80	7.00	4.90	(96)
Heat loss rate for mean internal temperature, Lm, W													
(97)m	1313.09	1275.49	1152.38	1003.81	767.24	518.48	310.98	310.60	538.59	816.05	1098.09	1264.55	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m - (95)m] x (41)m													
(98)m	469.97	370.58	303.75	184.53	84.18	0.00	0.00	0.00	0.00	166.79	333.76	453.13	

Total per year (kWh/year) = ∑(98)1...5, 10...12 = 2366.68 (98)

Space heating requirement in kWh/m²/year (98) ÷ (4) 24.78 (99)

9a. Energy Requirements - Individual heating systems including micro-CHP

Space heating:

Fraction of space heating from secondary/supplementary system (Table 11) 0.00 (201)

Fraction of space heating from main system(s) 1 - (201)	1.00	(202)
Fraction of main heating from main system 2	0.00	(203)
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 space heating system 1 (%)	93.00	(206)

(from database or Table 4a/4b, adjusted where appropriate by the amount shown in the 'space efficiency adjustment' column of Table 4c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement, kWh/month (as calculated above)												
(98)m	469.97	370.58	303.75	184.53	84.18	0.00	0.00	0.00	0.00	166.79	333.76	453.13
Space heating fuel (main heating system 1), kWh/month = (98)m x (204) x 100 ÷ (206)												
(211)m	505.34	398.47	326.61	198.42	90.51	0.00	0.00	0.00	0.00	179.35	358.88	487.24

Total per year (kWh/year) = ∑(211)1...5, 10...12 = 2544.81 (211)

Water heating:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Output from water heater, kWh/month (calculated above)												
(64)m	222.08	195.99	206.43	185.87	182.75	164.15	158.46	172.76	172.10	192.70	202.73	217.02

∑(64)1...12 = 2273.04 (64)

Efficiency of water heater per month												
(217)m	86.26	85.99	85.34	84.29	82.39	79.30	79.30	79.30	79.30	83.93	85.63	86.23
Fuel for water heating, kWh/month = (64)m x 100 ÷ (217)m												
(219)m	257.44	227.94	241.89	220.51	221.81	207.00	199.83	217.85	217.03	229.60	236.74	251.66

Total per year (kWh/year) = ∑(219)1...12 = 2729.29 (219)

Annual Totals Summary:	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		2544.81	(211)
Water heating fuel used		2729.29	(219)
Electricity for pumps, fans and electric keep-hot (Table 4f):			
mechanical ventilation fans - balanced, extract or positive input from outside	70.88		(230a)
warm air heating system fans	0.00		(230b)
central heating pump	130.00		(230c)
oil boiler pump	0.00		(230d)
boiler flue fan	45.00		(230e)
maintaining electric keep-hot facility for gas combi boiler	0.00		(230f)
pump for solar water heating	0.00		(230g)
Total electricity for the above	∑(230a)...(230g)	245.88	(231)
Electricity for lighting (calculated in Appendix L):		394.96	(232)
Energy saving/generation technologies (Appendices M, N and Q):			
Electricity generated by PVs (Appendix M) (negative quantity)		-891.02	(233)

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

	Fuel kWh/year		Fuel price (Table 12)		Fuel cost £/year	
Space heating - main system 1	2544.81	x	3.10	x 0.01 =	78.89	(240)
Water heating cost (other fuel)	2729.29	x	3.10	x 0.01 =	84.61	(247)
Pumps, fans and electric keep-hot	245.88	x	11.46	x 0.01 =	28.18	(249)
Energy for lighting	394.96	x	11.46	x 0.01 =	45.26	(250)
Additional standing charges (Table 12)					106.00	(251)
Energy saving/generation technologies (Appendices M, N and Q):						
PV savings (negative quantity)	-891.02	x	11.46	x 0.01 =	-102.11	(252)
Total energy cost				(240)...(242) + (245)...(254)	240.83	(255)

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

Energy cost deflator (Table 12)		0.47	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	0.81	(257)
SAP value		88.76	
SAP rating		89	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year		Emissions Factor		Emissions (kgCO2/year)	
Space heating - main system 1	2544.81	x	0.198	=	503.87	(261)
Water heating	2729.29	x	0.198	=	540.40	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1044.27	(265)
Pumps, fans and electric keep-hot	245.88	x	0.517	=	127.12	(267)
Lighting	394.96	x	0.517	=	204.20	(268)
Energy saving/generation technologies:						
PV emission savings (negative quantity)	-891.02	x	0.529	=	-471.35	(269)
Total carbon dioxide emissions			∑(261)...(271) =		904.24	(272)
Dwelling carbon dioxide emissions rate			(272) ÷ (4) =		9.47	(273)
EI value					91.38	
EI rating (see section 14)					91	(274)
EI band					B	

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

	Energy kWh/year		Primary Energy Factor		Primary Energy	
Space heating - main system 1	2544.81	x	1.02	=	2595.71	(261*)
Water heating	2729.29	x	1.02	=	2783.88	(264*)
Space and water heating			(261*) + (262*) + (263*) + (264*) =		5379.59	(265*)
Pumps, fans and electric keep-hot	245.88	x	2.92	=	717.98	(267*)
Lighting	394.96	x	2.92	=	1153.29	(268*)
Energy saving/generation technologies:						
PV primary energy savings (negative quantity)	-891.02	x	2.92	=	-2601.78	(269*)
Total primary energy kWh/year			∑(261*)...(271*) =		4649.09	(272*)
Primary energy kWh/m2/year			(272*) ÷ (4) =		48.68	(273*)

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Code for Sustainable Homes (November 2010)
Design - Draft

This report details the calculations and results for Ene 1, 2 and 7 of the Code For Sustainable Homes.

This Design Assessment has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed. Code calculations are from the Technical Guide (November 2010).

Assessor name	Mr Stuart Searle	Assessor number	2435
Client		Last modified	01/02/2013
Address	P07 4 St Augustines, London, NW1		

Building regulation assessment - criterion 1

	kg/m²/yr
DER	9.95
TER	15.66

Assessment of zero carbon home and low or zero carbon technologies

		Credits	Level
Dwelling emission rate (Ene 1)	CO_2 reduction = 36.5 %	4	4
Fabric Energy Efficiency	FEE = 42.0	5.5	
Low or zero carbon technologies (Ene 7)	CO_2 reduction = 15 %	2	

Ene 1 - dwelling emission rate

	%	kWh/m²	kgCO_2/m²/yr	
Assessment of Ene 1 (level 1-5)				
DER from SAP 2009 DER worksheet			9.95	
Additional allowable generation		0.00		
CO_2 emissions offset from generation			0.00	
CO_2 emissions offset from community biofuel CHP systems			0.00	
Total CO_2 emissions offset from SAP section 16 allowances			**0.00**	
DER accounting for SAP section 16 allowances			**9.95**	
CO_2 reduction compared to TER			5.71	
CO_2 reduction as % of TER	36.5			
Assessment of Ene 1 (level 6)				
DER from SAP 2009 DER worksheet			9.95	(ZC1)
CO_2 emissions from appliances (equation L14)			14.78	(ZC2)
CO_2 emissions from cooking (equation L16)			1.75	(ZC3)
Total CO_2 emissions			26.48	(ZC4)
Additional allowable generation and its CO_2 emissions offset		0.00		(ZC6)
CO_2 emissions offset from additional allowable generation			0.00	(ZC7)
CO_2 emissions offset from community biofuel CHP systems			0.00	(ZC5)
Net CO_2 emissions			**26.48**	(ZC8)

Ene 1 - dwelling emission rate - level 6

There is no Zero Carbon Home definition in the current technical guide

	Criterion	Value	Pass/Fail
FEE	<= 39	42.0	Fail
Net CO_2 emissions	<= 0.00	26.48	Fail

Result: Not level 6

Number of credits for Ene 1	**4**

Ene 2 - Fabric Energy Efficiency

FEE	42.0
Number of credits for Ene 2	**5.5**

Ene 7 - low or zero carbon technologies

	Emissions $kgCO_2/yr$	Reduction $kgCO_2/yr$
Standard case		
Space and water heating (265)	1373.23	
Mechanical cooling (266)	0.00	
Pumps and fans (267)	131.34	
Lighting (268)	221.45	
Appliances and cooking	1760.14	
Total CO_2	**1709.50**	
Actual case		
Space and water heating (265) or (376)	1373.23	
Space and water heating from LZCT considered in SAP 2009		0.00
Pumps and fans (267) or (378)	131.34	
Pumps and fans		0.00
Electricity generated by LZCT (269) + (380))		-525.84
Additional allowable electricity generation considered in SAP 2009 section 16		0.00
Offset from biofuel CHP [-1 x [(363)..(366) + (368)...(372)]]		0.00
LZCT electricity generation		-525.84
LZCT thermal generation		0
Total from specified LZCT		**-525.84**

	Emissions $kgCO_2/m^2/yr$	
Reduction in CO_2 Emissions		
Standard Case CO_2	32.74	
Actual Case CO_2	27.80	
% Reduction in CO_2	15	
Number of credits for Ene 7	**2**	

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DER 2009 Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Stuart Searle	Assessor number	2435
Client		Last modified	01/02/2013
Address	P07 4 St Augustines, London, NW1		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		106.50	(1a)	x 2.60	(2a) =	276.90	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	106.50	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	276.90	(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	5.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.25	(18)

Air permeability value applies if a pressurisation test has been done, or a design or specified air permeability is being used

Number of sides on which dwelling is sheltered		1	(19)
Shelter factor	1 - [0.075 x (19)] =	0.92	(20)
Adjusted infiltration rate	(18) x (20) =	0.23	(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 7													
(22)m	5.40	5.10	5.10	4.50	4.10	3.90	3.70	3.70	4.20	4.50	4.80	5.10	
										∑(22)1...12 =		54.10	(22)
Wind Factor (22a)m = (22)m ÷ 4													
(22a)m	1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.20	1.27	
										∑(22a)1...12 =		13.52	(22a)
Adjusted infiltration rate (allowing for shelter and wind speed) = (21) × (22a)m													
(22b)m	0.31	0.29	0.29	0.26	0.24	0.23	0.21	0.21	0.24	0.26	0.28	0.29	
										∑(22b)1...12 =		3.13	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)), otherwise (23b) = (23a)	0.5	(23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = N/A (23c)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b)m + 0.5 x (23b)

(24c)m	0.56	0.54	0.54	0.51	0.50	0.50	0.50	0.50	0.50	0.51	0.53	0.54	(24c)

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

(25)m	0.56	0.54	0.54	0.51	0.50	0.50	0.50	0.50	0.50	0.51	0.53	0.54	(25)

3. Heat losses and heat loss parameter

The κ-value is the heat capacity per unit area, see Table 1e.

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	
Doors			2.10	x	1.60	=	3.36	N/A	N/A	(26)
Window*			8.68	x	1.15	=	9.94	N/A	N/A	(27)
Window*			12.13	x	1.33	=	16.08	N/A	N/A	(27)
External wall			90.01	x	0.20	=	18.00	N/A	N/A	(29a)
Party Wall			34.19	x	0.00	=	0.00	N/A	N/A	(32)
Roof			30.00	x	0.15	=	4.50	N/A	N/A	(30)
Total area of external elements ∑A, m²			142.92	(31)						

** for windows and roof windows, effective window U-value is calculated using formula 1/[(1/UValue)+0.04] paragraph 3.2*

Fabric heat loss, W/K = ∑(A × U) (26)...(30) + (32) = 51.88 (33)

Heat capacity Cm = ∑(A x κ) (28)...(30) + (32) + (32a)...(32e) = N/A (34)

Thermal mass parameter (TMP) in kJ/m²K Calculated separately = 100.00 (35)

Thermal bridges: ∑(L x Ψ) calculated using Appendix K 12.17 (36)

if details of thermal bridging are not known then (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 64.05 (37)

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

(38)m	51.37	49.79	49.79	46.62	45.69	45.69	45.69	45.69	45.69	46.62	48.20	49.79	(38)

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

(39)m	115.42	113.84	113.84	110.67	109.74	109.74	109.74	109.74	109.74	110.67	112.25	113.84	

Average = ∑(39)1...12/12 = 111.60 (39)

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

(40)m	1.08	1.07	1.07	1.04	1.03	1.03	1.03	1.03	1.03	1.04	1.05	1.07	

Average = ∑(40)1...12/12 = 1.05 (40)

4. Water heating energy requirement

kWh/year

Assumed occupancy, N 2.79 (42)

If TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)

If TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 100.51 (43)

Annual average hot water usage has been reduced by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	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)													
(44)m	110.56	106.54	102.52	98.50	94.48	90.46	90.46	94.48	98.50	102.52	106.54	110.56	

∑(44)1...12 = 1206.15 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

(45)m	164.36	143.75	148.33	129.32	124.09	107.08	99.22	113.86	115.22	134.28	146.57	159.17	

∑(45)1...12 = 1585.24 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

For community heating include distribution loss whether or not hot water tank is present

Distribution loss 0.15 x (45)m

(46)m	24.65	21.56	22.25	19.40	18.61	16.06	14.88	17.08	17.28	20.14	21.99	23.88	(46)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):	1.85	(47)
Temperature factor from Table 2b	0.54	(48)
Energy lost from water storage, kWh/day (47) x (48)	1.00	(49)
Enter (49) or (54) in (55)	1.00	(55)

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

(56)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(56)

If cylinder contains dedicated solar storage, = (56)m x [(50) - (H11)] ÷ (50), else = (56)m where (H11) is from Appendix H

(57)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(57)

Primary circuit loss (annual) from Table 3: 360.00 (58)

Primary circuit loss for each month (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m	30.58	27.62	30.58	29.59	30.58	29.59	30.58	30.58	29.59	30.58	29.59	30.58	(59)

Combi loss for each month from Table 3a, 3b or 3c (enter '0' if not a combi boiler)

(61)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	(61)

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

(62)m	225.90	199.33	209.88	188.88	185.63	166.64	160.77	175.40	174.78	195.82	206.13	220.71	(62)

Solar DHW input calculated using Appendix H (negative quantity) ('0' entered if no solar contribution to water heating)

(63)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	

∑(63)1...12 = 0.00 (63)

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

(64)m	225.90	199.33	209.88	188.88	185.63	166.64	160.77	175.40	174.78	195.82	206.13	220.71	

∑(64)1...12 = 2309.87 (64)

if (64)m < 0 then set to 0

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

(65)m	103.88	92.27	98.56	90.65	90.49	83.25	82.23	87.09	85.96	93.88	96.38	102.16	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	139.61	139.61	139.61	139.61	139.61	139.61	139.61	139.61	139.61	139.61	139.61	139.61	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m	24.25	21.54	17.52	13.26	9.91	8.37	9.04	11.76	15.78	20.04	23.38	24.93	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m	266.43	269.19	262.23	247.39	228.67	211.08	199.32	196.56	203.52	218.35	237.08	254.67	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m	36.96	36.96	36.96	36.96	36.96	36.96	36.96	36.96	36.96	36.96	36.96	36.96	(69)
Pumps and fans gains (Table 5a)													
(70)m	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	(71)
Water heating gains (Table 5)													
(72)m	139.63	137.30	132.47	125.90	121.63	115.63	110.52	117.06	119.39	126.19	133.87	137.31	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m	505.19	502.92	487.09	461.44	435.10	409.95	393.77	400.25	413.57	439.46	469.21	491.79	(73)

6. Solar gains

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Rows (74) to (82) are used 12 times, one for each month, repeating as needed if there is more than one window type.

Details for month of January and annual totals are shown below:

	Access factor Table 6d		Area m²		Solar flux W/m²		g Specific data or Table 6b		FF Specific data or Table 6c		Gains (W)	
West	0.54	x	8.68	x	19.87	x 0.9 x	0.63	x	0.80	=	42.25	(80)
South	0.54	x	12.13	x	47.32	x 0.9 x	0.63	x	0.80	=	140.58	(78)

Solar gains in watts, calculated for each month ∑(74)m...(82)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(83)m	182.83	311.17	410.86	506.60	558.92	570.23	557.75	517.02	453.52	353.10	219.09	156.32	(83)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(84)m	688.02	814.09	897.95	968.03	994.02	980.18	951.51	917.28	867.09	792.55	688.29	648.11	(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, η1,m (see Table 9a)													
(86)m	0.96	0.94	0.90	0.85	0.75	0.61	0.44	0.45	0.67	0.85	0.94	0.96	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)													
(87)m	18.86	19.17	19.60	20.05	20.51	20.81	20.95	20.94	20.73	20.20	19.40	18.91	(87)
Temperature during heating periods in the living area from Table 9, Th2(°C)													
(88)m	20.02	20.03	20.03	20.05	20.06	20.06	20.06	20.06	20.06	20.05	20.04	20.03	(88)
Utilisation factor for gains for rest of dwelling η2,m (see Table 9a)													
(89)m	0.95	0.93	0.89	0.82	0.71	0.54	0.35	0.36	0.61	0.82	0.93	0.96	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)													
(90)m	17.16	17.61	18.23	18.88	19.51	19.88	20.03	20.02	19.80	19.10	17.95	17.24	(90)

Living area fraction fLA 24.00 ÷ (4) = 0.23 (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2													
(92)m	17.54	17.96	18.54	19.14	19.73	20.09	20.23	20.23	20.01	19.35	18.27	17.62	(92)
Apply adjustment to the mean internal temperature from Table 4e, where appropriate													
(93)m	17.39	17.81	18.39	18.99	19.58	19.94	20.08	20.08	19.86	19.20	18.12	17.47	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that tim = (93)m and recalculate the utilisation factor for gains using Table 9a)													
Utilisation factor for gains, ηm													
(94)m	0.93	0.90	0.85	0.79	0.68	0.53	0.35	0.36	0.60	0.79	0.90	0.93	(94)
Useful gains, ηmGm, W = (94)m x (84)m													
(95)m	639.48	731.62	766.46	766.88	679.57	520.92	335.59	334.07	518.38	627.00	621.35	605.14	(95)
Monthly average external temperature from Table 8													
(96)m	4.50	5.00	6.80	8.70	11.70	14.60	16.90	16.90	14.30	10.80	7.00	4.90	(96)
Heat loss rate for mean internal temperature, Lm, W													
(97)m	1488.26	1458.47	1319.37	1139.05	865.24	586.08	349.29	348.93	610.26	929.47	1248.58	1430.61	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m - (95)m] x (41)m													
(98)m	631.49	488.44	411.37	267.96	138.14	0.00	0.00	0.00	0.00	225.03	451.61	614.15	

Total per year (kWh/year) = ∑(98)1...5, 10...12 = 3228.19 (98)

Space heating requirement in kWh/m²/year (98) ÷ (4) 30.31 (99)

9a. Energy Requirements - Individual heating systems including micro-CHP

Space heating:

Fraction of space heating from secondary/supplementary system (Table 11) 0.00 (201)

Fraction of space heating from main system(s) 1 - (201)	1.00	(202)
Fraction of main heating from main system 2	0.00	(203)
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 space heating system 1 (%)	93.00	(206)

(from database or Table 4a/4b, adjusted where appropriate by the amount shown in the 'space efficiency adjustment' column of Table 4c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement, kWh/month (as calculated above)												
(98)m	631.49	488.44	411.37	267.96	138.14	0.00	0.00	0.00	0.00	225.03	451.61	614.15
Space heating fuel (main heating system 1), kWh/month = (98)m x (204) x 100 ÷ (206)												
(211)m	679.02	525.21	442.33	288.13	148.54	0.00	0.00	0.00	0.00	241.97	485.60	660.38

Total per year (kWh/year) = ∑(211)1...5, 10...12 = 3471.17 (211)

Water heating:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Output from water heater, kWh/month (calculated above)												
(64)m	225.90	199.33	209.88	188.88	185.63	166.64	160.77	175.40	174.78	195.82	206.13	220.71

∑(64)1...12 = 2309.87 (64)

Efficiency of water heater per month												
(217)m	86.91	86.61	86.08	85.24	83.54	79.30	79.30	79.30	79.30	84.68	86.35	86.90
Fuel for water heating, kWh/month = (64)m x 100 ÷ (217)m												
(219)m	259.92	230.14	243.83	221.57	222.21	210.13	202.73	221.19	220.40	231.24	238.72	253.99

Total per year (kWh/year) = ∑(219)1...12 = 2756.08 (219)

Annual Totals Summary:	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		3471.17	(211)
Water heating fuel used		2756.08	(219)
Electricity for pumps, fans and electric keep-hot (Table 4f):			
mechanical ventilation fans - balanced, extract or positive input from outside	79.05		(230a)
warm air heating system fans	0.00		(230b)
central heating pump	130.00		(230c)
oil boiler pump	0.00		(230d)
boiler flue fan	45.00		(230e)
maintaining electric keep-hot facility for gas combi boiler	0.00		(230f)
pump for solar water heating	0.00		(230g)
Total electricity for the above	∑(230a)...(230g)	254.05	(231)
Electricity for lighting (calculated in Appendix L):		428.34	(232)
Energy saving/generation technologies (Appendices M, N and Q):			
Electricity generated by PVs (Appendix M) (negative quantity)		-994.03	(233)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year		Emissions Factor		Emissions (kgCO2/year)	
Space heating - main system 1	3471.17	x	0.198	=	687.29	(261)
Water heating	2756.08	x	0.198	=	545.70	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1233.00	(265)
Pumps, fans and electric keep-hot	254.05	x	0.517	=	131.34	(267)
Lighting	428.34	x	0.517	=	221.45	(268)
Energy saving/generation technologies:						
PV emission savings (negative quantity)	-994.03	x	0.529	=	-525.84	(269)
Total carbon dioxide emissions				∑(261)...(271) =	1059.95	(272)

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SAP 2009 Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Stuart Searle	Assessor number	2435
Client		Last modified	01/02/2013
Address	P07 4 St Augustines, London, NW1		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		106.50	(1a) x	2.60	(2a) =	276.90	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	106.50	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	276.90	(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	5.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.25	(18)

Air permeability value applies if a pressurisation test has been done, or a design or specified air permeability is being used

Number of sides on which dwelling is sheltered		1	(19)
Shelter factor	1 - [0.075 x (19)] =	0.92	(20)
Adjusted infiltration rate	(18) x (20) =	0.23	(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 7													
(22)m	5.40	5.10	5.10	4.50	4.10	3.90	3.70	3.70	4.20	4.50	4.80	5.10	
											∑(22)1...12 =	54.10	(22)
Wind Factor (22a)m = (22)m ÷ 4													
(22a)m	1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.20	1.27	
											∑(22a)1...12 =	13.52	(22a)
Adjusted infiltration rate (allowing for shelter and wind speed) = (21) × (22a)m													
(22b)m	0.31	0.29	0.29	0.26	0.24	0.23	0.21	0.21	0.24	0.26	0.28	0.29	
											∑(22b)1...12 =	3.13	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)), otherwise (23b) = (23a)	0.5	(23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = N/A (23c)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b)m + 0.5 x (23b)

(24c)m	0.56	0.54	0.54	0.51	0.50	0.50	0.50	0.50	0.50	0.51	0.53	0.54	(24c)

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

(25)m	0.56	0.54	0.54	0.51	0.50	0.50	0.50	0.50	0.50	0.51	0.53	0.54	(25)

3. Heat losses and heat loss parameter

The κ-value is the heat capacity per unit area, see Table 1e.

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	
Doors			2.10	x	1.60	=	3.36	N/A	N/A	(26)
Window*			8.68	x	1.15	=	9.94	N/A	N/A	(27)
Window*			12.13	x	1.33	=	16.08	N/A	N/A	(27)
External wall			90.01	x	0.20	=	18.00	N/A	N/A	(29a)
Party Wall			34.19	x	0.00	=	0.00	N/A	N/A	(32)
Roof			30.00	x	0.15	=	4.50	N/A	N/A	(30)
Total area of external elements ∑A, m²			142.92	(31)						

** for windows and roof windows, effective window U-value is calculated using formula 1/[(1/UValue)+0.04] paragraph 3.2*

Fabric heat loss, W/K = ∑(A × U) (26)...(30) + (32) = 51.88 (33)

Heat capacity Cm = ∑(A x κ) (28)...(30) + (32) + (32a)...(32e) = N/A (34)

Thermal mass parameter (TMP) in kJ/m²K Calculated separately = 100.00 (35)

Thermal bridges: ∑(L x Ψ) calculated using Appendix K 12.17 (36)

if details of thermal bridging are not known then (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 64.05 (37)

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

(38)m	51.37	49.79	49.79	46.62	45.69	45.69	45.69	45.69	45.69	46.62	48.20	49.79	(38)

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

(39)m	115.42	113.84	113.84	110.67	109.74	109.74	109.74	109.74	109.74	110.67	112.25	113.84	

Average = ∑(39)1...12/12 = 111.60 (39)

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

(40)m	1.08	1.07	1.07	1.04	1.03	1.03	1.03	1.03	1.03	1.04	1.05	1.07	

Average = ∑(40)1...12/12 = 1.05 (40)

4. Water heating energy requirement

kWh/year

Assumed occupancy, N 2.79 (42)

If TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)

If TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 100.51 (43)

Annual average hot water usage has been reduced by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	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)													
(44)m	110.56	106.54	102.52	98.50	94.48	90.46	90.46	94.48	98.50	102.52	106.54	110.56	

∑(44)1...12 = 1206.15 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

(45)m	164.36	143.75	148.33	129.32	124.09	107.08	99.22	113.86	115.22	134.28	146.57	159.17	

∑(45)1...12 = 1585.24 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

For community heating include distribution loss whether or not hot water tank is present

Distribution loss 0.15 x (45)m

(46)m	24.65	21.56	22.25	19.40	18.61	16.06	14.88	17.08	17.28	20.14	21.99	23.88	(46)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):	1.85	(47)
Temperature factor from Table 2b	0.54	(48)
Energy lost from water storage, kWh/day (47) x (48)	1.00	(49)
Enter (49) or (54) in (55)	1.00	(55)

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

(56)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(56)

If cylinder contains dedicated solar storage, = (56)m x [(50) - (H11)] ÷ (50), else = (56)m where (H11) is from Appendix H

(57)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(57)

Primary circuit loss (annual) from Table 3: 360.00 (58)

Primary circuit loss for each month (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m	30.58	27.62	30.58	29.59	30.58	29.59	30.58	30.58	29.59	30.58	29.59	30.58	(59)

Combi loss for each month from Table 3a, 3b or 3c (enter '0' if not a combi boiler)

(61)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	(61)

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

(62)m	225.90	199.33	209.88	188.88	185.63	166.64	160.77	175.40	174.78	195.82	206.13	220.71	(62)

Solar DHW input calculated using Appendix H (negative quantity) ('0' entered if no solar contribution to water heating)

(63)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	

∑(63)1...12 = 0.00 (63)

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

(64)m	225.90	199.33	209.88	188.88	185.63	166.64	160.77	175.40	174.78	195.82	206.13	220.71	

∑(64)1...12 = 2309.87 (64)

if (64)m < 0 then set to 0

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

(65)m	103.88	92.27	98.56	90.65	90.49	83.25	82.23	87.09	85.96	93.88	96.38	102.16	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	167.53	167.53	167.53	167.53	167.53	167.53	167.53	167.53	167.53	167.53	167.53	167.53	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m	60.64	53.86	43.80	33.16	24.79	20.93	22.61	29.39	39.45	50.09	58.46	62.32	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m	397.65	401.78	391.38	369.25	341.30	315.04	297.49	293.37	303.76	325.90	353.85	380.11	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m	54.54	54.54	54.54	54.54	54.54	54.54	54.54	54.54	54.54	54.54	54.54	54.54	(69)
Pumps and fans gains (Table 5a)													
(70)m	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	-111.68	(71)
Water heating gains (Table 5)													
(72)m	139.63	137.30	132.47	125.90	121.63	115.63	110.52	117.06	119.39	126.19	133.87	137.31	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m	718.30	713.32	688.04	648.69	608.11	571.98	551.01	560.20	582.98	622.56	666.56	700.13	(73)

6. Solar gains

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Rows (74) to (82) are used 12 times, one for each month, repeating as needed if there is more than one window type.

Details for month of January and annual totals are shown below:

	Access factor Table 6d		Area m²		Solar flux W/m²		g Specific data or Table 6b		FF Specific data or Table 6c		Gains (W)	
West	0.54	x	8.68	x	19.87	x 0.9 x	0.63	x	0.80	=	42.25	(80)
South	0.54	x	12.13	x	47.32	x 0.9 x	0.63	x	0.80	=	140.58	(78)

Solar gains in watts, calculated for each month ∑(74)m...(82)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(83)m	182.83	311.17	410.86	506.60	558.92	570.23	557.75	517.02	453.52	353.10	219.09	156.32	(83)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(84)m	901.13	1024.50	1098.89	1155.28	1167.03	1142.20	1108.76	1077.23	1036.50	975.66	885.64	856.45	(84)

7. Mean internal temperature (heating season)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area, η1,m (see Table 9a)													
(86)m	0.93	0.90	0.85	0.79	0.69	0.54	0.39	0.40	0.60	0.79	0.90	0.93	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)													
(87)m	19.16	19.44	19.83	20.22	20.61	20.86	20.96	20.96	20.80	20.37	19.65	19.21	(87)
Temperature during heating periods in the living area from Table 9, Th2(°C)													
(88)m	20.02	20.03	20.03	20.05	20.06	20.06	20.06	20.06	20.06	20.05	20.04	20.03	(88)
Utilisation factor for gains for rest of dwelling η2,m (see Table 9a)													
(89)m	0.92	0.88	0.83	0.77	0.64	0.48	0.30	0.31	0.54	0.75	0.88	0.92	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)													
(90)m	17.59	17.99	18.54	19.10	19.63	19.93	20.04	20.03	19.87	19.31	18.31	17.67	(90)

Living area fraction fLA 24.00 ÷ (4) = 0.23 (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2													
(92)m	17.94	18.32	18.83	19.35	19.85	20.14	20.24	20.24	20.08	19.55	18.61	18.01	(92)
Apply adjustment to the mean internal temperature from Table 4e, where appropriate													
(93)m	17.79	18.17	18.68	19.20	19.70	19.99	20.09	20.09	19.93	19.40	18.46	17.86	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that tim = (93)m and recalculate the utilisation factor for gains using Table 9a)													
Utilisation factor for gains, ηm													
(94)m	0.89	0.85	0.80	0.74	0.63	0.47	0.31	0.32	0.53	0.73	0.85	0.89	(94)
Useful gains, ηmGm, W = (94)m x (84)m													
(95)m	798.97	873.39	882.26	852.49	729.63	541.97	340.86	339.99	549.75	708.79	754.93	762.92	(95)
Monthly average external temperature from Table 8													
(96)m	4.50	5.00	6.80	8.70	11.70	14.60	16.90	16.90	14.30	10.80	7.00	4.90	(96)
Heat loss rate for mean internal temperature, Lm, W													
(97)m	1534.34	1499.21	1352.49	1162.57	878.24	591.21	350.55	350.35	618.11	951.93	1286.63	1475.74	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m - (95)m] x (41)m													
(98)m	547.12	420.55	349.85	223.26	110.57	0.00	0.00	0.00	0.00	180.89	382.82	530.34	

Total per year (kWh/year) = ∑(98)1...5, 10...12 = 2745.39 (98)

Space heating requirement in kWh/m²/year (98) ÷ (4) 25.78 (99)

9a. Energy Requirements - Individual heating systems including micro-CHP

Space heating:

Fraction of space heating from secondary/supplementary system (Table 11) 0.00 (201)

Fraction of space heating from main system(s) 1 - (201)	1.00	(202)
Fraction of main heating from main system 2	0.00	(203)
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 space heating system 1 (%)	93.00	(206)

(from database or Table 4a/4b, adjusted where appropriate by the amount shown in the 'space efficiency adjustment' column of Table 4c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement, kWh/month (as calculated above)												
(98)m	547.12	420.55	349.85	223.26	110.57	0.00	0.00	0.00	0.00	180.89	382.82	530.34
Space heating fuel (main heating system 1), kWh/month = (98)m x (204) x 100 ÷ (206)												
(211)m	588.30	452.20	376.18	240.06	118.89	0.00	0.00	0.00	0.00	194.51	411.63	570.26

Total per year (kWh/year) = ∑(211)1...5, 10...12 = 2952.04 (211)

Water heating:

Output from water heater, kWh/month (calculated above)												
(64)m	225.90	199.33	209.88	188.88	185.63	166.64	160.77	175.40	174.78	195.82	206.13	220.71

∑(64)1...12 = 2309.87 (64)

Efficiency of water heater per month												
(217)m	86.59	86.26	85.67	84.76	82.98	79.30	79.30	79.30	79.30	84.10	85.94	86.57
Fuel for water heating, kWh/month = (64)m x 100 ÷ (217)m												
(219)m	260.90	231.09	245.00	222.84	223.70	210.13	202.73	221.19	220.40	232.84	239.85	254.96

Total per year (kWh/year) = ∑(219)1...12 = 2765.63 (219)

Annual Totals Summary:	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		2952.04	(211)
Water heating fuel used		2765.63	(219)
Electricity for pumps, fans and electric keep-hot (Table 4f):			
mechanical ventilation fans - balanced, extract or positive input from outside	79.05		(230a)
warm air heating system fans	0.00		(230b)
central heating pump	130.00		(230c)
oil boiler pump	0.00		(230d)
boiler flue fan	45.00		(230e)
maintaining electric keep-hot facility for gas combi boiler	0.00		(230f)
pump for solar water heating	0.00		(230g)
Total electricity for the above	∑(230a)...(230g)	254.05	(231)
Electricity for lighting (calculated in Appendix L):		428.34	(232)
Energy saving/generation technologies (Appendices M, N and Q):			
Electricity generated by PVs (Appendix M) (negative quantity)		-994.03	(233)

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

	Fuel kWh/year		Fuel price (Table 12)		Fuel cost £/year	
Space heating - main system 1	2952.04	x	3.10	x 0.01 =	91.51	(240)
Water heating cost (other fuel)	2765.63	x	3.10	x 0.01 =	85.73	(247)
Pumps, fans and electric keep-hot	254.05	x	11.46	x 0.01 =	29.11	(249)
Energy for lighting	428.34	x	11.46	x 0.01 =	49.09	(250)
Additional standing charges (Table 12)					106.00	(251)
Energy saving/generation technologies (Appendices M, N and Q):						
PV savings (negative quantity)	-994.03	x	11.46	x 0.01 =	-113.92	(252)
Total energy cost			(240)...(242) + (245)...(254)		247.53	(255)

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

Energy cost deflator (Table 12)		0.47	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	0.77	(257)
SAP value		89.29	
SAP rating		89	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year		Emissions Factor		Emissions (kgCO2/year)	
Space heating - main system 1	2952.04	x	0.198	=	584.50	(261)
Water heating	2765.63	x	0.198	=	547.60	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1132.10	(265)
Pumps, fans and electric keep-hot	254.05	x	0.517	=	131.34	(267)
Lighting	428.34	x	0.517	=	221.45	(268)
Energy saving/generation technologies:						
PV emission savings (negative quantity)	-994.03	x	0.529	=	-525.84	(269)
Total carbon dioxide emissions			∑(261)...(271) =		959.05	(272)
Dwelling carbon dioxide emissions rate			(272) ÷ (4) =		9.01	(273)
EI value					91.52	
EI rating (see section 14)					92	(274)
EI band					A	

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

	Energy kWh/year		Primary Energy Factor		Primary Energy	
Space heating - main system 1	2952.04	x	1.02	=	3011.08	(261*)
Water heating	2765.63	x	1.02	=	2820.95	(264*)
Space and water heating			(261*) + (262*) + (263*) + (264*) =		5832.03	(265*)
Pumps, fans and electric keep-hot	254.05	x	2.92	=	741.82	(267*)
Lighting	428.34	x	2.92	=	1250.75	(268*)
Energy saving/generation technologies:						
PV primary energy savings (negative quantity)	-994.03	x	2.92	=	-2902.56	(269*)
Total primary energy kWh/year			∑(261*)...(271*) =		4922.04	(272*)
Primary energy kWh/m2/year			(272*) ÷ (4) =		46.22	(273*)

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Code for Sustainable Homes (November 2010)
Design - Draft

This report details the calculations and results for Ene 1, 2 and 7 of the Code For Sustainable Homes.

This Design Assessment has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed. Code calculations are from the Technical Guide (November 2010).

Assessor name	Mr Stuart Searle	Assessor number	2435
Client		Last modified	01/02/2013
Address	P08 4 St Augustines, London, NW1		

Building regulation assessment - criterion 1

	kg/m²/yr
DER	10.55
TER	15.26

Assessment of zero carbon home and low or zero carbon technologies

		Credits	Level
Dwelling emission rate (Ene 1)	CO_2 reduction = 30.9 %	3.5	4
Fabric Energy Efficiency	FEE = 41.3	5.8	
Low or zero carbon technologies (Ene 7)	CO_2 reduction = 14 %	1	

Ene 1 - dwelling emission rate

	%	kWh/m²	kgCO_2/m²/yr	
Assessment of Ene 1 (level 1-5)				
DER from SAP 2009 DER worksheet			10.55	
Additional allowable generation		0.00		
CO_2 emissions offset from generation			0.00	
CO_2 emissions offset from community biofuel CHP systems			0.00	
Total CO_2 emissions offset from SAP section 16 allowances			**0.00**	
DER accounting for SAP section 16 allowances			**10.55**	
CO_2 reduction compared to TER			4.71	
CO_2 reduction as % of TER	30.9			
Assessment of Ene 1 (level 6)				
DER from SAP 2009 DER worksheet			10.55	(ZC1)
CO_2 emissions from appliances (equation L14)			15.39	(ZC2)
CO_2 emissions from cooking (equation L16)			1.92	(ZC3)
Total CO_2 emissions			27.87	(ZC4)
Additional allowable generation and its CO_2 emissions offset		0.00		(ZC6)
CO_2 emissions offset from additional allowable generation			0.00	(ZC7)
CO_2 emissions offset from community biofuel CHP systems			0.00	(ZC5)
Net CO_2 emissions			**27.87**	(ZC8)

Ene 1 - dwelling emission rate - level 6

There is no Zero Carbon Home definition in the current technical guide

	Criterion	Value	Pass/Fail
FEE	<= 39	41.3	Fail
Net CO_2 emissions	<= 0.00	27.87	Fail

Result: Not level 6

Number of credits for Ene 1	**3.5**

Ene 2 - Fabric Energy Efficiency

FEE	41.3
Number of credits for Ene 2	**5.8**

Ene 7 - low or zero carbon technologies

	Emissions $kgCO_2/yr$	Reduction $kgCO_2/yr$
Standard case		
Space and water heating (265)	1261.52	
Mechanical cooling (266)	0.00	
Pumps and fans (267)	127.12	
Lighting (268)	207.33	
Appliances and cooking	1653.87	
Total CO_2	**1578.66**	
Actual case		
Space and water heating (265) or (376)	1261.52	
Space and water heating from LZCT considered in SAP 2009		0.00
Pumps and fans (267) or (378)	127.12	
Pumps and fans		0.00
Electricity generated by LZCT (269) + (380))		-471.35
Additional allowable electricity generation considered in SAP 2009 section 16		0.00
Offset from biofuel CHP [-1 x [(363)..(366) + (368)...(372)]]		0.00
LZCT electricity generation		-471.35
LZCT thermal generation		0
Total from specified LZCT		**-471.35**

	Emissions $kgCO_2/m^2/yr$	
Reduction in CO_2 Emissions		
Standard Case CO_2	34.03	
Actual Case CO_2	29.10	
% Reduction in CO_2	14	
Number of credits for Ene 7	**1**	

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DER 2009 Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Stuart Searle	Assessor number	2435
Client		Last modified	01/02/2013
Address	P08 4 St Augustines, London, NW1		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		95.50	(1a) x	2.60	(2a) =	248.30	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	95.50	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	248.30	(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	5.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.25	(18)

Air permeability value applies if a pressurisation test has been done, or a design or specified air permeability is being used

Number of sides on which dwelling is sheltered		2	(19)
Shelter factor	1 - [0.075 x (19)] =	0.85	(20)
Adjusted infiltration rate	(18) x (20) =	0.21	(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 7													
(22)m	5.40	5.10	5.10	4.50	4.10	3.90	3.70	3.70	4.20	4.50	4.80	5.10	
											∑(22)1...12 =	54.10	(22)
Wind Factor (22a)m = (22)m ÷ 4													
(22a)m	1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.20	1.27	
											∑(22a)1...12 =	13.52	(22a)
Adjusted infiltration rate (allowing for shelter and wind speed) = (21) × (22a)m													
(22b)m	0.29	0.27	0.27	0.24	0.22	0.21	0.20	0.20	0.22	0.24	0.26	0.27	
											∑(22b)1...12 =	2.87	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)), otherwise (23b) = (23a)	0.5	(23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = N/A (23c)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b)m + 0.5 x (23b)

(24c)m	0.54	0.52	0.52	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.52	(24c)

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

(25)m	0.54	0.52	0.52	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.52	(25)

3. Heat losses and heat loss parameter

The κ-value is the heat capacity per unit area, see Table 1e.

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	
Doors			2.10	x	1.60	=	3.36	N/A	N/A	(26)
Window*			8.68	x	1.15	=	9.94	N/A	N/A	(27)
Window*			9.70	x	1.33	=	12.86	N/A	N/A	(27)
External wall			55.08	x	0.20	=	11.02	N/A	N/A	(29a)
Party Wall			33.80	x	0.00	=	0.00	N/A	N/A	(32)
Roof			30.00	x	0.15	=	4.50	N/A	N/A	(30)

Total area of external elements ∑A, m² 105.56 (31)

** for windows and roof windows, effective window U-value is calculated using formula 1/[(1/UValue)+0.04] paragraph 3.2*

Fabric heat loss, W/K = ∑(A × U) (26)...(30) + (32) = 41.68 (33)

Heat capacity Cm = ∑(A x κ) (28)...(30) + (32) + (32a)...(32e) = N/A (34)

Thermal mass parameter (TMP) in kJ/m²K Calculated separately = 100.00 (35)

Thermal bridges: ∑(L x Ψ) calculated using Appendix K 9.73 (36)

if details of thermal bridging are not known then (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 51.41 (37)

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

(38)m	43.99	42.69	42.69	40.97	40.97	40.97	40.97	40.97	40.97	40.97	41.38	42.69	(38)

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

(39)m	95.40	94.09	94.09	92.38	92.38	92.38	92.38	92.38	92.38	92.38	92.79	94.09	

Average = ∑(39)1...12/12 = 93.09 (39)

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

(40)m	1.00	0.99	0.99	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.99	

Average = ∑(40)1...12/12 = 0.97 (40)

4. Water heating energy requirement

kWh/year

Assumed occupancy, N 2.69 (42)

If TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)

If TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 98.18 (43)

Annual average hot water usage has been reduced by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	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)													
(44)m	108.00	104.07	100.14	96.21	92.29	88.36	88.36	92.29	96.21	100.14	104.07	108.00	

∑(44)1...12 = 1178.13 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

(45)m	160.54	140.41	144.89	126.32	121.20	104.59	96.92	111.21	112.54	131.16	143.17	155.47	

∑(45)1...12 = 1548.41 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

For community heating include distribution loss whether or not hot water tank is present

Distribution loss 0.15 x (45)m

(46)m	24.08	21.06	21.73	18.95	18.18	15.69	14.54	16.68	16.88	19.67	21.48	23.32	(46)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):	1.85	(47)
Temperature factor from Table 2b	0.54	(48)
Energy lost from water storage, kWh/day (47) x (48)	1.00	(49)
Enter (49) or (54) in (55)	1.00	(55)

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

(56)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(56)

If cylinder contains dedicated solar storage, = (56)m x [(50) - (H11)] ÷ (50), else = (56)m where (H11) is from Appendix H

(57)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(57)

Primary circuit loss (annual) from Table 3: 360.00 (58)

Primary circuit loss for each month (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m	30.58	27.62	30.58	29.59	30.58	29.59	30.58	30.58	29.59	30.58	29.59	30.58	(59)

Combi loss for each month from Table 3a, 3b or 3c (enter '0' if not a combi boiler)

(61)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	(61)

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

(62)m	222.08	195.99	206.43	185.87	182.75	164.15	158.46	172.76	172.10	192.70	202.73	217.02	(62)

Solar DHW input calculated using Appendix H (negative quantity) ('0' entered if no solar contribution to water heating)

(63)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	

∑(63)1...12 = 0.00 (63)

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

(64)m	222.08	195.99	206.43	185.87	182.75	164.15	158.46	172.76	172.10	192.70	202.73	217.02	

∑(64)1...12 = 2273.04 (64)

if (64)m < 0 then set to 0

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

(65)m	102.61	91.16	97.41	89.65	89.54	82.42	81.46	86.21	85.07	92.85	95.25	100.93	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	134.69	134.69	134.69	134.69	134.69	134.69	134.69	134.69	134.69	134.69	134.69	134.69	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m	22.71	20.17	16.40	12.42	9.28	7.84	8.47	11.01	14.77	18.76	21.89	23.34	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m	248.84	251.42	244.92	231.06	213.58	197.14	186.16	183.58	190.09	203.94	221.43	237.86	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m	36.47	36.47	36.47	36.47	36.47	36.47	36.47	36.47	36.47	36.47	36.47	36.47	(69)
Pumps and fans gains (Table 5a)													
(70)m	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	(71)
Water heating gains (Table 5)													
(72)m	137.92	135.65	130.93	124.51	120.34	114.48	109.49	115.88	118.15	124.79	132.29	135.66	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m	482.88	480.65	465.65	441.40	416.61	392.86	377.53	383.87	396.42	420.90	449.02	470.27	(73)

6. Solar gains

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Rows (74) to (82) are used 12 times, one for each month, repeating as needed if there is more than one window type.

Details for month of January and annual totals are shown below:

	Access factor Table 6d		Area m²		Solar flux W/m²		g Specific data or Table 6b		FF Specific data or Table 6c		Gains (W)	
West	0.54	x	8.68	x	19.87	x 0.9 x	0.63	x	0.80	=	42.25	(80)
Northwest	0.54	x	9.70	x	11.51	x 0.9 x	0.63	x	0.80	=	27.35	(81)

Solar gains in watts, calculated for each month ∑(74)m...(82)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(83)m	69.60	137.87	228.63	355.47	449.79	478.45	460.45	387.66	278.27	170.07	87.05	57.10	(83)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(84)m	552.48	618.52	694.28	796.86	866.40	871.31	837.98	771.53	674.69	590.97	536.07	527.36	(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, η1,m (see Table 9a)													
(86)m	0.97	0.95	0.92	0.86	0.74	0.59	0.43	0.46	0.71	0.89	0.95	0.97	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)													
(87)m	18.95	19.18	19.62	20.10	20.57	20.84	20.96	20.95	20.72	20.16	19.43	19.01	(87)
Temperature during heating periods in the living area from Table 9, Th2(°C)													
(88)m	20.09	20.10	20.10	20.11	20.11	20.11	20.11	20.11	20.11	20.11	20.11	20.10	(88)
Utilisation factor for gains for rest of dwelling η2,m (see Table 9a)													
(89)m	0.96	0.95	0.91	0.84	0.70	0.53	0.34	0.37	0.65	0.86	0.95	0.96	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)													
(90)m	17.32	17.67	18.30	18.98	19.62	19.96	20.08	20.08	19.83	19.09	18.04	17.42	(90)

Living area fraction fLA 31.30 ÷ (4) = 0.33 (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2													
(92)m	17.86	18.17	18.73	19.35	19.93	20.25	20.37	20.36	20.12	19.44	18.49	17.94	(92)
Apply adjustment to the mean internal temperature from Table 4e, where appropriate													
(93)m	17.71	18.02	18.58	19.20	19.78	20.10	20.22	20.21	19.97	19.29	18.34	17.79	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that tim = (93)m and recalculate the utilisation factor for gains using Table 9a)													
Utilisation factor for gains, ηm													
(94)m	0.94	0.93	0.88	0.81	0.69	0.53	0.35	0.38	0.64	0.84	0.93	0.95	(94)
Useful gains, ηmGm, W = (94)m x (84)m													
(95)m	521.68	572.45	613.70	647.39	595.00	458.21	296.14	293.27	434.94	495.66	496.18	499.16	(95)
Monthly average external temperature from Table 8													
(96)m	4.50	5.00	6.80	8.70	11.70	14.60	16.90	16.90	14.30	10.80	7.00	4.90	(96)
Heat loss rate for mean internal temperature, Lm, W													
(97)m	1259.78	1224.70	1108.30	969.67	746.45	508.32	306.74	306.10	524.22	784.41	1052.54	1212.79	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m - (95)m] x (41)m													
(98)m	549.15	438.31	367.98	232.04	112.68	0.00	0.00	0.00	0.00	214.83	400.58	530.94	

Total per year (kWh/year) = ∑(98)1...5, 10...12 = 2846.51 (98)

Space heating requirement in kWh/m²/year (98) ÷ (4) 29.81 (99)

9a. Energy Requirements - Individual heating systems including micro-CHP

Space heating:

Fraction of space heating from secondary/supplementary system (Table 11) 0.00 (201)

Fraction of space heating from main system(s) 1 - (201)	1.00	(202)
Fraction of main heating from main system 2	0.00	(203)
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 space heating system 1 (%)	93.00	(206)

(from database or Table 4a/4b, adjusted where appropriate by the amount shown in the 'space efficiency adjustment' column of Table 4c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement, kWh/month (as calculated above)												
(98)m	549.15	438.31	367.98	232.04	112.68	0.00	0.00	0.00	0.00	214.83	400.58	530.94
Space heating fuel (main heating system 1), kWh/month = (98)m x (204) x 100 ÷ (206)												
(211)m	590.48	471.31	395.68	249.51	121.16	0.00	0.00	0.00	0.00	231.00	430.73	570.90

Total per year (kWh/year) = ∑(211)1...5, 10...12 = 3060.77 (211)

Water heating:

Output from water heater, kWh/month (calculated above)												
(64)m	222.08	195.99	206.43	185.87	182.75	164.15	158.46	172.76	172.10	192.70	202.73	217.02

∑(64)1...12 = 2273.04 (64)

Efficiency of water heater per month												
(217)m	86.63	86.40	85.84	84.90	83.07	79.30	79.30	79.30	79.30	84.60	86.10	86.61
Fuel for water heating, kWh/month = (64)m x 100 ÷ (217)m												
(219)m	256.34	226.85	240.49	218.92	220.00	207.00	199.83	217.85	217.03	227.77	235.47	250.57

Total per year (kWh/year) = ∑(219)1...12 = 2718.12 (219)

Annual Totals Summary:	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		3060.77	(211)
Water heating fuel used		2718.12	(219)
Electricity for pumps, fans and electric keep-hot (Table 4f):			
mechanical ventilation fans - balanced, extract or positive input from outside	70.88		(230a)
warm air heating system fans	0.00		(230b)
central heating pump	130.00		(230c)
oil boiler pump	0.00		(230d)
boiler flue fan	45.00		(230e)
maintaining electric keep-hot facility for gas combi boiler	0.00		(230f)
pump for solar water heating	0.00		(230g)
Total electricity for the above	∑(230a)...(230g)	245.88	(231)
Electricity for lighting (calculated in Appendix L):		401.03	(232)
Energy saving/generation technologies (Appendices M, N and Q):			
Electricity generated by PVs (Appendix M) (negative quantity)		-891.02	(233)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year		Emissions Factor		Emissions (kgCO2/year)	
Space heating - main system 1	3060.77	x	0.198	=	606.03	(261)
Water heating	2718.12	x	0.198	=	538.19	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1144.22	(265)
Pumps, fans and electric keep-hot	245.88	x	0.517	=	127.12	(267)
Lighting	401.03	x	0.517	=	207.33	(268)
Energy saving/generation technologies:						
PV emission savings (negative quantity)	-891.02	x	0.529	=	-471.35	(269)
Total carbon dioxide emissions				∑(261)...(271) =	1007.33	(272)

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SAP 2009 Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Stuart Searle	Assessor number	2435
Client		Last modified	01/02/2013
Address	P08 4 St Augustines, London, NW1		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		95.50	(1a) x	2.60	(2a) =	248.30	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	95.50	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	248.30	(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	5.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.25	(18)

Air permeability value applies if a pressurisation test has been done, or a design or specified air permeability is being used

Number of sides on which dwelling is sheltered		2	(19)
Shelter factor	1 - [0.075 x (19)] =	0.85	(20)
Adjusted infiltration rate	(18) x (20) =	0.21	(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 7													
(22)m	5.40	5.10	5.10	4.50	4.10	3.90	3.70	3.70	4.20	4.50	4.80	5.10	
										∑(22)1...12 =		54.10	(22)
Wind Factor (22a)m = (22)m ÷ 4													
(22a)m	1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.20	1.27	
										∑(22a)1...12 =		13.52	(22a)
Adjusted infiltration rate (allowing for shelter and wind speed) = (21) × (22a)m													
(22b)m	0.29	0.27	0.27	0.24	0.22	0.21	0.20	0.20	0.22	0.24	0.26	0.27	
										∑(22b)1...12 =		2.87	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)), otherwise (23b) = (23a)	0.5	(23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = N/A (23c)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b)m + 0.5 x (23b)

(24c)m	0.54	0.52	0.52	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.52	(24c)

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

(25)m	0.54	0.52	0.52	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.52	(25)

3. Heat losses and heat loss parameter

The κ-value is the heat capacity per unit area, see Table 1e.

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	
Doors			2.10	x	1.60	=	3.36	N/A	N/A	(26)
Window*			8.68	x	1.15	=	9.94	N/A	N/A	(27)
Window*			9.70	x	1.33	=	12.86	N/A	N/A	(27)
External wall			55.08	x	0.20	=	11.02	N/A	N/A	(29a)
Party Wall			33.80	x	0.00	=	0.00	N/A	N/A	(32)
Roof			30.00	x	0.15	=	4.50	N/A	N/A	(30)

Total area of external elements ∑A, m² 105.56 (31)

** for windows and roof windows, effective window U-value is calculated using formula 1/[(1/UValue)+0.04] paragraph 3.2*

Fabric heat loss, W/K = ∑(A × U) (26)...(30) + (32) = 41.68 (33)

Heat capacity Cm = ∑(A x κ) (28)...(30) + (32) + (32a)...(32e) = N/A (34)

Thermal mass parameter (TMP) in kJ/m²K Calculated separately = 100.00 (35)

Thermal bridges: ∑(L x Ψ) calculated using Appendix K 9.73 (36)

if details of thermal bridging are not known then (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 51.41 (37)

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

(38)m	43.99	42.69	42.69	40.97	40.97	40.97	40.97	40.97	40.97	40.97	41.38	42.69	(38)

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

(39)m	95.40	94.09	94.09	92.38	92.38	92.38	92.38	92.38	92.38	92.38	92.79	94.09	

Average = ∑(39)1...12/12 = 93.09 (39)

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

(40)m	1.00	0.99	0.99	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.99	

Average = ∑(40)1...12/12 = 0.97 (40)

4. Water heating energy requirement

kWh/year

Assumed occupancy, N 2.69 (42)

If TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)

If TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 98.18 (43)

Annual average hot water usage has been reduced by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	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)													
(44)m	108.00	104.07	100.14	96.21	92.29	88.36	88.36	92.29	96.21	100.14	104.07	108.00	

∑(44)1...12 = 1178.13 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

(45)m	160.54	140.41	144.89	126.32	121.20	104.59	96.92	111.21	112.54	131.16	143.17	155.47	

∑(45)1...12 = 1548.41 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

For community heating include distribution loss whether or not hot water tank is present

Distribution loss 0.15 x (45)m

(46)m	24.08	21.06	21.73	18.95	18.18	15.69	14.54	16.68	16.88	19.67	21.48	23.32	(46)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day):	1.85	(47)
Temperature factor from Table 2b	0.54	(48)
Energy lost from water storage, kWh/day (47) x (48)	1.00	(49)
Enter (49) or (54) in (55)	1.00	(55)

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

(56)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(56)

If cylinder contains dedicated solar storage, = (56)m x [(50) - (H11)] ÷ (50), else = (56)m where (H11) is from Appendix H

(57)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97	(57)

Primary circuit loss (annual) from Table 3: 360.00 (58)

Primary circuit loss for each month (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m	30.58	27.62	30.58	29.59	30.58	29.59	30.58	30.58	29.59	30.58	29.59	30.58	(59)

Combi loss for each month from Table 3a, 3b or 3c (enter '0' if not a combi boiler)

(61)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	(61)

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

(62)m	222.08	195.99	206.43	185.87	182.75	164.15	158.46	172.76	172.10	192.70	202.73	217.02	(62)

Solar DHW input calculated using Appendix H (negative quantity) ('0' entered if no solar contribution to water heating)

(63)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	

∑(63)1...12 = 0.00 (63)

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

(64)m	222.08	195.99	206.43	185.87	182.75	164.15	158.46	172.76	172.10	192.70	202.73	217.02	

∑(64)1...12 = 2273.04 (64)

if (64)m < 0 then set to 0

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

(65)m	102.61	91.16	97.41	89.65	89.54	82.42	81.46	86.21	85.07	92.85	95.25	100.93	(65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	161.63	161.63	161.63	161.63	161.63	161.63	161.63	161.63	161.63	161.63	161.63	161.63	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m	56.77	50.42	41.01	31.04	23.21	19.59	21.17	27.52	36.93	46.90	54.73	58.35	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m	371.40	375.26	365.55	344.87	318.77	294.24	277.85	274.00	283.71	304.39	330.49	355.02	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m	53.86	53.86	53.86	53.86	53.86	53.86	53.86	53.86	53.86	53.86	53.86	53.86	(69)
Pumps and fans gains (Table 5a)													
(70)m	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	-107.75	(71)
Water heating gains (Table 5)													
(72)m	137.92	135.65	130.93	124.51	120.34	114.48	109.49	115.88	118.15	124.79	132.29	135.66	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m	683.83	679.06	655.21	618.16	580.05	546.04	526.25	535.13	556.53	593.81	635.25	666.76	(73)

6. Solar gains

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Rows (74) to (82) are used 12 times, one for each month, repeating as needed if there is more than one window type.

Details for month of January and annual totals are shown below:

	Access factor Table 6d		Area m²		Solar flux W/m²		g Specific data or Table 6b		FF Specific data or Table 6c		Gains (W)	
West	0.54	x	8.68	x	19.87	x 0.9 x	0.63	x	0.80	=	42.25	(80)
Northwest	0.54	x	9.70	x	11.51	x 0.9 x	0.63	x	0.80	=	27.35	(81)

Solar gains in watts, calculated for each month ∑(74)m...(82)m

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(83)m	69.60	137.87	228.63	355.47	449.79	478.45	460.45	387.66	278.27	170.07	87.05	57.10	(83)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(84)m	753.43	816.93	883.84	973.62	1029.84	1024.49	986.69	922.79	834.80	763.88	722.29	723.85	(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, η1,m (see Table 9a)													
(86)m	0.93	0.91	0.87	0.80	0.67	0.52	0.37	0.39	0.63	0.82	0.91	0.93	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)													
(87)m	19.28	19.49	19.88	20.28	20.67	20.89	20.97	20.97	20.81	20.36	19.72	19.34	(87)
Temperature during heating periods in the living area from Table 9, Th2(°C)													
(88)m	20.09	20.10	20.10	20.11	20.11	20.11	20.11	20.11	20.11	20.11	20.11	20.10	(88)
Utilisation factor for gains for rest of dwelling η2,m (see Table 9a)													
(89)m	0.92	0.90	0.85	0.77	0.63	0.46	0.29	0.31	0.57	0.79	0.90	0.93	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)													
(90)m	17.80	18.11	18.66	19.23	19.74	20.01	20.09	20.09	19.92	19.35	18.45	17.89	(90)

Living area fraction fLA 31.30 ÷ (4) = 0.33 (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2													
(92)m	18.28	18.56	19.06	19.58	20.05	20.30	20.38	20.38	20.21	19.69	18.87	18.36	(92)
Apply adjustment to the mean internal temperature from Table 4e, where appropriate													
(93)m	18.13	18.41	18.91	19.43	19.90	20.15	20.23	20.23	20.06	19.54	18.72	18.21	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that tim = (93)m and recalculate the utilisation factor for gains using Table 9a)													
Utilisation factor for gains, ηm													
(94)m	0.90	0.88	0.83	0.75	0.62	0.46	0.30	0.32	0.56	0.76	0.87	0.90	(94)
Useful gains, ηmGm, W = (94)m x (84)m													
(95)m	677.43	715.91	731.52	731.22	640.38	475.90	300.55	298.93	469.60	584.05	629.65	652.34	(95)
Monthly average external temperature from Table 8													
(96)m	4.50	5.00	6.80	8.70	11.70	14.60	16.90	16.90	14.30	10.80	7.00	4.90	(96)
Heat loss rate for mean internal temperature, Lm, W													
(97)m	1300.66	1262.16	1139.05	990.85	757.29	512.29	307.72	307.36	532.38	806.93	1087.08	1252.60	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m - (95)m] x (41)m													
(98)m	463.68	367.08	303.20	186.93	86.98	0.00	0.00	0.00	0.00	165.83	329.35	446.59	

Total per year (kWh/year) = ∑(98)1...5, 10...12 = 2349.65 (98)

Space heating requirement in kWh/m²/year (98) ÷ (4) 24.60 (99)

9a. Energy Requirements - Individual heating systems including micro-CHP

Space heating:

Fraction of space heating from secondary/supplementary system (Table 11) 0.00 (201)

Fraction of space heating from main system(s) 1 - (201)	1.00	(202)
Fraction of main heating from main system 2	0.00	(203)
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 space heating system 1 (%)	93.00	(206)

(from database or Table 4a/4b, adjusted where appropriate by the amount shown in the 'space efficiency adjustment' column of Table 4c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement, kWh/month (as calculated above)												
(98)m	463.68	367.08	303.20	186.93	86.98	0.00	0.00	0.00	0.00	165.83	329.35	446.59
Space heating fuel (main heating system 1), kWh/month = (98)m x (204) x 100 ÷ (206)												
(211)m	498.58	394.71	326.02	201.00	93.53	0.00	0.00	0.00	0.00	178.31	354.14	480.21

Total per year (kWh/year) = ∑(211)1...5, 10...12 = 2526.50 (211)

Water heating:

Output from water heater, kWh/month (calculated above)												
(64)m	222.08	195.99	206.43	185.87	182.75	164.15	158.46	172.76	172.10	192.70	202.73	217.02

∑(64)1...12 = 2273.04 (64)

Efficiency of water heater per month												
(217)m	86.23	85.96	85.34	84.33	82.46	79.30	79.30	79.30	79.30	83.91	85.60	86.20
Fuel for water heating, kWh/month = (64)m x 100 ÷ (217)m												
(219)m	257.54	228.00	241.90	220.42	221.62	207.00	199.83	217.85	217.03	229.64	236.83	251.77

Total per year (kWh/year) = ∑(219)1...12 = 2729.42 (219)

Annual Totals Summary:	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		2526.50	(211)
Water heating fuel used		2729.42	(219)
Electricity for pumps, fans and electric keep-hot (Table 4f):			
mechanical ventilation fans - balanced, extract or positive input from outside	70.88		(230a)
warm air heating system fans	0.00		(230b)
central heating pump	130.00		(230c)
oil boiler pump	0.00		(230d)
boiler flue fan	45.00		(230e)
maintaining electric keep-hot facility for gas combi boiler	0.00		(230f)
pump for solar water heating	0.00		(230g)
Total electricity for the above	∑(230a)...(230g)	245.88	(231)
Electricity for lighting (calculated in Appendix L):		401.03	(232)
Energy saving/generation technologies (Appendices M, N and Q):			
Electricity generated by PVs (Appendix M) (negative quantity)		-891.02	(233)

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

	Fuel kWh/year		Fuel price (Table 12)		Fuel cost £/year	
Space heating - main system 1	2526.50	x	3.10	x 0.01 =	78.32	(240)
Water heating cost (other fuel)	2729.42	x	3.10	x 0.01 =	84.61	(247)
Pumps, fans and electric keep-hot	245.88	x	11.46	x 0.01 =	28.18	(249)
Energy for lighting	401.03	x	11.46	x 0.01 =	45.96	(250)
Additional standing charges (Table 12)					106.00	(251)
Energy saving/generation technologies (Appendices M, N and Q):						
PV savings (negative quantity)	-891.02	x	11.46	x 0.01 =	-102.11	(252)
Total energy cost			(240)...(242) + (245)...(254)		240.96	(255)

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

Energy cost deflator (Table 12)		0.47	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	0.81	(257)
SAP value		88.76	
SAP rating		89	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year		Emissions Factor		Emissions (kgCO2/year)	
Space heating - main system 1	2526.50	x	0.198	=	500.25	(261)
Water heating	2729.42	x	0.198	=	540.43	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1040.67	(265)
Pumps, fans and electric keep-hot	245.88	x	0.517	=	127.12	(267)
Lighting	401.03	x	0.517	=	207.33	(268)
Energy saving/generation technologies:						
PV emission savings (negative quantity)	-891.02	x	0.529	=	-471.35	(269)
Total carbon dioxide emissions			∑(261)...(271) =		903.78	(272)
Dwelling carbon dioxide emissions rate			(272) ÷ (4) =		9.46	(273)
EI value					91.38	
EI rating (see section 14)					91	(274)
EI band					B	

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

	Energy kWh/year		Primary Energy Factor		Primary Energy	
Space heating - main system 1	2526.50	x	1.02	=	2577.03	(261*)
Water heating	2729.42	x	1.02	=	2784.01	(264*)
Space and water heating			(261*) + (262*) + (263*) + (264*) =		5361.05	(265*)
Pumps, fans and electric keep-hot	245.88	x	2.92	=	717.98	(267*)
Lighting	401.03	x	2.92	=	1171.02	(268*)
Energy saving/generation technologies:						
PV primary energy savings (negative quantity)	-891.02	x	2.92	=	-2601.78	(269*)
Total primary energy kWh/year			∑(261*)...(271*) =		4648.27	(272*)
Primary energy kWh/m2/year			(272*) ÷ (4) =		48.67	(273*)

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Code for Sustainable Homes (November 2010)
Design - Draft

This report details the calculations and results for Ene 1, 2 and 7 of the Code For Sustainable Homes.

This Design Assessment has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed. Code calculations are from the Technical Guide (November 2010).

Assessor name	Mr Stuart Searle	Assessor number	2435
Client		Last modified	01/02/2013
Address	P09 4 St Augustines, London, NW1		

Building regulation assessment - criterion 1

	kg/m²/yr
DER	11.93
TER	17.69

Assessment of zero carbon home and low or zero carbon technologies

		Credits	Level
Dwelling emission rate (Ene 1)	CO_2 reduction = 32.6 %	3.6	4
Fabric Energy Efficiency	FEE = 60.8	No credits	
Low or zero carbon technologies (Ene 7)	CO_2 reduction = 14 %	1	

Ene 1 - dwelling emission rate

	%	kWh/m²	kgCO_2/m²/yr	
Assessment of Ene 1 (level 1-5)				
DER from SAP 2009 DER worksheet			11.93	
Additional allowable generation		0.00		
CO_2 emissions offset from generation			0.00	
CO_2 emissions offset from community biofuel CHP systems			0.00	
Total CO_2 emissions offset from SAP section 16 allowances			**0.00**	
DER accounting for SAP section 16 allowances			**11.93**	
CO_2 reduction compared to TER			5.76	
CO_2 reduction as % of TER	32.6			
Assessment of Ene 1 (level 6)				
DER from SAP 2009 DER worksheet			11.93	(ZC1)
CO_2 emissions from appliances (equation L14)			13.08	(ZC2)
CO_2 emissions from cooking (equation L16)			1.35	(ZC3)
Total CO_2 emissions			26.37	(ZC4)
Additional allowable generation and its CO_2 emissions offset		0.00		(ZC6)
CO_2 emissions offset from additional allowable generation			0.00	(ZC7)
CO_2 emissions offset from community biofuel CHP systems			0.00	(ZC5)
Net CO_2 emissions			**26.37**	(ZC8)

Ene 1 - dwelling emission rate - level 6

There is no Zero Carbon Home definition in the current technical guide

	Criterion	Value	Pass/Fail
FEE	<= 39	60.8	Fail
Net CO_2 emissions	<= 0.00	26.37	Fail

Result: Not level 6

Number of credits for Ene 1	**3.6**

Ene 2 - Fabric Energy Efficiency

FEE	60.8
Number of credits for Ene 2	**No credits**

Ene 7 - low or zero carbon technologies

	Emissions $kgCO_2/yr$	Reduction $kgCO_2/yr$
Standard case		
Space and water heating (265)	2216.91	
Mechanical cooling (266)	0.00	
Pumps and fans (267)	152.24	
Lighting (268)	251.39	
Appliances and cooking	2013.72	
Total CO_2	**2606.11**	
Actual case		
Space and water heating (265) or (376)	2216.91	
Space and water heating from LZCT considered in SAP 2009		0.00
Pumps and fans (267) or (378)	152.24	
Pumps and fans		0.00
Electricity generated by LZCT (269) + (380))		-688.41
Additional allowable electricity generation considered in SAP 2009 section 16		0.00
Offset from biofuel CHP [-1 x [(363)..(366) + (368)...(372)]]		0.00
LZCT electricity generation		-688.41
LZCT thermal generation		0
Total from specified LZCT		**-688.41**

	Emissions $kgCO_2/m^2/yr$	
Reduction in CO_2 Emissions		
Standard Case CO_2	33.23	
Actual Case CO_2	28.29	
% Reduction in CO_2	14	
Number of credits for Ene 7	**1**	

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DER 2009 Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Stuart Searle	Assessor number	2435
Client		Last modified	01/02/2013
Address	P09 4 St Augustines, London, NW1		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		139.50	(1a) x	3.00	(2a) =	418.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	139.50	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	418.50	(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	5.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.25	(18)

Air permeability value applies if a pressurisation test has been done, or a design or specified air permeability is being used

Number of sides on which dwelling is sheltered		0	(19)
Shelter factor	1 - [0.075 x (19)] =	1.00	(20)
Adjusted infiltration rate	(18) x (20) =	0.25	(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 7													
(22)m	5.40	5.10	5.10	4.50	4.10	3.90	3.70	3.70	4.20	4.50	4.80	5.10	
										∑(22)1...12 =		54.10	(22)
Wind Factor (22a)m = (22)m ÷ 4													
(22a)m	1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.20	1.27	
										∑(22a)1...12 =		13.52	(22a)
Adjusted infiltration rate (allowing for shelter and wind speed) = (21) × (22a)m													
(22b)m	0.34	0.32	0.32	0.28	0.26	0.24	0.23	0.23	0.26	0.28	0.30	0.32	
										∑(22b)1...12 =		3.38	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)), otherwise (23b) = (23a)	0.5	(23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = N/A (23c)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b)m + 0.5 x (23b)

(24c)m	0.59	0.57	0.57	0.53	0.51	0.50	0.50	0.50	0.51	0.53	0.55	0.57	(24c)

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

(25)m	0.59	0.57	0.57	0.53	0.51	0.50	0.50	0.50	0.51	0.53	0.55	0.57	(25)

3. Heat losses and heat loss parameter

The κ-value is the heat capacity per unit area, see Table 1e.

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	
Doors			2.10	x	1.60	=	3.36	N/A	N/A	(26)
Window*			57.73	x	1.15	=	66.10	N/A	N/A	(27)
Exposed floor			10.00	x	0.15	=	1.50	N/A	N/A	(28b)
External wall			75.17	x	0.20	=	15.03	N/A	N/A	(29a)
Roof			177.00	x	0.15	=	26.55	N/A	N/A	(30)

Total area of external elements ∑A, m² 322.00 (31)

** for windows and roof windows, effective window U-value is calculated using formula 1/[(1/UValue)+0.04] paragraph 3.2*

Fabric heat loss, W/K = ∑(A × U) (26)...(30) + (32) = 112.55 (33)

Heat capacity Cm = ∑(A x κ) (28)...(30) + (32) + (32a)...(32e) = N/A (34)

Thermal mass parameter (TMP) in kJ/m²K Calculated separately = 100.00 (35)

Thermal bridges: ∑(L x Ψ) calculated using Appendix K 25.76 (36)

if details of thermal bridging are not known then (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 138.31 (37)

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

(38)m	81.14	78.55	78.55	73.37	69.92	69.05	69.05	69.05	70.78	73.37	75.96	78.55	(38)

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

(39)m	219.44	216.85	216.85	211.68	208.22	207.36	207.36	207.36	209.09	211.68	214.26	216.85	

Average = ∑(39)1...12/12 = 212.25 (39)

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

(40)m	1.57	1.55	1.55	1.52	1.49	1.49	1.49	1.49	1.50	1.52	1.54	1.55	

Average = ∑(40)1...12/12 = 1.52 (40)

4. Water heating energy requirement

kWh/year

Assumed occupancy, N 2.92 (42)

If TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)

If TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 103.46 (43)

Annual average hot water usage has been reduced by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	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)													
(44)m	113.80	109.67	105.53	101.39	97.25	93.11	93.11	97.25	101.39	105.53	109.67	113.80	

∑(44)1...12 = 1241.50 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

(45)m	169.17	147.96	152.68	133.11	127.72	110.21	102.13	117.20	118.60	138.21	150.87	163.83	

∑(45)1...12 = 1631.69 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

For community heating include distribution loss whether or not hot water tank is present

Distribution loss 0.15 x (45)m

(46)m	25.38	22.19	22.90	19.97	19.16	16.53	15.32	17.58	17.79	20.73	22.63	24.58 (46)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.85 (47)

Temperature factor from Table 2b 0.54 (48)

Energy lost from water storage, kWh/day (47) x (48) 1.00 (49)

Enter (49) or (54) in (55) 1.00 (55)

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

(56)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97 (56)

If cylinder contains dedicated solar storage, = (56)m x [(50) - (H11)] ÷ (50), else = (56)m where (H11) is from Appendix H

(57)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97 (57)

Primary circuit loss (annual) from Table 3 360.00 (58)

Primary circuit loss for each month (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m	30.58	27.62	30.58	29.59	30.58	29.59	30.58	30.58	29.59	30.58	29.59	30.58 (59)

Combi loss for each month from Table 3a, 3b or 3c (enter '0' if not a combi boiler)

(61)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 (61)

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

(62)m	230.72	203.55	214.22	192.67	189.27	169.77	163.67	178.74	178.15	199.76	210.43	225.38 (62)

Solar DHW input calculated using Appendix H (negative quantity) ('0' entered if no solar contribution to water heating)

(63)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

∑(63)1...12 = 0.00 (63)

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

(64)m	230.72	203.55	214.22	192.67	189.27	169.77	163.67	178.74	178.15	199.76	210.43	225.38

∑(64)1...12 = 2356.33 (64)

if (64)m < 0 then set to 0

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

(65)m	105.49	93.67	100.00	91.91	91.70	84.29	83.19	88.20	87.08	95.19	97.81	103.71 (65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	145.81	145.81	145.81	145.81	145.81	145.81	145.81	145.81	145.81	145.81	145.81	145.81	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m	27.53	24.46	19.89	15.06	11.26	9.50	10.27	13.35	17.91	22.74	26.55	28.30	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m	308.84	312.05	303.97	286.78	265.08	244.68	231.05	227.85	235.92	253.12	274.82	295.22	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m	37.58	37.58	37.58	37.58	37.58	37.58	37.58	37.58	37.58	37.58	37.58	37.58	(69)
Pumps and fans gains (Table 5a)													
(70)m	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m	-116.65	-116.65	-116.65	-116.65	-116.65	-116.65	-116.65	-116.65	-116.65	-116.65	-116.65	-116.65	(71)
Water heating gains (Table 5)													
(72)m	141.78	139.39	134.41	127.65	123.26	117.07	111.82	118.55	120.94	127.94	135.85	139.40	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m	554.90	552.63	535.01	506.22	476.33	448.00	429.88	436.49	451.52	480.55	513.95	539.65	(73)

6. Solar gains

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Rows (74) to (82) are used 12 times, one for each month, repeating as needed if there is more than one window type.

Details for month of January and annual totals are shown below:

	Access factor Table 6d		Area m²		Solar flux W/m²		g Specific data or Table 6b		FF Specific data or Table 6c		Gains (W)	
West	0.54	x	15.10	x	19.87	x 0.9 x	0.63	x	0.80	=	73.50	(80)
North	0.54	x	17.26	x	10.73	x 0.9 x	0.63	x	0.80	=	45.34	(74)
South	0.54	x	25.37	x	47.32	x 0.9 x	0.63	x	0.80	=	294.14	(78)

Solar gains in watts, calculated for each month ∑(74)m...(82)m

(83)m	412.97	708.24	954.27	1222.36	1403.95	1461.49	1416.93	1268.48	1067.37	808.50	495.74	352.59	(83)

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

(84)m	967.87	1260.87	1489.28	1728.59	1880.28	1909.49	1846.81	1704.96	1518.89	1289.05	1009.70	892.24	(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, η1,m (see Table 9a)													
(86)m	0.96	0.93	0.88	0.82	0.70	0.56	0.41	0.44	0.66	0.84	0.94	0.96	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)													
(87)m	17.99	18.42	19.02	19.64	20.29	20.70	20.90	20.89	20.55	19.78	18.68	18.04	(87)
Temperature during heating periods in the living area from Table 9, Th2(˚C)													
(88)m	19.64	19.65	19.65	19.68	19.70	19.70	19.70	19.70	19.69	19.68	19.66	19.65	(88)
Utilisation factor for gains for rest of dwelling η2,m (see Table 9a)													
(89)m	0.95	0.92	0.86	0.78	0.65	0.48	0.30	0.32	0.58	0.81	0.93	0.96	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)													
(90)m	15.72	16.33	17.19	18.07	18.95	19.45	19.65	19.64	19.29	18.28	16.73	15.80	(90)

Living area fraction fLA 45.00 ÷ (4) = 0.32 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2													
(92)m	16.45	17.00	17.78	18.58	19.38	19.86	20.05	20.04	19.70	18.77	17.36	16.52	(92)
Apply adjustment to the mean internal temperature from Table 4e, where appropriate													
(93)m	16.30	16.85	17.63	18.43	19.23	19.71	19.90	19.89	19.55	18.62	17.21	16.37	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that tim = (93)m and recalculate the utilisation factor for gains using Table 9a)													
Utilisation factor for gains, ηm													
(94)m	0.92	0.88	0.82	0.75	0.63	0.48	0.32	0.34	0.57	0.77	0.89	0.93	(94)
Useful gains, ηmGm, W = (94)m x (84)m													
(95)m	893.49	1110.51	1227.13	1291.75	1178.59	911.87	585.77	578.30	870.75	992.88	901.81	829.36	(95)
Monthly average external temperature from Table 8													
(96)m	4.50	5.00	6.80	8.70	11.70	14.60	16.90	16.90	14.30	10.80	7.00	4.90	(96)
Heat loss rate for mean internal temperature, Lm, W													
(97)m	2589.66	2570.50	2348.07	2058.81	1568.59	1059.17	622.79	620.70	1096.75	1654.42	2187.01	2487.78	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m - (95)m] x (41)m													
(98)m	1261.95	981.11	833.98	552.28	290.16	0.00	0.00	0.00	0.00	492.18	925.34	1233.86	

Total per year (kWh/year) = ∑(98)1...5, 10...12 = 6570.86 (98)

Space heating requirement in kWh/m²/year (98) ÷ (4) 47.10 (99)

9a. Energy Requirements - Individual heating systems including micro-CHP

Space heating:

Fraction of space heating from secondary/supplementary system (Table 11) 0.00 (201)

Fraction of space heating from main system(s) 1 - (201) 1.00 (202)

Fraction of main heating from main system 2	0.00	(203)
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 space heating system 1 (%)	93.00	(206)

(from database or Table 4a/4b, adjusted where appropriate by the amount shown in the 'space efficiency adjustment' column of Table 4c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement, kWh/month (as calculated above)												
(98)m	1261.95	981.11	833.98	552.28	290.16	0.00	0.00	0.00	0.00	492.18	925.34	1233.86
Space heating fuel (main heating system 1), kWh/month = (98)m x (204) x 100 ÷ (206)												
(211)m	1356.93	1054.96	896.75	593.85	312.00	0.00	0.00	0.00	0.00	529.23	994.99	1326.73

Total per year (kWh/year) = ∑(211)1...5, 10...12 = 7065.44 (211)

Water heating:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Output from water heater, kWh/month (calculated above)												
(64)m	230.72	203.55	214.22	192.67	189.27	169.77	163.67	178.74	178.15	199.76	210.43	225.38

∑(64)1...12 = 2356.33 (64)

Efficiency of water heater per month												
(217)m	88.16	87.96	87.58	86.97	85.45	79.30	79.30	79.30	79.30	86.63	87.80	88.16
Fuel for water heating, kWh/month = (64)m x 100 ÷ (217)m												
(219)m	261.70	231.41	244.59	221.55	221.50	214.09	206.40	225.40	224.66	230.60	239.65	255.64

Total per year (kWh/year) = ∑(219)1...12 = 2777.17 (219)

Annual Totals Summary:	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		7065.44	(211)
Water heating fuel used		2777.17	(219)
Electricity for pumps, fans and electric keep-hot (Table 4f):			
mechanical ventilation fans - balanced, extract or positive input from outside	119.47		(230a)
warm air heating system fans	0.00		(230b)
central heating pump	130.00		(230c)
oil boiler pump	0.00		(230d)
boiler flue fan	45.00		(230e)
maintaining electric keep-hot facility for gas combi boiler	0.00		(230f)
pump for solar water heating	0.00		(230g)
Total electricity for the above	∑(230a)...(230g)	294.47	(231)
Electricity for lighting (calculated in Appendix L):		486.25	(232)
Energy saving/generation technologies (Appendices M, N and Q):			
Electricity generated by PVs (Appendix M) (negative quantity)		-1301.33	(233)

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year		Emissions Factor		Emissions (kgCO2/year)	
Space heating - main system 1	7065.44	x	0.198	=	1398.96	(261)
Water heating	2777.17	x	0.198	=	549.88	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1948.84	(265)
Pumps, fans and electric keep-hot	294.47	x	0.517	=	152.24	(267)
Lighting	486.25	x	0.517	=	251.39	(268)
Energy saving/generation technologies:						
PV emission savings (negative quantity)	-1301.33	x	0.529	=	-688.41	(269)
Total carbon dioxide emissions				∑(261)...(271) =	1664.07	(272)
Dwelling Carbon Dioxide Emissions Rate (DER)					11.93	(273)

DRAFT

SAP 2009 Worksheet
Design - Draft

This design submission has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the property as constructed.

Assessor name	Mr Stuart Searle	Assessor number	2435
Client		Last modified	01/02/2013
Address	P09 4 St Augustines, London, NW1		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		139.50	(1a) x	3.00	(2a) =	418.50	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	139.50	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	418.50	(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	5.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.25	(18)

Air permeability value applies if a pressurisation test has been done, or a design or specified air permeability is being used

Number of sides on which dwelling is sheltered		0	(19)
Shelter factor	1 - [0.075 x (19)] =	1.00	(20)
Adjusted infiltration rate	(18) x (20) =	0.25	(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 7													
(22)m	5.40	5.10	5.10	4.50	4.10	3.90	3.70	3.70	4.20	4.50	4.80	5.10	
										∑(22)1...12 =		54.10	(22)
Wind Factor (22a)m = (22)m ÷ 4													
(22a)m	1.35	1.27	1.27	1.12	1.02	0.98	0.92	0.92	1.05	1.12	1.20	1.27	
										∑(22a)1...12 =		13.52	(22a)
Adjusted infiltration rate (allowing for shelter and wind speed) = (21) × (22a)m													
(22b)m	0.34	0.32	0.32	0.28	0.26	0.24	0.23	0.23	0.26	0.28	0.30	0.32	
										∑(22b)1...12 =		3.38	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.5	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)), otherwise (23b) = (23a)	0.5	(23b)

If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) = N/A (23c)

c) If whole house extract ventilation or positive input ventilation from outside

if (22b)m < 0.5 x (23b), then (24c) = (23b); otherwise (24c) = (22b)m + 0.5 x (23b)

(24c)m	0.59	0.57	0.57	0.53	0.51	0.50	0.50	0.50	0.51	0.53	0.55	0.57	(24c)

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

(25)m	0.59	0.57	0.57	0.53	0.51	0.50	0.50	0.50	0.51	0.53	0.55	0.57	(25)

3. Heat losses and heat loss parameter

The κ-value is the heat capacity per unit area, see Table 1e.

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	
Doors			2.10	x	1.60	=	3.36	N/A	N/A	(26)
Window*			57.73	x	1.15	=	66.10	N/A	N/A	(27)
Exposed floor			10.00	x	0.15	=	1.50	N/A	N/A	(28b)
External wall			75.17	x	0.20	=	15.03	N/A	N/A	(29a)
Roof			177.00	x	0.15	=	26.55	N/A	N/A	(30)

Total area of external elements ∑A, m² 322.00 (31)

** for windows and roof windows, effective window U-value is calculated using formula 1/[(1/UValue)+0.04] paragraph 3.2*

Fabric heat loss, W/K = ∑(A × U) (26)...(30) + (32) = 112.55 (33)

Heat capacity Cm = ∑(A x κ) (28)...(30) + (32) + (32a)...(32e) = N/A (34)

Thermal mass parameter (TMP) in kJ/m²K Calculated separately = 100.00 (35)

Thermal bridges: ∑(L x Ψ) calculated using Appendix K 25.76 (36)

if details of thermal bridging are not known then (36) = 0.15 x (31)

Total fabric heat loss (33) + (36) = 138.31 (37)

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

(38)m	81.14	78.55	78.55	73.37	69.92	69.05	69.05	69.05	70.78	73.37	75.96	78.55	(38)

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

(39)m	219.44	216.85	216.85	211.68	208.22	207.36	207.36	207.36	209.09	211.68	214.26	216.85	

Average = ∑(39)1...12/12 = 212.25 (39)

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

(40)m	1.57	1.55	1.55	1.52	1.49	1.49	1.49	1.49	1.50	1.52	1.54	1.55	

Average = ∑(40)1...12/12 = 1.52 (40)

4. Water heating energy requirement

kWh/year

Assumed occupancy, N 2.92 (42)

If TFA > 13.9, N = 1 + 1.76 x [1 - exp(-0.000349 x (TFA - 13.9)²)] + 0.0013 x (TFA - 13.9)

If TFA ≤ 13.9, N = 1

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 103.46 (43)

Annual average hot water usage has been reduced by 5% if the dwelling is designed to achieve a water use target of not more than 125 litres per person per day (all water use, hot and cold)

	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)													
(44)m	113.80	109.67	105.53	101.39	97.25	93.11	93.11	97.25	101.39	105.53	109.67	113.80	

∑(44)1...12 = 1241.50 (44)

Energy content of hot water used - calculated monthly = 4.190 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)

(45)m	169.17	147.96	152.68	133.11	127.72	110.21	102.13	117.20	118.60	138.21	150.87	163.83	

∑(45)1...12 = 1631.69 (45)

If instantaneous water heating at point of use (no hot water storage), enter 0 in boxes (46) to (61)

For community heating include distribution loss whether or not hot water tank is present

Distribution loss 0.15 x (45)m

(46)m	25.38	22.19	22.90	19.97	19.16	16.53	15.32	17.58	17.79	20.73	22.63	24.58 (46)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 1.85 (47)

Temperature factor from Table 2b 0.54 (48)

Energy lost from water storage, kWh/day (47) x (48) 1.00 (49)

Enter (49) or (54) in (55) 1.00 (55)

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

(56)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97 (56)

If cylinder contains dedicated solar storage, = (56)m x [(50) - (H11)] ÷ (50), else = (56)m where (H11) is from Appendix H

(57)m	30.97	27.97	30.97	29.97	30.97	29.97	30.97	30.97	29.97	30.97	29.97	30.97 (57)

Primary circuit loss (annual) from Table 3 360.00 (58)

Primary circuit loss for each month (58) ÷ 365 × (41)m

(modified by factor from Table H5 if there is solar water heating and a cylinder thermostat)

(59)m	30.58	27.62	30.58	29.59	30.58	29.59	30.58	30.58	29.59	30.58	29.59	30.58 (59)

Combi loss for each month from Table 3a, 3b or 3c (enter '0' if not a combi boiler)

(61)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 (61)

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

(62)m	230.72	203.55	214.22	192.67	189.27	169.77	163.67	178.74	178.15	199.76	210.43	225.38 (62)

Solar DHW input calculated using Appendix H (negative quantity) ('0' entered if no solar contribution to water heating)

(63)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

∑(63)1...12 = 0.00 (63)

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

(64)m	230.72	203.55	214.22	192.67	189.27	169.77	163.67	178.74	178.15	199.76	210.43	225.38

∑(64)1...12 = 2356.33 (64)

if (64)m < 0 then set to 0

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

(65)m	105.49	93.67	100.00	91.91	91.70	84.29	83.19	88.20	87.08	95.19	97.81	103.71 (65)

include (57)m in calculation of (65)m only if cylinder is in the dwelling or hot water is from community heating

5. Internal gains (see Table 5 and 5a)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5), Watts													
(66)m	174.97	174.97	174.97	174.97	174.97	174.97	174.97	174.97	174.97	174.97	174.97	174.97	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m	68.83	61.14	49.72	37.64	28.14	23.75	25.67	33.36	44.78	56.86	66.36	70.75	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m	460.96	465.74	453.69	428.03	395.64	365.19	344.85	340.07	352.12	377.78	410.18	440.62	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m	55.41	55.41	55.41	55.41	55.41	55.41	55.41	55.41	55.41	55.41	55.41	55.41	(69)
Pumps and fans gains (Table 5a)													
(70)m	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	(70)
Losses e.g. evaporation (negative values) (Table 5)													
(71)m	-116.65	-116.65	-116.65	-116.65	-116.65	-116.65	-116.65	-116.65	-116.65	-116.65	-116.65	-116.65	(71)
Water heating gains (Table 5)													
(72)m	141.78	139.39	134.41	127.65	123.26	117.07	111.82	118.55	120.94	127.94	135.85	139.40	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m													
(73)m	795.31	790.00	761.56	717.05	670.77	629.76	606.08	615.72	641.58	686.32	736.12	774.50	(73)

6. Solar gains

Solar gains are calculated using solar flux from Table 6a and associated equations to convert to the applicable orientation.

Rows (74) to (82) are used 12 times, one for each month, repeating as needed if there is more than one window type.

Details for month of January and annual totals are shown below:

	Access factor Table 6d		Area m²		Solar flux W/m²		g Specific data or Table 6b		FF Specific data or Table 6c		Gains (W)	
West	0.54	x	15.10	x	19.87	x 0.9 x	0.63	x	0.80	=	73.50	(80)
North	0.54	x	17.26	x	10.73	x 0.9 x	0.63	x	0.80	=	45.34	(74)
South	0.54	x	25.37	x	47.32	x 0.9 x	0.63	x	0.80	=	294.14	(78)

Solar gains in watts, calculated for each month ∑(74)m...(82)m

(83)m	412.97	708.24	954.27	1222.36	1403.95	1461.49	1416.93	1268.48	1067.37	808.50	495.74	352.59	(83)

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

(84)m	1208.28	1498.24	1715.83	1939.41	2074.72	2091.25	2023.00	1884.20	1708.96	1494.83	1231.87	1127.09	(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, η1,m (see Table 9a)													
(86)m	0.94	0.90	0.85	0.78	0.67	0.53	0.38	0.41	0.62	0.80	0.91	0.94	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)													
(87)m	18.22	18.62	19.19	19.77	20.37	20.74	20.91	20.90	20.61	19.91	18.88	18.27	(87)
Temperature during heating periods in the living area from Table 9, Th2(˚C)													
(88)m	19.64	19.65	19.65	19.68	19.70	19.70	19.70	19.70	19.69	19.68	19.66	19.65	(88)
Utilisation factor for gains for rest of dwelling η2,m (see Table 9a)													
(89)m	0.93	0.89	0.83	0.75	0.61	0.45	0.27	0.29	0.54	0.76	0.90	0.93	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)													
(90)m	16.04	16.62	17.42	18.23	19.04	19.49	19.66	19.65	19.35	18.45	17.01	16.12	(90)

Living area fraction fLA 45.00 ÷ (4) = 0.32 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2													
(92)m	16.75	17.27	17.99	18.73	19.47	19.89	20.06	20.06	19.76	18.92	17.61	16.82	(92)
Apply adjustment to the mean internal temperature from Table 4e, where appropriate													
(93)m	16.60	17.12	17.84	18.58	19.32	19.74	19.91	19.91	19.61	18.77	17.46	16.67	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Set Ti to the mean internal temperature obtained at step 11 of Table 9b, so that tim = (93)m and recalculate the utilisation factor for gains using Table 9a)													
Utilisation factor for gains, ηm													
(94)m	0.89	0.85	0.79	0.71	0.59	0.45	0.29	0.31	0.53	0.73	0.86	0.90	(94)
Useful gains, ηmGm, W = (94)m x (84)m													
(95)m	1079.03	1272.60	1357.87	1386.59	1233.83	936.56	593.31	587.52	912.68	1091.54	1058.19	1013.71	(95)
Monthly average external temperature from Table 8													
(96)m	4.50	5.00	6.80	8.70	11.70	14.60	16.90	16.90	14.30	10.80	7.00	4.90	(96)
Heat loss rate for mean internal temperature, Lm, W													
(97)m	2654.28	2627.24	2393.75	2090.70	1585.84	1066.26	624.88	623.27	1109.49	1687.88	2241.30	2551.41	(97)
Space heating requirement for each month, kWh/month = 0.024 x [(97)m - (95)m] x (41)m													
(98)m	1171.99	910.31	770.70	506.96	261.90	0.00	0.00	0.00	0.00	443.67	851.84	1144.05	

Total per year (kWh/year) = ∑(98)1...5, 10...12 = 6061.43 (98)

Space heating requirement in kWh/m²/year (98) ÷ (4) 43.45 (99)

9a. Energy Requirements - Individual heating systems including micro-CHP

Space heating:

Fraction of space heating from secondary/supplementary system (Table 11) 0.00 (201)

Fraction of space heating from main system(s) 1 - (201) 1.00 (202)

Fraction of main heating from main system 2	0.00	(203)
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 space heating system 1 (%)	93.00	(206)

(from database or Table 4a/4b, adjusted where appropriate by the amount shown in the 'space efficiency adjustment' column of Table 4c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating requirement, kWh/month (as calculated above)												
(98)m	1171.99	910.31	770.70	506.96	261.90	0.00	0.00	0.00	0.00	443.67	851.84	1144.05
Space heating fuel (main heating system 1), kWh/month = (98)m x (204) x 100 ÷ (206)												
(211)m	1260.21	978.83	828.71	545.12	281.61	0.00	0.00	0.00	0.00	477.07	915.96	1230.16

Total per year (kWh/year) = ∑(211)1...5, 10...12 = 6517.66 (211)

Water heating:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Output from water heater, kWh/month (calculated above)												
(64)m	230.72	203.55	214.22	192.67	189.27	169.77	163.67	178.74	178.15	199.76	210.43	225.38

∑(64)1...12 = 2356.33 (64)

Efficiency of water heater per month												
(217)m	88.05	87.83	87.43	86.78	85.18	79.30	79.30	79.30	79.30	86.38	87.66	88.04
Fuel for water heating, kWh/month = (64)m x 100 ÷ (217)m												
(219)m	262.04	231.74	245.01	222.03	222.20	214.09	206.40	225.40	224.66	231.25	240.06	255.98

Total per year (kWh/year) = ∑(219)1...12 = 2780.86 (219)

Annual Totals Summary:	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		6517.66	(211)
Water heating fuel used		2780.86	(219)
Electricity for pumps, fans and electric keep-hot (Table 4f):			
mechanical ventilation fans - balanced, extract or positive input from outside	119.47		(230a)
warm air heating system fans	0.00		(230b)
central heating pump	130.00		(230c)
oil boiler pump	0.00		(230d)
boiler flue fan	45.00		(230e)
maintaining electric keep-hot facility for gas combi boiler	0.00		(230f)
pump for solar water heating	0.00		(230g)
Total electricity for the above	∑(230a)...(230g)	294.47	(231)
Electricity for lighting (calculated in Appendix L):		486.25	(232)
Energy saving/generation technologies (Appendices M, N and Q):			
Electricity generated by PVs (Appendix M) (negative quantity)		-1301.33	(233)

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

	Fuel kWh/year		Fuel price (Table 12)		Fuel cost £/year	
Space heating - main system 1	6517.66	x	3.10	x 0.01 =	202.05	(240)
Water heating cost (other fuel)	2780.86	x	3.10	x 0.01 =	86.21	(247)
Pumps, fans and electric keep-hot	294.47	x	11.46	x 0.01 =	33.75	(249)
Energy for lighting	486.25	x	11.46	x 0.01 =	55.72	(250)
Additional standing charges (Table 12)					106.00	(251)
Energy saving/generation technologies (Appendices M, N and Q):						
PV savings (negative quantity)	-1301.33	x	11.46	x 0.01 =	-149.13	(252)
Total energy cost			(240)...(242) + (245)...(254)		334.59	(255)

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

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Energy cost deflator (Table 12)		0.47	(256)
Energy cost factor (ECF)	[(255) x (256)] ÷ [(4) + 45.0] =	0.85	(257)
SAP value		88.11	
SAP rating		88	(258)
SAP band		B	

12a. Carbon dioxide emissions - Individual heating systems including micro-CHP

	Energy kWh/year		Emissions Factor		Emissions (kgCO2/year)	
Space heating - main system 1	6517.66	x	0.198	=	1290.50	(261)
Water heating	2780.86	x	0.198	=	550.61	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1841.11	(265)
Pumps, fans and electric keep-hot	294.47	x	0.517	=	152.24	(267)
Lighting	486.25	x	0.517	=	251.39	(268)
Energy saving/generation technologies:						
PV emission savings (negative quantity)	-1301.33	x	0.529	=	-688.41	(269)
Total carbon dioxide emissions			∑(261)...(271) =		1556.34	(272)
Dwelling carbon dioxide emissions rate			(272) ÷ (4) =		11.16	(273)
EI value					88.70	
EI rating (see section 14)					89	(274)
EI band					B	

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

	Energy kWh/year		Primary Energy Factor		Primary Energy	
Space heating - main system 1	6517.66	x	1.02	=	6648.02	(261*)
Water heating	2780.86	x	1.02	=	2836.47	(264*)
Space and water heating			(261*) + (262*) + (263*) + (264*) =		9484.49	(265*)
Pumps, fans and electric keep-hot	294.47	x	2.92	=	859.86	(267*)
Lighting	486.25	x	2.92	=	1419.85	(268*)
Energy saving/generation technologies:						
PV primary energy savings (negative quantity)	-1301.33	x	2.92	=	-3799.90	(269*)
Total primary energy kWh/year			∑(261*)...(271*) =		7964.31	(272*)
Primary energy kWh/m2/year			(272*) ÷ (4) =		57.09	(273*)

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Code for Sustainable Homes for Multiple Dwellings

Energy averaging for the Code for Sustainable Homes Ene 1 and Ene 2 is permitted where a building contains multiple dwellings. For Ene 1 the area weighted average DER and TER must be calculated in accordance with the block averaging methodology defined in clauses 4.6 and 4.14 of the ADL1A. For apartment blocks it is acceptable to assess Ene 2 based on area weighted average FEE. The area weighted FEE must be calculated in accordance with the methodology defined in clause 4.6 of ADL1A. The use of energy averaging to assess performance against Ene 2 is at the discretion of the developer and Assessor.

Assessor name	Mr Stuart Searle	Assessor number	2435
		Created	01/02/2013

Energy Averaging

URN	Vrs	Address	Built Form	DER	TER	FEE	Floor Area (m^2)	DER x Floor Area	TER x Floor Area
13-010-09 Planning	1	P09 4 St Augustines	Flat	11.93	17.69	60.8	139.50	1664.24	2467.76
13-010-08 Planning	1	P08 4 St Augustines	Flat	10.55	15.26	41.3	95.50	1007.53	1457.33
13-010-07 Planning	1	P07 4 St Augustines	Flat	9.95	15.66	42.0	106.50	1059.68	1667.79
13-010-06 Planning	1	P06 4 St Augustines	Flat	10.53	15.03	41.7	95.50	1005.61	1435.37
13-010-05 Planning	1	P05 4 St Augustines	Flat	9.58	15.02	40.4	106.50	1020.27	1599.63
13-010-04 Planning	1	P04 4 St Augustines	Flat	12.12	15.73	45.6	80.00	969.60	1258.40
13-010-03 Planning	1	P03 4 St Augustines	Flat	9.57	14.98	40.8	107.00	1023.99	1602.86
13-010-02 Planning	1	P02 4 St Augustines	Flat	13.69	18.82	53.8	80.00	1095.20	1505.60
13-010-01 Planning	1	P01 4 St Augustines	Flat	10.82	17.77	48.1	109.50	1184.79	1945.82
						Total	**920.00**	**10030.91**	**14940.56**

Multiple dwelling DER = 10.90

Multiple dwelling TER = 16.24

Multiple dwelling FEE = 46.5

Ene 1 Results

Ene 1 using energy averaging = 32.9 % improvement*

3.7 credits

*100 x (1 - (DER/TER))

Ene 2 Results

Mid terrace and apartment blocks

Number of dwellings of this type = 9

FEE using energy averaging = 46.5

credits = 3.5

End terrace, semi-detached and detached

Number of dwellings of this type = 0

Ene 2 credits using energy averaging for all dwelling types = 3.5

(Flats-MidTerrace-TFA x Flats-MidTerrace-Credits) + (Detached-Semi-TFA x Detached-Semi-Credits) / (TFA-All-Dwellings)

(920 x 3.5) + (0 x 0) / (920)