Energy Statement

For

Barrett Lloyd Davis Associates Ltd.

Project:

1 Norfolk Road, Camden, NW8

September 2012 V3.1

TABLE OF CONTENTS

1 Energy Statement

1.1 Background to statement

There is a requirement for an Energy Statement to be submitted with planning documents for the following project:

Development of a detached house at 1 Norfolk Road, Camden, London, NW8 6AX.

This energy statement has been prepared, according to the guidelines published by London Borough of Camden.

This statement fulfills all the requirements of Camden Planning Guidance, in particular CPG 2.6, CPG 3.2, CPG 3.21, CPG 3.12.

The related SAP calculations have been carried out by an NHER Registered SAP assessor.

1.2 About this document

This report has been written by Steven Knight of Code Consultancy Services Ltd, who is an NHER registered SAP Assessor, with input from Tasc Building Services Engineering Ltd and Edward Pearce LLP.

The brief was provided by Neil Carr of Barrett Lloyd Davis Associates.

For further clarification of any details in this proposal or to discuss any related issues, please contact:

Steven Knight: M: 07768 814554 T: 0207 608 5524

Email: steven@codeconsultancy.co.uk

145 St John Street, London EC1V 4PW

2 Code for Sustainable Homes – Level 5

This development is required to meet the Code for Sustainable Homes (version November 2010) level 5, which means there are mandatory threshold requirements for both Ene 1: Energy and Carbon Dioxide emissions and Ene 2: Fabric Energy Efficiency.

SAP calculations must be done to satisfy Building regulations AD L1A, using SAP 2009.

2.1 Ene 1: Energy and Carbon Dioxide emissions

To reach Code Level 5, a 100% improvement in dwelling emission rate (DER) over the target emission rate (TER) is required.

2.2 Ene 2: Fabric Energy Efficiency.

To reach Code Level 5, for a detached house, the Fabric Energy Efficiency must be 46 kWh/m^2/year or less.

3 Camden Planning Guidance (CPG) requirements

3.1 Policy section 2.6: Energy Statement requirements

- Baseline Energy demand and CO2 emissions
- Reduce Demand for energy
- Supply energy efficiently
- Use renewable energy
- Conclusion

3.2 Policy section 3.20 Minimising CO2 Emissions

A 25% reduction in CO2 emissions is required from the 2010 building regulations.

3.3 Policy section 3.21/2 Building Fabric Standards

Fabric performance minimum required is shown below

Fabric element	Minimum Requirement
External wall - u value	0.20
Roof - u value	0.13
Floor - u value	0.20
Windows - u values	1.50 British Fenestration Rating Council band B or better
Doors - u value	1.00 (solid), 1.50 (glazed)
Air tightness	3.00 (m3/h.m2 at 50 Pa)
Proportion of energy efficient lighting	100%
Code for Sustainable Homes	Developments should achieve 50% of the un-weighted credits in the Energy category

4 Baseline Case

The baseline case is based on a standard case SAP as defined in the Code Ene 7, Table Cat 1.2.

This provides the baseline reference for the reductions predicted when the specification is improved.

4.1 Baseline Specification Summary

The baseline specification (see Code for Sustainable Homes Table Cat 1.2 for full specification)
Actual construction as shown on the plans submitted with the planning application
Mains Gas
Boiler (88% efficiency) and radiators
Heating controls: Programmer, room thermostats, TRV's, Boiler interlock
Stored hot water – cylinder 150 litre, insulated with 35mm foam
Primary pipework insulated

4.2 Baseline energy consumption – Regulated and non-regulated

The baseline total energy demand for both regulated and unregulated energy is **119,384.25 kWh/yr.**

4.3 Baseline CO_2 emissions

The baseline Total CO2 emissions are **23,560.41 kgCO2/yr.**

4.4 **Unregulated energy calculations**

The non-regulated energy from appliances has been calculated from the following:

Kg CO_2/year from appliances and cooking. See Ene 1:

$$99.9 \times (TFA \times N)^{0.4714} - (3.267 \times TFA) + (32.23 \times N) + 72.6$$

Where TFA = Total Floor area and N = Number of Occupants

For TFA < 43 m^2; N = 1.46

TFA ≥ 43 m^2; $N = 2.844 \times (1 - \exp(-0.000391 \times TFA^2))$

The NHER calculator tool was used for this calculation.

The table below shows the calculations, with figures taken from the SAP sheet and NHER calculator.

Baseline Demand	Total Energy Demand (kWh/yr)	Associated Total CO2 emissions (kgCO2/yr)
Hot water	3,343.06	661.93
Space Heating	70,152.68	13,890.23
Fixed Electrical	2,657.99	1,374.18
Appliances / Non- regulated	14,766.09	7,634.07
Other energy consumption	0.00	0.00
TOTAL - Baseline case for house	90,919.82	23,560.41

This assumes the following SAP input values

External walls: U value = 0.14 W/m^2K
Ground Floor: U value = 0.10 W/m^2K
Roof: U value = 0.10 W/m^2K
Windows double glazed U value = 1.2 W/m^2K

100% low energy lights

Air permeability q50 (M^3/hour/m^2) = 3.0

Other values as per standard case SAP.

5 Proposed Build

The proposed build improves the performance, to achieve at least 20% reduction in CO2 emissions compared with the baseline case. This follows the energy hierarchy in the council's guidelines:
1st Using less energy – via fabric improvements and heat recovery
2nd Supplying energy efficiently – high efficiency systems and appliances
3rd Using renewable energy

The highest priority is given to Number 1 in the energy hierarchy 'Using less energy' as can be seen in the approach to the proposed specification.

5.1 Proposed Specification Summary – Energy Efficiency measures

Fabric enhancement

External walls:	U value = 0.14 W/m^{2}K
Ground Floor:	U value = 0.10 W/m^{2}K
Roof:	U value = 0.10 W/m^{2}K
Windows double glazed	U value = 1.2 W/m^{2}K

Air permeability q50 (M^3/hour/m^2) = 3.0

Heating systems
Biomass Boiler, Air source Heat Pump, gas hot water boiler, secondary wood burner

Heat recovery Technology
Mechanical Ventilation Heat recovery
Shower Heat recovery – Waste Water Heat recovery (2no. Units)

Renewable Energy
Solar PV panels will be installed on the roof

The energy hierarchy has been followed with the fabric first being enhanced to the highest practical performance level for this type of dwelling, then all means of heat recovery implemented, then renewables added to the maximum available roof space.

5.2 **Predicted Energy Consumption -** Regulated and non-regulated

The predicted energy consumption for the house is **71,216.94 kWh/yr**. This includes both regulated and non-regulated energy.

5.3 Predicted Total CO_2 emissions

The predicted Total CO2 emissions are **7,054.69 kgCO2/yr**

5.4 **Predicted CO_2 emissions reductions**

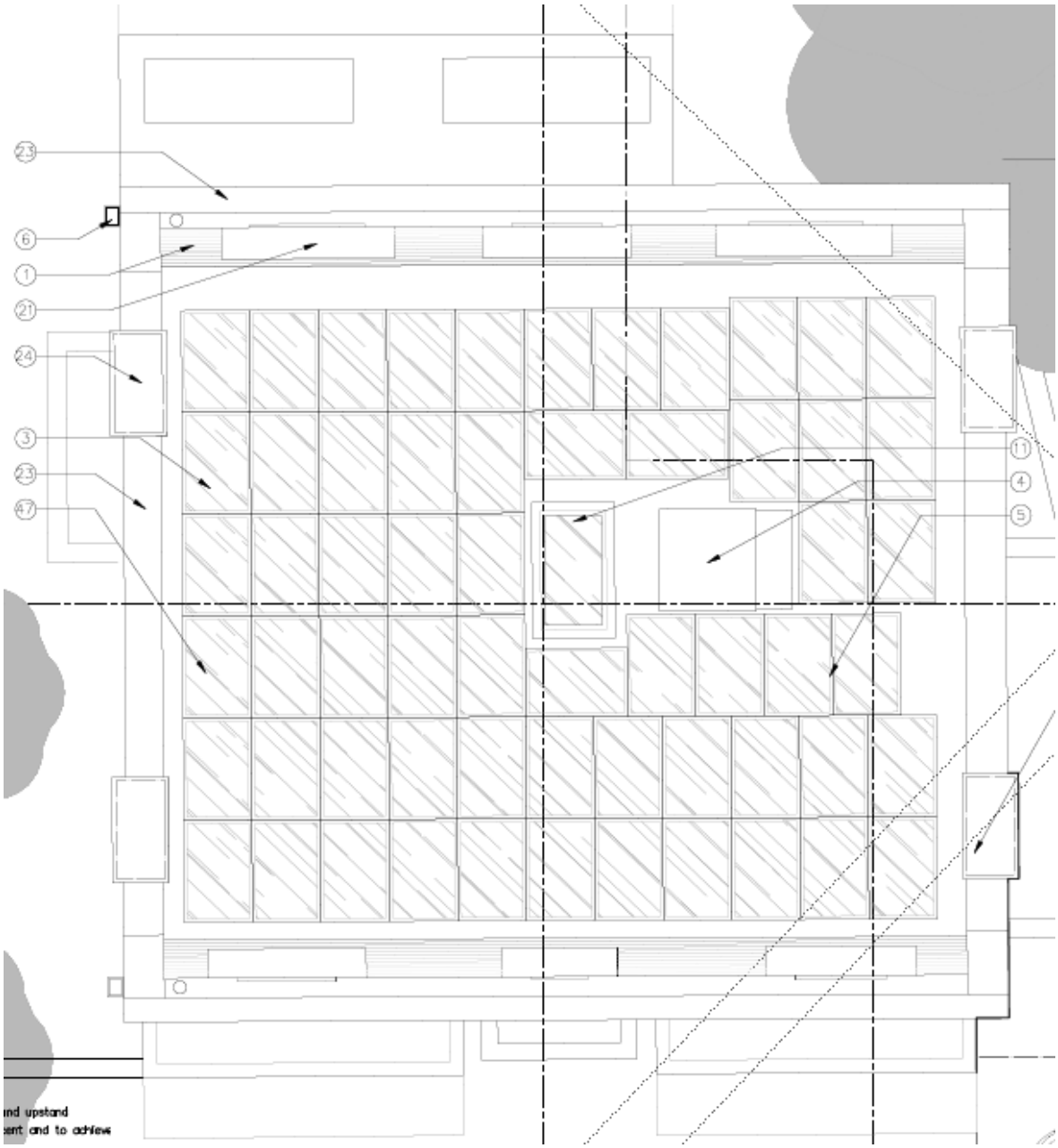
The predicted Total CO2 emissions reductions below the baseline case are 16,505 kgCO2/yr. **This represents a reduction of 70.06 % from the baseline case.**

5.5 Renewable Energy – Roof plan

The maximum available roof area for installation of solar PV panels is approximately 95 m2.

The roof is flat (very slight pitch), and is South West facing.

The plan below shows the roof area available. (excerpt from Roof Plan P205 PB)



6 Summary Tables - Baseline Energy Demand & CO2 Emissions Reductions

6.1 Summary of baseline energy demand

Baseline Demand	Total Energy Demand (kWh/yr)	Associated Total CO2 emissions (kgCO2/yr)
Hot water	3,343.06	661.93
Space Heating	70,152.68	13,890.23
Fixed Electrical	2,657.99	1,374.18
Appliances / Non- regulated	14,766.09	7,634.07
Other energy consumption	0.00	0.00
TOTAL - Baseline case for house	90,919.82	23,560.41

6.2 Summary of predicted energy demand/CO2 emissions

	Total Energy Demand (kWh/yr)	Associated Total CO2 emissions (kgCO2/yr)
Hot water (gas)	4,080.03	807.85
Space Heating 1 (biomass)	36,034.76	1,008.97
Space Heating 2 (Heat Pump)	1,441.39	745.20
Space Heating 3 (log burner)	5,719.80	45.76
Fixed Electrical	9,211.15	4,762.16
Appliances / Non- regulated	14,729.81	7,615.31
PV generation	-14,991.60	-7,930.56
Other energy consumption	0.00	
TOTAL - predicted for house	56,225.34	7,054.69

6.3 Summary of CO2 emissions reductions

Summary of reductions	Total CO_2 emissions ($kgCO_2$/year)
Baseline emissions	23,560.41
Improved emissions (after Fabric, energy efficiency, renewables)	7,054.69
% CO2 displaced in total	70.06%
% CO2 displaced by renewable energy	33.66%

7 Conclusion

This statement fulfills all the requirements of Camden Planning Guidance, in particular CPG 2.6, CPG 3.2, CPG 3.21, CPG 3.12.

The baseline CO2 emissions for this dwelling are **23,560.41** kgCO2/year, which are reduced to **7,054.69** kgCO2/year once the improvements have been made.

A 25% reduction in CO2 emissions is required from the 2010 building regulations to meet the CPG and this house exceeds this by a large margin to achieve 70.06 % $C0_2$ reductions.

The energy hierarchy has been followed with the fabric first being enhanced to the highest practical performance level for this type of dwelling, then all means of heat recovery implemented, then renewables added to the maximum available roof space.

Fabric enhancement

Fabric element	Minimum Requirement	Achieved by proposed design	Complies with CPG?
External wall - u value	0.20	0.14 W/m^2K	**Yes** ✓
Roof - u value	0.13	0.10 W/m^2K	**Yes** ✓
Floor - u value	0.20	0.10 W/m^2K	**Yes** ✓
Windows - u values	1.50 British Fenestration Rating Council band B or better	1.2 W/m^2K	**Yes** ✓
Doors - u value	1.00 (solid), 1.50 (glazed)	1.0 (solid), 1.2 (glazed) W/m^2K	**Yes** ✓
Air tightness	3.00 (m3/h.m2 at 50 Pa)	3.00 (m3/h.m2 at 50 Pa)	**Yes** ✓
Proportion of energy efficient lighting	100%	100%	**Yes** ✓
Code for Sustainable Homes	Developments to achieve 50% of the Energy credits	96% of credits achieved in Energy Category	**Yes** ✓

This fabric enhancement, exceeds the minimum required in policy CPG 3.21/2.

Over 50% of the credits are achieved in the energy category of the Code as required. A total of 96% achieved.

Air permeability q50 (M3/hour/m2) = 3.0 which meets the required standard.

Heating systems
Biomass Pellet Boiler (main system), Air source Heat Pump , Gas Boiler, secondary wood burner

Heat recovery Technology
Mechanical Ventilation Heat recovery
Shower Heat recovery – Waste Water Heat recovery (2no. Units)

Renewable Energy
Solar PV panels will be installed on the roof giving a peak power of 19.5 kwp.

8 Appendices

8.1 SAP Calculations – Baseline and Actual

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 Steven Knight	Assessor number	1641
Client		Last modified	21/09/2012
Address	1 Norfolk Road, St Johns Wood, London		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		484.47	(1a)	x	2.95	(2a)	=	1429.19	(3a)
+1		484.47	(1b)	x	3.50	(2b)	=	1695.64	(3b)
+2		238.14	(1c)	x	3.40	(2c)	=	809.68	(3c)
+3		238.14	(1d)	x	3.15	(2d)	=	750.14	(3d)
+4		179.05	(1e)	x	2.95	(2e)	=	528.20	(3e)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	1624.27	(4)						
Dwelling volume						(3a) + (3b) + (3c) + (3d)...(3n) =		5212.85	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	2	x 20 =	40	(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) =	40	÷ (5) =	0.01	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.16	(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) =	0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table 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	0.18	0.17	0.17	0.15	0.14	0.13	0.12	0.12	0.14	0.15	0.16	0.17	

∑(22b)1...12 =	1.81	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	N/A	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)), otherwise (23b) = (23a)	N/A	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	N/A	(23c)

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

if (22b)m ≥ 1, then (24d)m = (22b)m; otherwise (24d)m = 0.5 + [(22b)m2 x 0.5]

(24d)m	0.52	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	(24d)

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

(25)m	0.52	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	(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	
Window*			90.41	x	1.15	=	103.52	N/A	N/A	(27)
Doors			1.89	x	1.00	=	1.89	N/A	N/A	(26)
Roof window*			7.75	x	1.15	=	8.87	N/A	N/A	(27a)
Basement floor			484.47	x	0.10	=	48.45	N/A	N/A	(28)
External wall			788.80	x	0.14	=	110.43	N/A	N/A	(29a)
Roof			575.35	x	0.10	=	57.54	N/A	N/A	(30)
Total area of external elements ∑A, m²			1948.67	(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) =	330.70 (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		194.87 (36)
if details of thermal bridging are not known then (36) = 0.15 x (31)		
Total fabric heat loss	(33) + (36) =	525.57 (37)

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

(38)m	888.28	885.23	885.23	879.67	876.35	874.81	873.34	873.34	877.15	879.67	882.37	885.23	(38)

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

(39)m	1413.84	1410.80	1410.80	1405.24	1401.92	1400.37	1398.91	1398.91	1402.72	1405.24	1407.93	1410.80	

Average = ∑(39)1...12/12 = 1405.62 (39)

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

(40)m	0.87	0.87	0.87	0.87	0.86	0.86	0.86	0.86	0.86	0.87	0.87	0.87	

Average = ∑(40)1...12/12 = 0.87 (40)

4. Water heating energy requirement

kWh/year

Assumed occupancy, N 4.85 (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) + 36 149.47 (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	164.42	158.44	152.46	146.48	140.50	134.52	134.52	140.50	146.48	152.46	158.44	164.42	

											∑(44)1...12 =	1793.64	(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	244.41	213.76	220.58	192.31	184.53	159.23	147.55	169.32	171.34	199.68	217.97	236.70	
											∑(45)1...12 =	2357.37	(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	36.66	32.06	33.09	28.85	27.68	23.88	22.13	25.40	25.70	29.95	32.69	35.50	(46)

Water storage loss:

Cylinder volume (litres) including any solar storage within same cylinder	0	(50)
Energy lost from water storage, kWh/day (50) x (51) x (52) x (53)	0.00	(54)
Enter (49) or (54) in (55)	0.00	(55)

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

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

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

(57)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	(57)

Primary circuit loss (annual) from Table 3 0.00 (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	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)

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

(61)m	50.79	45.79	50.48	48.58	50.02	48.15	49.53	49.82	48.31	50.21	48.91	50.69	(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	295.20	259.55	271.07	240.89	234.54	207.38	197.09	219.14	219.65	249.89	266.88	287.39	(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	295.20	259.55	271.07	240.89	234.54	207.38	197.09	219.14	219.65	249.89	266.88	287.39	
											∑(64)1...12 =	2948.66	(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	93.96	82.52	85.96	76.09	73.86	64.98	61.44	68.75	69.05	78.95	84.70	91.38	(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	291.21	291.21	291.21	291.21	291.21	291.21	291.21	291.21	291.21	291.21	291.21	291.21	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m	351.49	312.19	253.89	192.21	143.68	121.30	131.07	170.37	228.67	290.35	338.88	361.26	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m	1864.28	1883.62	1834.87	1731.09	1600.08	1476.96	1394.70	1375.35	1424.10	1527.89	1658.89	1782.02	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m	68.97	68.97	68.97	68.97	68.97	68.97	68.97	68.97	68.97	68.97	68.97	68.97	(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	-194.14	-194.14	-194.14	-194.14	-194.14	-194.14	-194.14	-194.14	-194.14	-194.14	-194.14	-194.14	(71)
Water heating gains (Table 5)													
(72)m	126.30	122.80	115.54	105.68	99.27	90.25	82.59	92.41	95.90	106.11	117.64	122.82	(72)

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

(73)m	2518.11	2494.66	2380.35	2205.03	2019.08	1864.56	1784.40	1814.18	1924.72	2100.39	2291.46	2442.14	(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)	
North	0.77	x	22.88	x	10.73	x	0.63	x	1.00	=	119.05	(74)
South	0.77	x	10.11	x	47.32	x	0.63	x	1.00	=	232.09	(78)
Rooflights	1.00	x	7.75	x	26.00	x	0.63	x	1.00	=	126.94	(82)
Southeast	0.77	x	36.85	x	37.39	x	0.63	x	1.00	=	668.34	(77)
Northwest	0.77	x	15.97	x	11.51	x	0.63	x	1.00	=	89.17	(81)
East	0.77	x	1.40	x	19.87	x	0.63	x	1.00	=	13.50	(76)
West	0.77	x	3.20	x	19.87	x	0.63	x	1.00	=	30.85	(80)

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

(83)m	1279.94	2275.91	3252.30	4433.51	5264.47	5519.60	5338.71	4679.61	3734.63	2653.26	1551.77	1082.58	(83)

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

(84)m	3798.05	4770.57	5632.65	6638.54	7283.56	7384.16	7123.11	6493.79	5659.35	4753.65	3843.23	3524.72	(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	1.00	0.99	0.99	0.97	0.92	0.83	0.67	0.71	0.91	0.98	1.00	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)													
(87)m	18.62	18.83	19.24	19.68	20.23	20.65	20.88	20.86	20.48	19.82	19.06	18.66	(87)
Temperature during heating periods in the living area from Table 9, Th2(˚C)													
(88)m	20.19	20.20	20.20	20.20	20.20	20.20	20.20	20.20	20.20	20.20	20.20	20.20	(88)
Utilisation factor for gains for rest of dwelling η2,m (see Table 9a)													
(89)m	1.00	0.99	0.98	0.96	0.91	0.78	0.58	0.62	0.88	0.97	0.99	1.00	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)													
(90)m	17.95	18.16	18.57	19.01	19.55	19.95	20.14	20.13	19.80	19.15	18.40	17.99	(90)

Living area fraction fLA 38.98 ÷ (4) = 0.02 (91)

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2													
(92)m	17.97	18.18	18.58	19.02	19.57	19.96	20.16	20.15	19.81	19.17	18.41	18.01	(92)
Apply adjustment to the mean internal temperature from Table 4e, where appropriate													
(93)m	17.82	18.03	18.43	18.87	19.42	19.81	20.01	20.00	19.66	19.02	18.26	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	0.99	0.99	0.98	0.95	0.88	0.75	0.55	0.59	0.85	0.96	0.99	1.00	(94)
Useful gains, ηmGm, W = (94)m x (84)m													
(95)m	3777.74	4718.67	5501.23	6304.89	6432.80	5572.56	3938.01	3836.02	4832.36	4576.95	3808.97	3508.30	(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	18830.49	18377.25	16413.04	14295.25	10817.43	7302.21	4348.99	4330.72	7523.19	11547.74	15857.58	18283.88	(97)

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

(98)m	11199.25	9178.57	8118.39	5753.06	3262.16	0.00	0.00	0.00	0.00	5186.27	8675.00	10993.03

Total per year (kWh/year) = ∑(98)1...5, 10...12 = 62365.73 (98)

Space heating requirement in kWh/m²/year (98) ÷ (4) 38.40 (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 (%)	88.90	(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	11199.25	9178.57	8118.39	5753.06	3262.16	0.00	0.00	0.00	0.00	5186.27	8675.00	10993.03
Space heating fuel (main heating system 1), kWh/month = (98)m x (204) x 100 ÷ (206)												
(211)m	12597.58	10324.60	9132.04	6471.38	3669.48	0.00	0.00	0.00	0.00	5833.82	9758.16	12365.61

Total per year (kWh/year) = ∑(211)1...5, 10...12 = 70152.68 (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	295.20	259.55	271.07	240.89	234.54	207.38	197.09	219.14	219.65	249.89	266.88	287.39
Efficiency of water heater per month												
(217)m	88.84	88.84	88.83	88.81	88.75	86.70	86.70	86.70	86.70	88.80	88.83	88.84
Fuel for water heating, kWh/month = (64)m x 100 ÷ (217)m												
(219)m	332.28	292.16	305.16	271.24	264.27	239.19	227.32	252.75	253.34	281.42	300.43	323.48

∑(64)1...12 = 2948.66 (64)

Total per year (kWh/year) = ∑(219)1...12 = 3343.06 (219)

Annual Totals Summary:	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		70152.68	(211)
Water heating fuel used		3343.06	(219)
Electricity for pumps, fans and electric keep-hot (Table 4f):			
mechanical ventilation fans - balanced, extract or positive input from outside	0.00		(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)	175.00	(231)
Electricity for lighting (calculated in Appendix L):		2482.99	(232)

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

	Fuel kWh/year		**Fuel price (Table 12)**		**Fuel cost £/year**	
Space heating - main system 1	70152.68	x	3.10	x 0.01 =	2174.73	(240)
Water heating cost (other fuel)	3343.06	x	3.10	x 0.01 =	103.63	(247)
Pumps, fans and electric keep-hot	175.00	x	11.46	x 0.01 =	20.06	(249)
Energy for lighting	2482.99	x	11.46	x 0.01 =	284.55	(250)

Additional standing charges (Table 12)		106.00	(251)
Total energy cost	(240)...(242) + (245)...(254)	2688.97	(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] =	0.76	(257)
SAP value		89.44	
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	70152.68	x	0.198	=	13890.23	(261)
Water heating	3343.06	x	0.198	=	661.93	(264)
Space and water heating			(261) + (262) + (263) + (264) =		14552.16	(265)
Pumps, fans and electric keep-hot	175.00	x	0.517	=	90.48	(267)
Lighting	2482.99	x	0.517	=	1283.71	(268)
Total carbon dioxide emissions			∑(261)...(271) =		15926.34	(272)
Dwelling carbon dioxide emissions rate			(272) ÷ (4) =		9.81	(273)
EI value					87.22	
EI rating (see section 14)					87	(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	70152.68	x	1.02	=	71555.73	(261*)
Water heating	3343.06	x	1.02	=	3409.92	(264*)
Space and water heating			(261*) + (262*) + (263*) + (264*) =		74965.65	(265*)
Pumps, fans and electric keep-hot	175.00	x	2.92	=	511.00	(267*)
Lighting	2482.99	x	2.92	=	7250.33	(268*)
Total primary energy kWh/year			∑(261*)...(271*) =		82726.98	(272*)
Primary energy kWh/m2/year			(272*) ÷ (4) =		50.93	(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 Steven Knight	Assessor number	1641
Client		Last modified	21/09/2012
Address	1 Norfolk Road, St Johns Wood, London		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		484.47	(1a)	x	2.95	(2a)	=	1429.19	(3a)
+1		484.47	(1b)	x	3.50	(2b)	=	1695.64	(3b)
+2		238.14	(1c)	x	3.40	(2c)	=	809.68	(3c)
+3		238.14	(1d)	x	3.15	(2d)	=	750.14	(3d)
+4		179.05	(1e)	x	2.95	(2e)	=	528.20	(3e)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	1624.27	(4)						
Dwelling volume						(3a) + (3b) + (3c) + (3d)...(3n) =		5212.85	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	2	x 20 =	40	(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) =	40	÷ (5) =	0.01	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area	3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)	0.16	(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) = 0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table 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	0.18	0.17	0.17	0.15	0.14	0.13	0.12	0.12	0.14	0.15	0.16	0.17	

∑(22b)1...12 =	1.81	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If exhaust air heat pump using Appendix N, (23b) = (23a) × Fmv (equation (N5)), otherwise (23b) = (23a)	0.50	(23b)
If balanced with heat recovery: efficiency in % allowing for in-use factor (from Table 4h) =	75.65	(23c)

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

(24a)m	0.30	0.29	0.29	0.27	0.26	0.25	0.25	0.25	0.26	0.27	0.28	0.29	(24a)

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

(25)m	0.30	0.29	0.29	0.27	0.26	0.25	0.25	0.25	0.26	0.27	0.28	0.29	(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	
Window*			90.41	x	1.15	=	103.52	N/A	N/A	(27)
Doors			1.89	x	1.00	=	1.89	N/A	N/A	(26)
Roof window*			7.75	x	1.15	=	8.87	N/A	N/A	(27a)
Basement floor			484.47	x	0.10	=	48.45	N/A	N/A	(28)
External wall			788.80	x	0.14	=	110.43	N/A	N/A	(29a)
Roof			575.35	x	0.10	=	57.54	N/A	N/A	(30)
Total area of external elements ∑A, m²			1948.67	(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) =	330.70 (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		194.87 (36)
if details of thermal bridging are not known then (36) = 0.15 x (31)		
Total fabric heat loss	(33) + (36) =	525.57 (37)

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

(38)m	520.68	503.39	503.39	468.81	445.75	434.23	422.70	422.70	451.52	468.81	486.10	503.39	(38)

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

(39)m	1046.25	1028.96	1028.96	994.38	971.32	959.79	948.27	948.27	977.09	994.38	1011.67	1028.96	

Average = ∑(39)1...12/12 = 994.86 (39)

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

(40)m	0.64	0.63	0.63	0.61	0.60	0.59	0.58	0.58	0.60	0.61	0.62	0.63	

Average = ∑(40)1...12/12 = 0.61 (40)

4. Water heating energy requirement

	kWh/year	
Assumed occupancy, N	4.85	(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	149.47	(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	164.42	158.44	152.46	146.48	140.50	134.52	134.52	140.50	146.48	152.46	158.44	164.42	

∑(44)1...12 = 1793.64 (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	244.41	213.76	220.58	192.31	184.53	159.23	147.55	169.32	171.34	199.68	217.97	236.70	

∑(45)1...12 = 2357.37 (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	36.66	32.06	33.09	28.85	27.68	23.88	22.13	25.40	25.70	29.95	32.69	35.50	(46)

Water storage loss:

a) If manufacturer's declared loss factor is known (kWh/day): 3.00 (47)

Temperature factor from Table 2b 0.60 (48)

Energy lost from water storage, kWh/day (47) x (48) 1.80 (49)

Enter (49) or (54) in (55) 1.80 (55)

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

(56)m	55.80	50.40	55.80	54.00	55.80	54.00	55.80	55.80	54.00	55.80	54.00	55.80	(56)

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

(57)m	55.80	50.40	55.80	54.00	55.80	54.00	55.80	55.80	54.00	55.80	54.00	55.80	(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	330.78	291.78	306.96	275.90	270.90	242.82	233.93	255.69	254.93	286.06	301.56	323.07	(62)

Waste water heat recovery input calculated using Appendix G (negative quantity)

(S)m	-79.97	-70.35	-71.89	-59.36	-55.23	-45.78	-39.13	-47.00	-48.34	-59.41	-68.50	-77.39	

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	250.81	221.43	235.06	216.54	215.67	197.04	194.80	208.69	206.59	226.64	233.06	245.68	

∑(64)1...12 = 2652.02 (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	150.37	133.49	142.44	130.81	130.46	119.82	118.16	125.40	123.84	135.49	139.35	147.80	(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	291.21	291.21	291.21	291.21	291.21	291.21	291.21	291.21	291.21	291.21	291.21	291.21	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5													
(67)m	351.49	312.19	253.89	192.21	143.68	121.30	131.07	170.37	228.67	290.35	338.88	361.26	(67)
Appliances gains (calculated in Appendix L, equation L13 or L13a), also see Table 5													
(68)m	1864.28	1883.62	1834.87	1731.09	1600.08	1476.96	1394.70	1375.35	1424.10	1527.89	1658.89	1782.02	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5													
(69)m	68.97	68.97	68.97	68.97	68.97	68.97	68.97	68.97	68.97	68.97	68.97	68.97	(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	-194.14	-194.14	-194.14	-194.14	-194.14	-194.14	-194.14	-194.14	-194.14	-194.14	-194.14	-194.14	(71)

Water heating gains (Table 5)

(72)m	202.11	198.64	191.46	181.69	175.34	166.41	158.82	168.55	172.00	182.12	193.53	198.66	(72)

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

(73)m	2593.92	2570.50	2456.27	2281.03	2095.15	1940.71	1860.63	1890.32	2000.82	2176.40	2367.35	2517.99	(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)	
North	0.77	x	22.88	x	10.73	x	0.63	x	1.00	=	119.05	(74)
South	0.77	x	10.11	x	47.32	x	0.63	x	1.00	=	232.09	(78)
Rooflights	1.00	x	7.75	x	26.00	x	0.63	x	1.00	=	126.94	(82)
Southeast	0.77	x	36.85	x	37.39	x	0.63	x	1.00	=	668.34	(77)
Northwest	0.77	x	15.97	x	11.51	x	0.63	x	1.00	=	89.17	(81)
East	0.77	x	1.40	x	19.87	x	0.63	x	1.00	=	13.50	(76)
West	0.77	x	3.20	x	19.87	x	0.63	x	1.00	=	30.85	(80)

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

(83)m	1279.94	2275.91	3252.30	4433.51	5264.47	5519.60	5338.71	4679.61	3734.63	2653.26	1551.77	1082.58	(83)

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

(84)m	3873.86	4846.41	5708.56	6714.55	7359.63	7460.32	7199.35	6569.93	5735.45	4829.66	3919.12	3600.56	(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	1.00	0.99	0.98	0.96	0.88	0.72	0.52	0.56	0.85	0.97	1.00	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)													
(87)m	19.59	19.76	20.03	20.34	20.67	20.86	20.92	20.92	20.76	20.38	19.90	19.63	(87)
Temperature during heating periods in the living area from Table 9, Th2(˚C)													
(88)m	20.39	20.40	20.40	20.42	20.43	20.44	20.45	20.45	20.43	20.42	20.41	20.40	(88)
Utilisation factor for gains for rest of dwelling η2,m (see Table 9a)													
(89)m	1.00	0.99	0.98	0.95	0.86	0.68	0.46	0.50	0.82	0.97	0.99	1.00	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)													
(90)m	18.42	18.68	19.07	19.54	20.01	20.26	20.34	20.33	20.14	19.59	18.88	18.48	(90)

Living area fraction fLA 38.98 ÷ (4) = 0.02 (91)

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

(92)m	18.45	18.70	19.09	19.56	20.03	20.27	20.35	20.35	20.16	19.61	18.91	18.51	(92)

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

(93)m	18.30	18.55	18.94	19.41	19.88	20.12	20.20	20.20	20.01	19.46	18.76	18.36	(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, ?m

(94)m	1.00	0.99	0.97	0.94	0.83	0.65	0.43	0.46	0.79	0.95	0.99	1.00	(94)

Useful gains, ?mGm, W = (94)m x (84)m

(95)m	3856.50	4796.11	5561.83	6284.41	6131.41	4849.81	3076.12	3052.14	4539.61	4611.09	3887.07	3587.04	(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	14435.38	13944.60	12489.98	10647.88	7941.38	5301.91	3131.78	3127.87	5574.54	8614.66	11892.83	13848.45	(97)

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

(98)m	7870.69	6147.79	5154.55	3141.70	1346.62	0.00	0.00	0.00	0.00	2978.66	5764.15	7634.49	

Total per year (kWh/year) = ∑(98)1...5, 10...12 = 40038.63 (98)

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

8c. Space cooling requirement

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

Calculated for June, July and August. See Table 10b.

Heat loss rate Lm (calculated using 24˚C internal temperature and external temperature from Table 10)

(100)m	0.00	0.00	0.00	0.00	0.00	8254.23	5879.25	5879.25	0.00	0.00	0.00	0.00	(100)

Utilisation factor for loss, m

(101)m	0.00	0.00	0.00	0.00	0.00	0.82	0.91	0.89	0.00	0.00	0.00	0.00	(101)

Useful loss, mLm (Watts) = (100)m x (101)m

(102)m	0.00	0.00	0.00	0.00	0.00	6790.32	5378.63	5249.98	0.00	0.00	0.00	0.00	(102)

Gains (internal gains as for heating except that column (A) of Table 5 is always used; solar gains calculated for applicable weather region based on Table 10, not Table 6a)

(103)m	0.00	0.00	0.00	0.00	0.00	8628.54	8230.25	7559.96	0.00	0.00	0.00	0.00	(103)

Space cooling requirement for the month, whole dwelling, continuous (kWh) = 0.024 x [(103)m - (102)m] x (41)m

set (104)m to zero if (104)m < 3 x (98)m with (98)m with (98)m calculated using weather data from Table 10

(104)m	0.00	0.00	0.00	0.00	0.00	1323.52	2121.60	1718.63	0.00	0.00	0.00	0.00	

Total = ∑(104)6...8 = 5163.75 (104)

Cooled fraction fc = cooled area ÷ (4) = 0.62 (105)

Intermittency factor (Table 10b)

(106)m	0.00	0.00	0.00	0.00	0.00	0.25	0.25	0.25	0.00	0.00	0.00	0.00	

Total = ∑(106)6...8 = 0.75 (106)

Space cooling requirement for month = (104)m x (105) x (106)m

(107)m	0.00	0.00	0.00	0.00	0.00	203.71	326.55	264.52	0.00	0.00	0.00	0.00	

Total = ∑(107)6...8 = 794.78 (107)

Space cooling requirement in kWh/m²/year (107) ÷ (4) = 0.49 (108)

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

Space heating:

Fraction of space heating from secondary/supplementary system (Table 11)	0.10	(201)
Fraction of space heating from main system(s) 1 - (201)	0.90	(202)
Fraction of main heating from main system 2	0.10	(203)
Fraction of total space heat from main system 1 (202) x [1 - (203)]	0.81	(204)
Fraction of total space heat from main system 2 (202) x (203)	0.09	(205)
Efficiency of main space heating system 1 (%)	90.00	(206)
(from database or Table 4a/4b, adjusted where appropriate by the amount shown in the 'space efficiency adjustment' column of Table 4c)		
Efficiency of main space heating system 2 (%)	250.00	(207)
(from database or Table 4a/4b, adjusted where appropriate by the amount shown in the 'space efficiency adjustment' column of Table 4c		
Efficiency of secondary/supplementary heating system, from Table 4a or Appendix E (%)	70.00	(208)
Cooling System Energy Efficiency Ratio (see Table 10c)	4.05	(209)

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

Space heating requirement, kWh/month (as calculated above)

(98)m	7870.69	6147.79	5154.55	3141.70	1346.62	0.00	0.00	0.00	0.00	2978.66	5764.15	7634.49	

Space heating fuel (main heating system 1), kWh/month = (98)m x (204) x 100 ÷ (206)

(211)m	7083.62	5533.01	4639.09	2827.53	1211.95	0.00	0.00	0.00	0.00	2680.79	5187.73	6871.04	

Total per year (kWh/year) = ∑(211)1...5, 10...12 = 36034.76 (211)

Space heating fuel (main heating system 2), kWh/month = (98)m x (203) x 100 ÷ (206)

(213)m	283.34	221.32	185.56	113.10	48.48	0.00	0.00	0.00	0.00	107.23	207.51	274.84

Total per year (kWh/year) = ∑(213)1...5, 10...12 = 1441.39 (213)

Space heating fuel (secondary), kWh/month = (98)m x (201) x 100 ÷ (208)

(215)m	1124.38	878.26	736.36	448.81	192.37	0.00	0.00	0.00	0.00	425.52	823.45	1090.64

Total per year (kWh/year) = ∑(215)1...5, 10...12 = 5719.80 (215)

Water heating:

Output from water heater, kWh/month (calculated above)

(64)m	250.81	221.43	235.06	216.54	215.67	197.04	194.80	208.69	206.59	226.64	233.06	245.68

∑(64)1...12 = 2652.02 (64)

Efficiency of water heater per month

(217)m	65.00	65.00	65.00	65.00	65.00	65.00	65.00	65.00	65.00	65.00	65.00	65.00

Fuel for water heating, kWh/month = (64)m x 100 ÷ (217)m

(219)m	385.87	340.66	361.64	333.14	331.80	303.14	299.69	321.06	317.83	348.68	358.55	377.97

Total per year (kWh/year) = ∑(219)1...12 = 4080.03 (219)

Space cooling

Space cooling fuel, kWh/month (107)m ÷ (209)

(221)m	0.00	0.00	0.00	0.00	0.00	50.30	80.63	65.31	0.00	0.00	0.00	0.00

Total per year (kWh/year) = ∑(221)6...8 = 196.24 (221)

Annual Totals Summary:	**kWh/year**	**kWh/year**	
Space heating fuel used, main system 1		36034.76	(211)
Space heating fuel used, main system 2		1441.39	(213)
Space heating fuel used, secondary		5719.80	(215)
Water heating fuel used		4080.03	(219)
Space cooling fuel used		196.24	(221)
Electricity for pumps, fans and electric keep-hot (Table 4f):			
mechanical ventilation fans - balanced, extract or positive input from outside	6598.16		(230a)
warm air heating system fans	0.00		(230b)
central heating pump	130.00		(230c)
oil boiler pump	0.00		(230d)
boiler flue fan	0.00		(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)	6728.16	(231)
Electricity for lighting (calculated in Appendix L):		2482.99	(232)
Energy saving/generation technologies (Appendices M, N and Q):			
Electricity generated by PVs (Appendix M) (negative quantity)		-14991.60	(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	36034.76	x	4.93	x 0.01 =	1776.51	(240)
Space heating - main system 2	1441.39	x	11.46	x 0.01 =	165.18	(241)
Space heating - secondary	5719.80	x	3.42	x 0.01 =	195.62	(242)
Water heating cost (other fuel)	4080.03	x	3.10	x 0.01 =	126.48	(247)
Space cooling	196.24	x	11.46	x 0.01 =	22.49	(248)
Pumps, fans and electric keep-hot	6728.16	x	11.46	x 0.01 =	771.05	(249)
Energy for lighting	2482.99	x	11.46	x 0.01 =	284.55	(250)
Additional standing charges (Table 12)					106.00	(251)

Energy saving/generation technologies (Appendices M, N and Q):

PV savings (negative quantity)	-14991.60	x	11.46	x 0.01 =	-1718.04	(252)
Total energy cost			(240)...(242) + (245)...(254)		1729.85	(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] =	0.49	(257)
SAP value		93.21	
SAP rating		93	(258)
SAP band		A	

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

	Energy kWh/year		Emissions Factor		Emissions (kgCO2/year)	
Space heating - main system 1	36034.76	x	0.028	=	1008.97	(261)
Space heating - main system 2	1441.39	x	0.517	=	745.20	(262)
Space heating - secondary	5719.80	x	0.008	=	45.76	(263)
Water heating	4080.03	x	0.198	=	807.85	(264)
Space and water heating			(261) + (262) + (263) + (264) =		2607.78	(265)
Space cooling	196.24	x	0.517	=	101.46	(266)
Pumps, fans and electric keep-hot	6728.16	x	0.517	=	3478.46	(267)
Lighting	2482.99	x	0.517	=	1283.71	(268)
Energy saving/generation technologies:						
PV emission savings (negative quantity)	-14991.60	x	0.529	=	-7930.56	(269)
Total carbon dioxide emissions				∑(261)...(271) =	-459.16	(272)
Dwelling carbon dioxide emissions rate				(272) ÷ (4) =	-0.28	(273)
EI value					100.37	
EI rating (see section 14)					100	(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	36034.76	x	1.20	=	43241.72	(261*)
Space heating - main system 2	1441.39	x	2.92	=	4208.86	(262*)
Space heating - secondary	5719.80	x	1.05	=	6005.79	(263*)
Water heating	4080.03	x	1.02	=	4161.63	(264*)
Space and water heating			(261*) + (262*) + (263*) + (264*) =		57618.01	(265*)
Space cooling	196.24	x	2.92	=	573.03	(266*)
Pumps, fans and electric keep-hot	6728.16	x	2.92	=	19646.23	(267*)
Lighting	2482.99	x	2.92	=	7250.33	(268*)
Energy saving/generation technologies:						
PV primary energy savings (negative quantity)	-14991.60	x	2.92	=	-43775.47	(269*)
Total primary energy kWh/year				∑(261*)...(271*) =	41312.12	(272*)
Primary energy kWh/m2/year				(272*) ÷ (4) =	25.43	(273*)