

Energy Statement

For

Barrett Lloyd Davis Associates Ltd.

Project:

1 Norfolk Road, Camden, NW8

September 2012 V3.1

TABLE OF CONTENTS

1 EN	IERGY STATEMENT	3
1.1 1.2	BACKGROUND TO STATEMENT	3 3
2 CC	DDE FOR SUSTAINABLE HOMES – LEVEL 5	4
2.1 2.2	ENE 1: ENERGY AND CARBON DIOXIDE EMISSIONS ENE 2: FABRIC ENERGY EFFICIENCY	4 4
3 CA	MDEN PLANNING GUIDANCE (CPG) REQUIREMENTS	4
3.1 3.2 3.3	POLICY SECTION 2.6: ENERGY STATEMENT REQUIREMENTS POLICY SECTION 3.20 MINIMISING CO2 EMISSIONS POLICY SECTION 3.21/2 BUILDING FABRIC STANDARDS	4 4 4
4 BA	SELINE CASE	5
4.1 4.2 4.3 4.4	$\begin{array}{l} \text{Baseline Specification Summary} \\ \text{Baseline energy consumption} & - \text{Regulated and non-regulated} \\ \text{Baseline CO}_2 \text{ emissions} \\ \text{Unregulated energy calculations} \\ \end{array}$	5 5 5 5
5 PR	OPOSED BUILD	7
5.1 5.2 5.3 5.4 5.5	$\begin{array}{l} \mbox{Proposed Specification Summary} - \mbox{Energy Efficiency measures} \dots \\ \mbox{Predicted Energy Consumption} - \mbox{Regulated and non-regulated} \dots \\ \mbox{Predicted Total CO}_2 \mbox{Emissions} \dots \\ \mbox{Predicted CO}_2 \mbox{Emissions reductions} \dots \\ \mbox{Renewable Energy} - \mbox{Roof plan} \dots \end{array}$	7 7 7 7 8
6 SU EMISS	IMMARY TABLES - BASELINE ENERGY DEMAND & CO2 SIONS REDUCTIONS	9
6.1 6.2 6.3	SUMMARY OF BASELINE ENERGY DEMAND SUMMARY OF PREDICTED ENERGY DEMAND/CO2 EMISSIONS SUMMARY OF CO2 EMISSIONS REDUCTIONS	9 9 9
7 CC	NCLUSION1	0
8 AP	PENDICES1	1
8.1	SAP CALCULATIONS – BASELINE AND ACTUAL	1

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: <u>steven@codeconsultancy.co.uk</u>

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	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 CO₂ 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<sub>2</sub>/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<sup>2</sup>; N = 1.46

TFA \ge 43 m<sup>2</sup>; N = 2.844 \times (1 - exp(-0.000391 \times TFA<sup>2</sup>))
```

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

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

 2^{nd} Supplying energy efficiently – high efficiency systems and appliances 2^{rd} Using renewable energy

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

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 CO₂ emissions

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

5.4 **Predicted CO₂ 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 CO2 emissions (kgCO2/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 % CO_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 element	Minimum Requirement	Achieved by proposed design	Complies with CPG?
External wall - u value	0.20	0.14 W/m ² K	Yes ✓
Roof - u value	0.13	0.10 W/m ² K	Yes ✓
Floor - u value	0.20	0.10 W/m ² K	Yes ✓
	1.50	1.2 W/m ² K	Yes ✓
Windows - u values	British Fenestration Rating Council band B or better		
Doors - u value	1.00 (solid), 1.50 (glazed)	1.0 (solid), 1.2 (glazed) W/m ² K	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 ✓

Fabric enhancement

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)	х	3.40	(2c)	=	809.68	(3c)
+3	[238.14] (1d)	х	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) + (3d	c) + (3d	d)(3n) =	5212.85	(5)

2. Ventilation rate

											m	³ per hour	
Number of chi	mneys								0	x 40 =	=	0	(6a)
Number of op	en flues								2	x 20 =	=	40	(6b)
Number of int	ermittent fans								0	x 10 :	=	0	(7a)
Number of pas	ssive vents								0	x 10 :	=	0	(7b)
Number of flu	eless gas fires								0	x 40 =	=	0	(7c)
											Air	changes pe hour	r
Infiltration due	e to chimneys,	flues, fans,	PSVs		(6a)	+ (6b) + (7	a) + (7b) + (7c) =	40	÷ (5)	=	0.01	(8)
lf a pressurisa	tion test has be	en carried	out or is int	ended, pro	ceed to (17	7), otherwis	e continue j	from (9) to	o (16)				
Air permeabili	ty value, q50, e	expressed in	n cubic met	res per ho	ur per squa	re metre of	f envelope a	area				3.00	(17)
If based on air	permeability v	alue, then	(18) = [(17)	÷ 20] + (8)	, otherwise	(18) = (16)						0.16	(18)
Air permeabili	ty value applies	s if a pressu	irisation tes	st has been	done, or a	design or s	pecified air	permeabi	lity is being	used			
Number of sid	es on which dw	velling is sh	eltered									2	(19)
Shelter factor									1	- [0.075 x (1	.9)] =	0.85	(20)
Adjusted infilt	ration rate									(18) x (20) =	0.13	(21)
Infiltration rat	e modified for	monthly wi	nd speed:										
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly avera	ige wind speed	from Table	e 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 (2	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 infilt	ration rate (allo	owing for sl	nelter and v	wind speed) = (21) × (2	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	7

SAP version 9.90

					2	∑(22b)112 =	1.81	(22b)
Calculate effective air change rate fo	r the applicable o	case:						
If mechanical ventilation: air chan	ge rate through	system					N/A	(23a)
If exhaust air heat pump using Ap	pendix N, (23b) =	= (23a) × Fmv (equ	ation (N5)), othe	erwise (23b) = (23	a)		N/A	(23b)
If balanced with heat recovery: ef	ficiency in % allo	wing for in-use fac	ctor (from Table	4h) =			N/A	(23c)
d) If natural ventilation or whole l if (22b)m ≥ 1, then (24d)m = (2 (24d)m 0.52 0.51	nouse positive in 22b)m; otherwise 0.51	put ventilation fro e (24d)m = 0.5 + [(2 0.51 0.51	om loft 22b)m2 x 0.5] 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 (2	25)	ł				
(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 parame	eter							
The κ-value is the heat capacity per u	init area, see Tab	le 1e.						
Element	Gross Area, m ²	Openings, m ²	Net area A, m²	U-value, W/m ² K	A x U, W/K	к-value, kJ/m².К	Ахк, 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, r	n²		1948.67 <mark>(</mark> 3	1)				
* for windows and roof windows, effe	ective window U-	value is calculated	d using formula :	1/[(1/UValue)+0.0	4] paragraph	3.2		
Fabric heat loss, W/K = ∑(A × U)					(26).	(30) + (32) =	330.70	(33)
Heat capacity Cm = Σ(A x κ)				(28)	.(30) + (32) + (32a)(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ	/m²K				Calculated	d separately =	100.00	(35)
Thermal bridges: $\Sigma(L \times \Psi)$ calculated	using Appendix k	κ.					194.87	(36)
if details of thermal bridging are r	not known then (36) = 0.15 x (31)						
Total fabric heat loss						(33) + (36) =	525.57	(37)
Ventilation heat loss calculated mont	thly 0.33 x (25)r	n x (5)						_
(38)m 888.28 885.2	.3 885.23	879.67 876.35	874.81 8	73.34 873.34	877.15	879.67 882.3	7 885.23	(38)
Heat transfer coefficient, W/K (37)n	n + (38)m				1			-
(39)m <u>1413.84 1410.</u> 8	80 1410.80 1	1405.24 1401.92	2 1400.37 13	398.91 1398.91	1402.72	1405.24 1407.9	93 1410.80	
Heat loss parameter (HLP), W/m ² K ((39)m ÷ (4)				Average = $\sum_{i=1}^{n} (3i)$	39)112/12 =	1405.62	(39)
(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 = ∑(4	40)112/12 =	0.87	(40)
4. Water heating energy requireme	ent							
							kWh/year	
Assumed occupancy, N					Γ	4.85 (4	12)	
If TFA > 13.9, N = 1 + 1.76 x [1 - ex	xp(-0.000349 x (T	FA - 13.9)²)] + 0.00	013 x (TFA - 13.9)				
If TFA ≤ 13.9, N = 1								
Annual average hot water usage in li	tres per day Vd,a	verage = (25 x N) -	+ 36		Γ	149.47 (4	13)	
Annual average hot water usage has	been reduced by	5% if the dwelling	g is designed to a	achieve a water us	e target of no	t more than 125	litres	
per person per day (all water use, ho	t and cold)							
Jan Feb	Mar	Apr May	Jun	Jul Aug	Sep	Oct Nov	Dec	
Hot water usage in litres per day for (44)m 164.42 158.4	each month Vd,r	n = factor from Tal	ble 1c x (43)	34.52 140.50	146.48	152.46 158.4	4 164.42	7
. ,						200.1		

SAP version 9.90

										∑(44)1	12 =	1793.64	(44)
Energy content of	hot water	used - calcu	lated mon	thly = 4.190) x Vd,m x r	nm x Tm/36	500 kWh/i	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	7
											12 = 2	2357.37	_ (45)
lf instantaneous v	vater heatir	na at point (of use (no h	ot water st	toraae), ent	ter 0 in box	es (46) to (6	51)		2. /			_ · ·
For community he	eatina inclu	de distribut	ion loss wh	ether or no	t hot water	tank is pre	esent	,					
Distribution loss	0 15 v (45)n	n											
(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	
(+0)		52.00	33.05	20.05	27.00	23.00	22.15	23.40	25.70	25.55	52.05	35.50] (40)
Cylinder yolun	ns: na (litrac) in	cluding any	color store	ao within c	ama culind	or			0				
	ie (intres) in			ige within s		er			0] (50)			
Energy lost fro	om water sto	orage, kW	h/day (50)) x (51) x (5	2) x (53)				0.00] (54) 1			
Enter (49) or (54)	in (55)								0.00	(55)			
Water storage los	s calculated	d for each n	nonth = (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 contain	s dedicated	d solar stora	age, = (56)n	n x [(50) - (H	+11)] ÷ (50)	, else = (56	i)m where (H11) is fror	n Appendi>	сH			
(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 los	ss (annual) f	from Table	3						0.00	(58)			
Primary circuit los	s for each r	month (58)	÷ 365 × (41)m									
(modified by facto	or from Tab	le H5 if the	re is solar w	, vater heatir	ng and a cy	linder theri	mostat)						
(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 ead	ch month fr	om Table 3	a, 3b or 3c	(enter '0' if	not a com	bi 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 require	d for water	r heating ca	lculated for	r each mon	th 0.85 x (4	l5)m + (46)	m + (57)m -	+ (59)m + (f	51)m			1	_ · · /
(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 u		div H (nog		(0)		olar contrib	ution to w	ator hoatin	g)		207.00] (01)
(63)m											0.00	0.00	٦
(03)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5/(2)/1	12	0.00	
					(2(63)1	12 =	0.00] (63)
Output from wate	er heater to	r each mon	th, kWh/m	onth (62)m	n + (63)m							1	٦
(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 s	set to 0												
Heat gains from w	vater heatir	ng, kWh/mc	onth 0.25 ×	[0.85 × (45	5)m + (61)m	n] + 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 calcul	lation of (65	5)m only if c	cylinder is in	n the dwelli	ing or hot w	vater is from	n communi	ty 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), Wa	atts											_
(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 (cal	culated in A	Appendix L,	equation L	9 or L9a), a	lso see Tab	le 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 i	in Appendix	k L, equatio	n L13 or L1	3a), also se	e 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 (cal	lculated in A	Appendix L,	equation L	15 or L15a)), also see T	able 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 ø	ains (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)
	ration (neg	ative values) (Table 5)		1								_ \: ♥/
(71)m	-194 1/	_19 <u>4</u> 1/	-194 1/	-194 17	-194 17	-194 1/	-194 17	-194 17	-194 17	-194 14	-194 17	-194 1/	7 (71)
Water beating and		\ \	137.17	134.14	194.14	194.14	1.24.14	197.17	197.17	137.17	104.14	1, 1, 2, 3, 1, 4] (' +)
(72)m		1 1 2 2 0 0	115 54	105.69	00.27	00.25	07 E0	02.41	05.00	106 11	11764	122.02	$\int (72)$
(/2)/11	120.30	122.80	115.54	80.CUT	39.27	90.25	02.39	92.41	32.90	100.11	117.04	122.82] (72)

Fotal internal gain:	s (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:

	P	Access facto Table 6d	r	Area m²	So	lar flux W/	m² g	s Specific dat or Table 6b	a I	F Specific da or Table 6c	ita	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	х	47.32] x	0.63	x	1.00	=	232.09] (78)
Rooflights		1.00	x	7.75	x	26.00] x	0.63	х	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	х	19.87	x	0.63	x	1.00	=	13.50	(76)
West		0.77	x	3.20	х	19.87	x	0.63	x	1.00	=	30.85	(80)
Solar gains in watt	s, calculate	ed for each i	month ∑(74	1)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 - interr	nal and sola	ar (73)m + (8	33)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	temperatu	ure (heating	season)										
Temperature duri	ng heating	periods in t	he living ar	ea from Tal	ble 9, Th1(°	°C)						21.00	(85)
·	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	1, ,
Utilisation factor f	or gains for	r 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 tem	np of living	area T1 (ste	eps 3 to 7 ir	n 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 duri	ng heating	periods in t	he living ar	ea from Tal	ble 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 f	or gains for	r rest of dwo	elling 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 tem	perature i	n the rest of	f dwelling T	2 (follow s	teps 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	n							fLA 🔤	38.98	÷ (4) =	-	0.02] (91)
Mean internal tem	perature f	or the whol	e dwelling	fLA x T1 +(1	L - fLA) x T2	<u>.</u>							_
(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 mea	in internal t	emperatur	e from Tab	le 4e, wher	e appropria	ate						_
(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	requireme	nt											
	Jan	Feb	Mar	Apr	Mav	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Set Ti to the mean	internal te	mperature	obtained a	t step 11 of	f Table 9b,	so that tim	= (93)m a	nd recalculat	e the uti	lisation facto	r for gains	using Table	9a)
Utilisation factor f	or gains, 🛛	n									-	-	
(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, ⊡mG	m <i>,</i> 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 e	external ter	mperature f	rom 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 inter	nal tempera	ature, Lm, N	N									_
(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 req	uirement fo	or each mor	nth, kWh/n	nonth = 0.0	24 x [(97)m	n - (95)m] x	(41)m						

Total per year (kWh/year) = $\S(98)15, 1012 = 62365.73$ Space heating requirement in kWh/m²/year(98) \div (4) 38.409a. Energy Requirements - Individual heating systems including micro-CHPSpace heating:Fraction of space heating from secondary/supplementary system (Table 11)Fraction of space heating from main system(s) 1 - (201)1.00Fraction of main heating from main system 20.00Fraction of total space heat from main system 1 (202) × [1 - (203)]1.00Fraction of total space heat from main system 2 (202) × (203)0.00Efficiency of main space heating system 1 (%)0.00Efficiency of main space heating system 1 (%)88.90	(98) (99)
Space heating requirement in kWh/m²/year (98) ÷ (4) 38.40 9a. Energy Requirements - Individual heating systems including micro-CHP Space heating: Fraction of space heating from secondary/supplementary system (Table 11) Fraction of space heating from main system(s) 1 - (201) Fraction of main heating from main system 2 O.00 (203) Fraction of total space heat from main system 1 (202) x [1 - (203)] Fraction of total space heat from main system 2 (202) x (203) Efficiency of main space heating system 1 (%)	(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)	
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) Fraction of main heating from main system 2 0.00 (202) Fraction of total space heat from main system 1 (202) x [1 - (203)] 1.00 (204) Fraction of total space heat from main system 2 (202) x (203) 0.00 (205) Efficiency of main space heating system 1 (%) 88.90 (206)	
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)	
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 20.00(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)	
Fraction of space heating from main system(s)1 - (201)1.00(202)Fraction of main heating from main system 20.00(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)	
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)	
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)	
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)	
Efficiency of main space beating system 1 (%)	
(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.)3
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.	51
Total per year (kWh/year) = Σ(211)15, 1012 = 70152.68	(211)
Water heating:	
Output from water heater, kWh/month (calculated above)	
(64)m 295.20 259.55 271.07 240.89 234.54 207.38 197.09 219.14 219.65 249.89 266.88 287.3)
Σ(64)112 = 2948.66	(64)
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 332.28 292.16 305.16 271.24 264.27 239.19 227.32 252.75 253.34 281.42 300.43 323.4	3
Total per year (kWh/year) = $\Sigma(219)112 = 3343.06$	(219)
Annual Tatala Summann	
Annual Totals Summary: RWII/year RWII/year RWII/year	
Space heating fuel used, main system 1 70152.68	(211)
Space heating fuel used, main system 1 70152.68 Water heating fuel used 3343.06	(211) (219)
Annual Totals Summary: RWII/year Space heating fuel used, main system 1 70152.68 Water heating fuel used 3343.06 Electricity for pumps, fans and electric keep-hot (Table 4f): 3343.06	(211) (219)
Annual Totals Summary: kWil/year Space heating fuel used, main system 1 70152.68 Water heating fuel used 3343.06 Electricity for pumps, fans and electric keep-hot (Table 4f): 0.00	(211) (219)
Annual Totals Summary: kWil/year Space heating fuel used, main system 1 70152.68 Water heating fuel used 3343.06 Electricity for pumps, fans and electric keep-hot (Table 4f): 0.00 wechanical ventilation fans - balanced, extract or positive input from outside 0.00 warm air heating system fans 0.00	(211) (219) (230a) (230b)
Annual Totals Summary: kWilly year Space heating fuel used, main system 1 70152.68 Water heating fuel used 3343.06 Electricity for pumps, fans and electric keep-hot (Table 4f): 0.00 warm air heating system fans 0.00 central heating pump 130.00	(211) (219) (230a) (230b) (230c)
Annual Totals Summary: kWilly Year Space heating fuel used, main system 1 70152.68 Water heating fuel used 3343.06 Electricity for pumps, fans and electric keep-hot (Table 4f): 3343.06 mechanical ventilation fans - balanced, extract or positive input from outside 0.00 warm air heating system fans 0.00 central heating pump 130.00 oil boiler pump 0.00	(211) (219) (230a) (230b) (230c) (230d)
Annual Totals Summary: KWII/year Space heating fuel used, main system 1 70152.68 Water heating fuel used 3343.06 Electricity for pumps, fans and electric keep-hot (Table 4f): 3343.06 mechanical ventilation fans - balanced, extract or positive input from outside 0.00 warm air heating system fans 0.00 central heating pump 130.00 oil boiler pump 0.00 boiler flue fan 45.00	(211) (219) (230a) (230b) (230c) (230d) (230e)
Annual rotals summary: kWilly year Space heating fuel used, main system 1 70152.68 Water heating fuel used 3343.06 Electricity for pumps, fans and electric keep-hot (Table 4f): 0.00 mechanical ventilation fans - balanced, extract or positive input from outside 0.00 warm air heating system fans 0.00 central heating pump 130.00 oil boiler pump 0.00 boiler flue fan 45.00 maintaining electric keep-hot facility for gas combi boiler 0.00	(211) (219) (230a) (230b) (230c) (230d) (230e) (230e) (230f)
Annual Totals Summary: KWIT/Year Space heating fuel used, main system 1 70152.68 Water heating fuel used 3343.06 Electricity for pumps, fans and electric keep-hot (Table 4f): 3343.06 mechanical ventilation fans - balanced, extract or positive input from outside 0.00 warm air heating system fans 0.00 central heating pump 130.00 oil boiler pump 0.00 boiler flue fan 45.00 maintaining electric keep-hot facility for gas combi boiler 0.00 pump for solar water heating 0.00	(211) (219) (230a) (230b) (230c) (230d) (230e) (230f) (230g)
Annual Yotals Summary:KWII/YealSpace heating fuel used, main system 170152.68Water heating fuel used3343.06Electricity for pumps, fans and electric keep-hot (Table 4f):3343.06mechanical ventilation fans - balanced, extract or positive input from outside0.00warm air heating system fans0.00central heating pump130.00oil boiler pump0.00boiler flue fan45.00maintaining electric keep-hot facility for gas combi boiler0.00pump for solar water heating0.00Total electricity for the aboveΣ(230a)(230g)	(211) (219) (230a) (230b) (230c) (230d) (230e) (230f) (230g) (231)
Annual Yotas Summary: KWity Yeal Space heating fuel used, main system 1 70152.68 Water heating fuel used 3343.06 Electricity for pumps, fans and electric keep-hot (Table 4f): 0.00 mechanical ventilation fans - balanced, extract or positive input from outside 0.00 warm air heating system fans 0.00 central heating pump 130.00 oil boiler pump 0.00 boiler flue fan 45.00 maintaining electric keep-hot facility for gas combi boiler 0.00 pump for solar water heating 0.00 Total electricity for the above \$2(230a)(230g)	(211) (219) (230a) (230b) (230c) (230d) (230e) (230f) (230g) (231)
Annual Yota's Summary: KWinyean Space heating fuel used, main system 1 70152.68 Water heating fuel used 3343.06 Electricity for pumps, fans and electric keep-hot (Table 4f): 0.00 warm air heating system fans 0.00 central heating pump 130.00 oil boiler pump 0.00 boiler flue fan 45.00 maintaining electric keep-hot facility for gas combi boiler 0.00 pump for solar water heating 0.00 Total electricity for Ilighting (calculated in Appendix L): 2482.99	(211) (219) (230a) (230b) (230c) (230c) (230c) (230c) (230f) (230g) (231) (232)
Annual rotals summary: KWiryyear Space heating fuel used, main system 1 70152.68 Water heating fuel used 3343.06 Electricity for pumps, fans and electric keep-hot (Table 4f): 0.00 warm air heating system fans 0.00 central heating pump 130.00 oil boiler pump 0.00 boiler flue fan 45.00 maintaining electric keep-hot facility for gas combi boiler 0.00 pump for solar water heating 0.00 Total electricity for lighting (calculated in Appendix L): 2482.99	(211) (219) (230a) (230b) (230c) (230d) (230e) (230f) (230g) (231) (232)
Annual rotals summary: KWiryeal KWiryeal Space heating fuel used, main system 1 70152.68 Water heating fuel used 3343.06 Electricity for pumps, fans and electric keep-hot (Table 4f): 0.00 mechanical ventilation fans - balanced, extract or positive input from outside 0.00 warm air heating system fans 0.00 central heating pump 130.00 oil boiler pump 0.00 boiler flue fan 45.00 maintaining electric keep-hot facility for gas combi boiler 0.00 pump for solar water heating 0.00 Total electricity for lighting (calculated in Appendix L): 2482.99 10a. Fuel costs - Individual heating systems including micro-CHP Not the state	(211) (219) (230a) (230b) (230c) (230c) (230c) (230g) (230g) (231) (232)
Annual rotals summary: KWII/year Space heating fuel used, main system 1 70152.68 Water heating fuel used 3343.06 Electricity for pumps, fans and electric keep-hot (Table 4f): 0.00 mechanical ventilation fans - balanced, extract or positive input from outside 0.00 warm air heating system fans 0.00 central heating pump 130.00 oil boiler pump 0.00 boiler flue fan 45.00 maintaining electric keep-hot facility for gas combi boiler 0.00 pump for solar water heating 0.00 Total electricity for the above \$2(230a)(230g) 175.00 Electricity for lighting (calculated in Appendix L): 2482.99 10a. Fuel costs - Individual heating systems including micro-CHP Fuel kWh/year Fuel price (Table 12)	(211) (219) (230a) (230b) (230c) (230c) (230c) (230f) (230g) (231) (231) (232)
Annual totals summary: KWitygeal KWitygeal Space heating fuel used, main system 1 70152.68 Water heating fuel used 3343.06 Electricity for pumps, fans and electric keep-hot (Table 4f): 0.00 werm air heating system fans 0.00 central heating pump 130.00 oil boiler pump 0.00 boiler flue fan 45.00 maintaining electric keep-hot facility for gas combi boiler 0.00 pump for solar water heating 0.00 Total electricity for lighting (calculated in Appendix L): 2482.99 10a. Fuel costs - Individual heating systems including micro-CHP Fuel kWh/year Fuel price (Table 12) Fuel cost £/y	(211) (219) (230a) (230b) (230c) (230c) (230c) (230g) (230g) (231) (231) (232) (232)
Annual rotals Summary: KWI/Year Space heating fuel used, main system 1 70152.68 Water heating fuel used 3343.06 Electricity for pumps, fans and electric keep-hot (Table 4f): 0.00 warm air heating system fans 0.00 central heating pump 130.00 oil boiler pump 0.00 boiler flue fan 45.00 maintaining electric keep-hot facility for gas combi boiler 0.00 pump for solar water heating 0.00 Total electricity for lighting (calculated in Appendix L): 2482.99 10a. Fuel costs - Individual heating systems including micro-CHP Fuel kWh/year Fuel price (Table 12) Space heating - main system 1 70152.68 x 3.10 x 0.01 = 2174.73	(211) (219) (230a) (230b) (230c) (230d) (230e) (230f) (230g) (231) (231) (232) (232)
Annual rotals Summary: KWI/Year Space heating fuel used, main system 1 70152.68 Water heating fuel used 3343.06 Electricity for pumps, fans and electric keep-hot (Table 4f): 0.00 warm air heating system fans 0.00 central heating pump 130.00 oil boiler pump 0.00 boiler flue fan 45.00 maintaining electric keep-hot facility for gas combi boiler 0.00 pump for solar water heating 0.00 Total electricity for lighting (calculated in Appendix L): 2482.99 10a. Fuel costs - Individual heating systems including micro-CHP Fuel kWM/year Fuel price (Table 12) Space heating - main system 1 70152.68 x 3.10 x 0.01 = 2174.73 Water heating cost (other fuel) 3343.06 x 3.10 x 0.01 = 103.63	(211) (219) (230a) (230b) (230c) (230d) (230e) (230f) (230g) (231) (231) (232) (232) Sar (240) (240) (247)
Annual rotals Summary: KWI/Year Space heating fuel used, main system 1 70152.68 Water heating fuel used 3343.06 Electricity for pumps, fans and electric keep-hot (Table 4f): 0.00 mechanical ventilation fans - balanced, extract or positive input from outside 0.00 warm air heating system fans 0.00 central heating pump 0.00 oil boiler pump 0.00 boiler flue fan 45.00 maintaining electric keep-hot facility for gas combi boiler 0.00 pump for solar water heating 0.00 Total electricity for lighting (calculated in Appendix L): 2482.99 10a. Fuel costs - Individual heating systems including micro-CHP Fuel price (rable 12) Fuel cost f/y (rable 12) Space heating - main system 1 70152.68 x 3.10 x $0.01 =$ 2174.73 Water heating cost (other fuel) 3343.06 x 3.10 x $0.01 =$ 2174.73 Water heating cost (other fuel) 3343.06 x 3.10 x $0.01 =$ 20.06	(211) (219) (230a) (230b) (230c) (230d) (230e) (230f) (230g) (231) (231) (232) (232) (232) (240) (247) (249)

NHER Plan Assessor version 5.4.2

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		В	

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



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*) + (2	63*) + (264*) =	74965.65	(265*)
Pumps, fans and electric keep-hot	175.00	x	2.92	=	511.00	(267*)
Lighting	2482.99	×	2.92	=	7250.33	(268*)
Total primary energy kWh/year			<u>Σ</u> (2	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)	х	3.40	(2c)	=	809.68	(3c)
+3		238.14] (1d)	х	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) + (3d	c) + (3o	d)(3n) =	5212.85	(5)

2. Ventilation rate

											m	³ per hour	
Number of chi	mneys								0	x 40 =	=	0	(6a)
Number of op	en flues								2	x 20 =	-	40	(6b)
Number of int	ermittent fans								0	x 10 =	-	0	(7a)
Number of pa	ssive vents								0	x 10 =	-	0	(7b)
Number of flu	eless gas fires								0	x 40 =	-	0	(7c)
											Air	changes pe hour	r
Infiltration due	e to chimneys, t	flues, fans,	PSVs		(6a)	+ (6b) + (7	a) + (7b) + (7c) =	40	÷ (5) :	=	0.01	(8)
lf a pressurisa	tion test has be	en carried	out or is int	ended, pro	ceed to (17	7), otherwis	e continue j	from (9) to	(16)				
Air permeabili	ty value, q50, e	expressed in	n cubic met	res per ho	ur per squa	ire metre o	f envelope a	area				3.00	(17)
If based on air	permeability v	alue, then	(18) = [(17)	÷ 20] + (8)	, otherwise	e (18) = (16)	1					0.16	(18)
Air permeabili	ty value applies	s if a pressu	risation tes	st has been	done, or a	design or s	pecified air	permeabi	ity is being	used			
Number of sid	es on which dw	velling is sh	eltered									2	(19)
Shelter factor									1	- [0.075 x (1	.9)] =	0.85	(20)
Adjusted infilt	ration rate									(18) x (20) =	0.13	(21)
Infiltration rat	e modified for	monthly wi	nd speed:										
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly avera	ige wind speed	from Table	27										
(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 (2	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 infilt	ration rate (allo	owing for sh	nelter and v	wind speed) = (21) × (2	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 eff	ective air chan	ge rate for t	he applicabl	e case:										
If mechar	nical ventilatior	n: air change	e rate throug	gh system									0.50	(23a)
If exhaust	t air heat pump	using Appe	ndix N, (23t	o) = (23a) ×	Fmv (equa	ation (N5)), (otherw	vise (2	23b) = (23a	a)			0.50	(23b)
If balance	ed with heat re	covery: effic	iency in % a	llowing for	r in-use fac	tor (from Ta	ble 4h) =					75.65	 (23c)
a) if halas				-	AV(11D) (2))	\ [1	(22-)	1001					
a) it balar $(24a)m$						20)m + (230		(230)	100] = 0.25	0.26	0.27	0.28	0.20	(24a)
	chango rato	ntor (242) o	r(24b) or (2)	$(1.2) \circ (2.4)$	1 in hoy (2)	5)	0.2		0.25	0.20	0.27	0.28	0.29	_ (24a)
(25)m						0.25	0.7	5	0.25	0.26	0.27	0.28	0.20	(25)
(23)11	0.50	0.29	0.23	0.27	0.20	0.25	0.2		0.25	0.20	0.27	0.28	0.29	_ (23)
3. Heat loss	ses and heat lo	ss paramete	er											
The к-value i	is the heat cape	acity per uni	t area, see T	able 1e.										
	Element		Gross	Ope	nings,	Net area		U-va	lue,	A x U,	к-v	alue,	Ахк,	
			Area, m ²	r	m²	A, m²		W/r	m²K	W/K	kJ/	'n².K	kJ/K	
Window*						90.41] × [1.:	15 =	103.52]	N/A	N/A	(27)
Doors						1.89] × [1.(= 00	1.89		N/A	N/A	(26)
Roof window	v*					7.75] x [1.1	15 =	8.87	1	N/A	N/A	(27a)
Basement flo	oor					484.47] x [0.3	10 =	48.45		N/A	N/A	(28)
External wall	I					788.80] x [0.2	14 =	110.43	1	N/A	N/A	(29a)
Roof						575.35] x [0.:	10 =	57.54	1	N/A	N/A	(30)
Total area of	f external elem	ents ∑A, m²				1948.67	(31)							
* for window	vs and roof win	dows, effect	tive window	U-value is	calculated	using form	.la 1/[((1/UV	/alue)+0.04	4] paragrap	oh 3.2			
Fabric heat l	oss, W/K = ∑(A	× U)								(2	6)(30) +	(32) =	330.70	(33)
Heat capacit	:y Cm = ∑(А x к)								(28)	(30) + (32)	+ (32a)(3	32e) =	N/A	(34)
Thermal mas	ss parameter (T	·MP) in kJ/m	1²K							Calcula	ted separa	tely =	100.00	(35)
Thermal brid	lges: ∑(L x Ψ) ca	alculated us	ing Appendi	×К									194.87	(36)
if details	of thermal brid	ging are no	t known the	n (36) = 0.1	15 x (31)									_
Total fabric h	neat loss										(33) +	(36) =	525.57	(37)
Ventilation h	neat loss calcula	ated monthl	y 0.33 x (2	5)m x (5)								· · <u> </u>		
(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 transfe	r coefficient, W	//K (37)m+	- (38)m											_
(39)m	1046.25	5 1028.96	1028.96	994.38	971.32	959.79	948	.27	948.27	977.09	994.38	1011.67	1028.96	
										Average = 2	∑(39)112	/12 =	994.86	(39)
Heat loss par	rameter (HLP),	W/m²K (39	9)m ÷ (4)											
(40)m	0.64	0.63	0.63	0.61	0.60	0.59	0.5	58	0.58	0.60	0.61	0.62	0.63	
										Average =	∑(40)112	/12 =	0.61	(40)
4. Water he	eating energy r	equirement										-		
												•	Wh/year	
Assumed occ	cupancy, N										4.85	5 (42	2)	
If TFA > 1	.3.9, N = 1 + 1.7	'6 x [1 - exp(-0.000349 x	(TFA - 13.9	9)²)] + 0.00	13 x (TFA - 1	.3.9)							
If TFA ≤ 1	.3.9, N = 1													
Annual avera	age hot water ι	isage in litre	s per day Vo	d,average =	= (25 x N) +	36					149.4	17 (43	3)	
Annual avera	age hot water u	isage has be	een reduced	by 5% if th	ne dwelling	is designed	to ach	ieve (a water us	e target of	not more t	han 125 lit	res	
per person p	er day (all wate	er use, hot a	nd cold)											
	Jan	Feb	Mar	Apr	May	Jun	Ju	I	Aug	Sep	Oct	Nov	Dec	
Hot water us	sage in litres pe	r day for ea	ch month V	d,m = facto	or from Tab	le 1c x (43)	40.0	<u> </u>	140 50	146.40	453.40	450.45	464.45	7
(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	
											<u></u> ∑(44)1.	12 =	1793.64	(44)

Energy content of	hot water	used - calcu	lated mon	thly = 4.190) x Vd,m x r	ım x Tm/36	00 kWh/r	nonth (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)
lf instantaneous v	vater heatir	ng at point (of use (no ł	not water st	orage), ent	er 0 in box	es (46) to (6	51)					
For community he	ating inclue	de distribut	ion loss wh	ether or no	t hot water	tank is pre	sent						
Distribution loss	0.15 x (45)n	n											
(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 los	s:				•								_ · ·
a) If manufacture	's declared	loss factor	is known (kWh/day):					3.00	(47)			
Temperature f	actor from	Table 2b							0.60	(48)			
Energy lost fro	m water sto	orage kW	h/day (47) x (48)					1 80	(49)			
Enter (19) or (54)	in (55)		.,,	, (,					1.80	(55)			
Mater storage los		l for oach n	oonth - (EE	$(1) \times (11)$ m					1.80	[(55]			
(E6)m				5/ X (41)11	55.90	54.00	55.90	55.90	54.00	55.90	54.00	55.90	7 (56)
(SU)			-55.00	 	111)] · (50)) m whata ((111) is from	 		54.00	55.80] (30)
(EZ)m			$ge_r = (56)n$	n x [(50) - (r	111)]÷(50)	, eise = (56)m where (E4.00	EE 90	7 (57)
(57)	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 los	s (annual) f	rom Table	3						360.00	(58)			
Primary circuit los	s for each r	nonth (58)	÷ 365 × (41	.)m									
(modified by facto	br from Tab	le H5 if the	re is solar v	vater heatir	ng and a cyl	inder ther	nostat)	20.50	20.50	20.50	20.50	20.50	7 (50)
(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 ead	ch month fr	om Table 3	a, 3b or 3c	(enter '0' if	not a com	oi boiler)	0.00	0.00					7
(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 require	d for water	heating ca	Iculated fo	r each mon	th 0.85 × (4	5)m + (46)	m + (57)m +	+ (59)m + (6	51)m				۲
(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 ir	nput calcula	ited using A	Appendix G	(negative c	juantity)						1	٦
(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	alculated u	ising Apper	idix H (nega	ative quanti	ity) ('0' ente	ered if no s	olar contrib	ution to w	ater heating	g)	1	1	٦
(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 wate	r heater fo	r each mon	th, kWh/m	onth (62)m	n + (63)m							1	-
(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 s	et to 0												
Heat gains from w	ater heatin	ig, kWh/mc	onth 0.25 ×	: [0.85 × (45	5)m + (61)m] + 0.8 × [(4	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 calcul	ation of (65	5)m only if a	cylinder is in	n the dwelli	ng or hot w	vater is fron	n communi	ty 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), Wa	atts		L									٦
(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 (cal	culated in A	Appendix L,	equation L	9 or L9a), a	lso see Tab	le 5					1		٦
(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 i	in Appendix	(L, equatio	n L13 or L1	3a), also se	e Table 5			1	1		1	-
(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 (cal	culated in A	Appendix L,	equation L	.15 or L15a)	, also see T	able 5			1				_
(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 g	ains (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. evapor	ration (nega	tive 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 gain	ns (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 gain	s (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:

	P	Access facto Table 6d	r	Area m ²	So	lar flux W/	m² g	Specific da or Table 6b	ta F	F Specific da or Table 60	ata C	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	×	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 watt	s, calculate	ed for each i	month ∑(74	4)m(82)m	1								
(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 - intern	al and sola	ar (73)m + (8	33)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	temperati	ire (heating	season)	· -				-] /=_\
Temperature durin	ig heating	periods in tl 	he living ar	ea from Ta	ble 9, Th1(`	°C)						21.00] (85)
	Jan	Feb	Mar	Apr	Мау	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor fo	or gains for	r living area,	, η1,m (see	a lable 9a)	0.00	0.72	0.52	0.56	0.95	0.07	1.00	1.00	
	n of living	0.99	0.50		0.88	0.72	0.52	0.50	0.85	0.97	1.00	1.00] (80)
(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)
	g heating	neriods in t	he living ar	rea from Ta	ble 9 Th2('	°C)	20.52	20.52	20.70	20.50	15.50	15.05] (07)
(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	or gains for	r rest of dwe	elling n2.m	(see Table	9a)			1			4	<u> </u>], ,
(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 tem	perature i	n the rest of	f dwelling 1	F2 (follow s	teps 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	ı							fLA	38.98	÷ (4) =	=	0.02	(91)
Mean internal tem	perature f	or the whol	e dwelling	fLA x T1 +(:	1 - fLA) x T2	2							-
(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 mea	in internal t	emperatur	e from Tab	le 4e, wher	e appropria	ate						
(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	requireme	nt											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Set Ti to the mean	internal te	emperature	obtained a	t step 11 o	f Table 9b,	so that tim	= (93)m a	nd recalcula	te the util	isation facto	or for gains	using Table	e 9a)
Utilisation factor for	or gains, 🛛	n											
(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, ImGr	n, 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 e	xternal ter	nperature f	rom 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 r	nean inter	nal tempera	ture, Lm, V	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 rec	quirement fo	or each mor	nth, kWh/n	nonth = 0.0	24 x [(97)m	n - (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 y	/ear (kWh/y	/ear) = ∑(98	8)15, 10	.12 = 40	0038.63	(98)
Space heating rec	quirement ir	n kWh/m²/y	vear							(98)	÷ (4)	24.65	(99)
8c. Space coolin	g requireme	ent											
	Jan	Feb	Mar	Apr	Мау	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Calculated for Jur	ne, July and	August. See	e Table 10b										
Heat loss rate Lm	(calculated	using 24°C	internal te	mperature	and extern	al tempera	ture from T	able 10)	0.00	0.00	0.00	0.00	1 (100)
(100)m		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	0.00	0.00	0.00	0.00	0.02	0.01	0.80	0.00	0.00	0.00	0.00	1 (101)
(101)m		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, @mLn	n (Watts) = (100)m x (10	01)m	0.00	0.00	6700.22	F 2 7 9 6 2	5240.08	0.00	0.00	0.00	0.00	1 (102)
	0.00		0.00	0.00		0790.32	5378.03	5249.98	0.00	0.00	0.00	0.00] (102)
Gains (Internal ga	ins as for ne	eating excep	ot that coll	imn (A) of I Table 6a)	able 5 is ai	ways used;	solar gains	calculated	tor				
(103)m					0.00	8628 54	8230.25	7559.96	0.00	0.00	0.00] (103)
Space cooling roo	uiromont fo	o.00	b whole d			h(h) = 0.02	$1 \times [(102)m]$	(102)ml	(41)m	0.00	0.00	0.00] (105)
set (104)m to zer	o if (104) m	$< 3 \times (98) m$	with (98)m	weiling, cor with (98)m		1 using wea	ther data f	rom Table 1	(41)III IO				
(104)m		0.00	0.00	0.00	0.00	1323.52	2121.60	1718.63	0.00	0.00	0.00	0.00]
(,									Tota	$I = \Sigma(104)6$	8 = 5	163 75]] (104)
Cooled fraction									fc = cou	= 2(10+)0	(4) -	0.62) (105)
Intermittency fac	tor (Tabla 1)	0h)							10 - 000		(4) -	0.02] (105)
(106)m			0.00	0.00	0.00	0.25	0.25	0.25	0.00	0.00	0.00	0.00	1
(100)	0.00	0.00	0.00	0.00	0.00	0.25	0.25	0.25	U.UU Tota	1 - 5(106)6	0.00 0 _ [0.75]] (106)
		u un a satis	(104)	05) (100)					TOLA	1 - 2(100)0	o –	0.75] (100)
(107)m		r month = 0	(104)m x (1	.05) X (106)	m 0.00	202 71	226 55	264 52	0.00	0.00	0.00	0.00	1
(107)	0.00	0.00	0.00	0.00	0.00	203.71	320.33	204.52	U.UU Toto	$1 - \Sigma(107)C$	0.00]
C		1.14/1-12/-							TOLA	(107) (107)		/94.78	
Space cooling req	luirement in	i kvvn/m⁻/y	ear							(107)÷	(4) =	0.49] (108)
9a. Energy Requ	irements - I	ndividual h	eating sys	tems incluc	ling micro-	СНР							
Space heating:													
Fraction of space	heating from	m secondar	v/supplem	entary syst	em (Table 3	11)			0.10	(201)			
Fraction of space	heating from	m main syst	tem(s) 1 -	(201)		,			0.90	(202)			
Fraction of main	heating from	n main syst	em 2	(201)					0.10	(203)			
Eraction of total	nace heat f	rom main syste	ustem 1 (2	02) y [1 - (2	03)]				0.81	(204)			
Fraction of total s	pace heat f		$y_{\text{stem}} = \frac{1}{2}$	$(2) \times (202)$	03]]				0.01	(205)			
Efficiency of main		ing system	1 (0/)	02) X (203)					0.09	(205)			
Efficiency of main	r Tabla 4a/	ing system	1 (%)	aranziata h	, the amou	nt chown ir	the lenges		90.00	(200)	f Tabla da)		
Efficiency of main	r rubie 40/4	ing system	$\sim (\infty)$	propriate by	r the amou	nt snown in	i the space			$\left[\begin{array}{c} column \\ co$	Tuble 4C)		
(from database o	r Tabla Aa/	ing system	2 (70)	arapriata h	, the amou	nt chown ir	the 'snace		z Ju.00] (207) t' column of	f Tabla Ac		
Efficiency of soco	ndaru/supp	lomontory k	where upp	tom from T	Table 4a or	Appondix E					TUDIE 4C		
Cooling Custom E		iennentary i	reating sys			Appendix	[70]		1.05	(200)			
Cooling System E	nergy Efficie	ency Ratio (s	see rable 1	.00)			1.1		4.05] (209)	New	Dee	
Charles heating and	Jan	Feb		Apr	iviay	Jun	JUI	Aug	sep	Uct	NOV	Dec	
space neating red	Juirement, k	6147 70		31/11 70	13/6 67	0.00	0.00	0.00	0.00	2078 66	5764 15	7634 40	1
(Jojiii		ting sustant	1) LANE /	$\frac{3141.70}{200000000000000000000000000000000000$	$m_{\rm X}$ (204)	v 100 + (20)	0.00	0.00	0.00	2370.00	_ 5704.15	7034.49	1
space neating fue		LING SYSTEM	т), кwn/n	101111 = (98	און (204) ג גענע גענע גענע גענע גענע גענע גענע גע	x 100 ÷ (20		0.00	0.00	2600 70	5107 73	6871.04	1
(211)	7003.02	5555.01	4035.09	2027.33	1211.93	0.00			0.00	1)1 5 10	12 =	6024 70	
C		•••	a)		(222)	. 100 - 12-	rotal per ye	ar (kvvn/ye	ar) = ∑(21)	1)15, 10	.12 = 30	5034.70] (211)
space heating fue	ei (main hea	ting system	2), kWh/n	10nth = (98)m x (203) :	x 100 ÷ (20	6)						

(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	1
(213)	205.54	221.52	105.50	115.10	40.40	0.00	otal par va	r (k) h/h	$(v_{00}) = 5(21)$	107.23	12 - [1441 20]] (<u>212</u>)
Canada haatina fu	- I <i>(</i>		(00)		100 . (200)		otai per ye		year) – 2(21	5/15, 10	.12	1441.55] (213)
(215)m		9), KWN/IIIC	736 36	лля ял	100 ÷ (208)	0.00	0.00	0.00	0.00	125 52	873/	15 1090 64	1
(213)	1124.50	070.20	750.50	440.01	152.57	0.00	otal par va	or (k) Mb /	(0.00)	1 + 25.52	12 - [E710.90]] (215)
Mater beating						I	otai per ye		year) – 2(21	5)15, 10	.12 – _	5719.80] (215)
water neating:													
Output from wat	er heater, k	Wn/month		d above)	215 67	107.04	104.90	208.60	206 50	226.64	2220		1
(64)111	250.81	221.43	235.00	210.54	215.07	197.04	194.80	208.09	206.59	Z20.04		245.08	
										∑(64)1	.12 = _	2652.02	(64)
Lifticiency of wate	er heater pe	r month	65.00	65.00	65.00	65.00	65.00	65.00	65.00	65.00	65.0		1
(217)111		05.00	05.00	05.00	05.00	05.00	05.00	65.00	05.00	05.00	05.0	0 05.00	
Fuel for water he	ating, kWh/	month = (6)	4)m x 100 -	÷ (217)m	221.90	202.14	200.60	221.06	217.02	210 60	2501	E 277.07	1
(219)11	505.07	540.00	501.04	555.14	551.60	505.14	299.09	521.00	517.05	540.00	<u>556.5</u>	1000.02	
							lotai	per year	(kwn/year)	= 2(219)1	.12 = _	4080.03] (219)
Space cooling													
Space cooling fue	el, kWh/mor	107)m	÷ (209)		0.00		22.52						T
(221)m	0.00	0.00	0.00	0.00	0.00	50.30	80.63	65.31	0.00	0.00		0.00]
							Tota	al per yea	ar (kWh/year	·) = ∑(221)6	8 =	196.24] (221)
Annual Totals Su	immary:									kWh/ye	ear 	kWh/year	-
Space heating fu	el used, mai	in system 1										36034.76	(211)
Space heating fu	el used, mai	in system 2									L	1441.39	(213)
Space heating fu	el used, sec	ondary										5719.80	(215)
Water heating fuel used												4080.03	(219)
Space cooling fue	el used											196.24	(221)
Electricity for pu	mps, fans ai	nd electric l	keep-hot (1	Table 4f):									
mechanical ve	entilation fai	ns - balance	d, extract o	or positive i	nput from o	outside				6598.1	L6		(230a)
warm air heat	ting system f	fans								0.00			(230b)
central heatin	ng pump									130.0	0		(230c)
oil boiler pum	р									0.00			(230d)
boiler flue far	1									0.00			(230e)
maintaining e	lectric keep	-hot facility	for gas cor	nbi boiler						0.00			(230f)
pump for sola	ir water hea	ting								<u> </u>		6720.46	(230g)
lotal electricity f	or the above	2								∑(230a)(2	230g)	6728.16] (231)
Flootsicity for ligh	hting (solaul	atad in Ann	andix I \								Г	2492.00	(222)
											L	2462.99] (252)
Energy saving/ge	eneration te	chnologies	(Appendic	es IVI, N and	a Q):						Г	44004.60	
Electricity genera	ated by PVs (Appendix N	/I) (negativ	e quantity)							L	-14991.60] (233)
10a. Fuel costs	- Individual	heating sys	tems inclu	ding micro-	СНР								
					Fuel	kWh/year			Fuel price		F	uel cost £/yea	r
						-			(Table 12)			-	
Space heating - n	nain system	1			36	6034.76] x		4.93	x 0.01	=	1776.51	(240)
Space heating - n	nain system	2			1	441.39] x		11.46	x 0.01	=	165.18	(241)
Space heating - s	econdary				5	719.80	x		3.42	x 0.01	= [195.62	(242)
Water heating co	ost (other fue	el)			4	080.03	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 kee	p-hot			6	728.16	x		11.46	x 0.01	= [771.05	(249)
Energy for lightin	Ig				2	482,99	 		11.46	 	= [284.55	(250)
	0				_			L	*	I	L		/

106.00

(251)

Additional standing charges (Table 12)

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 11.6 AP rating - Individual heating systems including micro-CHP 0.47 (256 Energy cost deflator (Table 12) 0.47 (256 Energy cost factor (ECF) [(255) x (256)] + [(4) + 45.0] = 0.49 (257 SAP rating 93.21 93 (258 SAP rating 93.21 93 (258 SAP rating 93 (258 A 0.28 $=$ 1008.97 (261 Space heating - main system 1 36034.76 x 0.028 $=$ 1008.97 (261 Space heating - secondary 5719.80 x 0.008 $=$ 45.76 (263 Space and water heating (261) + (263) + (264) = 2607.78 (265 Space colling 196.24 x 0.517 $=$ 3478.46 (267 Pumps, fans and electric keep-hot 6728.16 x 0.517 $=$ 328.71 (268 <t< th=""><th>Energy saving/generation technologies (Appendices M, N and</th><th>Q):</th><th></th><th></th><th></th><th></th><th></th></t<>	Energy saving/generation technologies (Appendices M, N and	Q):					
Total energy cost $(240)(242) + (245)(254)$ 1729.85 (255 113. SAP rating - Individual heating systems including micro-CHP Energy cost deflator (Table 12) 0.47 (256 SAP value 0.37 (255) × (256)] + [(4) + 45.0] = 0.49 (257 SAP value 93.21 SAP value 93.21 SAP value 93.21 SAP band A 12.2. Carbon dioxide emissions - Individual heating systems including micro-CHP Emergy cost deflator (Table 7.2) Emergy cost deting - main system 1 36034.76 × 0.028 = 1008.97 (261 Space heating - main system 2 Emissions Emissions KWh/year Factor KgcO2/year) (262 Space heating - secondary 5719.80 × 0.008 = 45.76 (263 Space cooling 196.24 × 0.517 = 101.46 (266 Pumps, fans and electric keep-hot 6728.16 × 0.517 = 2432.91 (261 </th <th>PV savings (negative quantity)</th> <th>-14991.60</th> <th>x</th> <th>11.46</th> <th>x 0.01 =</th> <th>-1718.04</th> <th>(252)</th>	PV savings (negative quantity)	-14991.60	x	11.46	x 0.01 =	-1718.04	(252)
11a. SAP rating - Individual heating systems including micro-CHP $ 0.47 (255 (255) x (256)] + [(4) + 45.0] = 0.47 (255 x (256)] + [(4) + 45.0] = 0.49 (257 SAP value SAP rating SAP band 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP Energy KWh/year KuWh/year Factor Emissions Emissions Factor (gCO2/year) 261 302.8 263 302.9 264 302.8 264 302.9 264 302.8 264 302.8 264 302.8 264 302.8 264 302.8 264 302.8 264 302.9 261 302.8 262 302.8 262 302.8 262 302.8 262 302.8 262 302.8 262 302.8 262 302.8 262 302.8 262 302.8 262 302.8 262 302.8 262 302.8 262 302.8 262 302.8 262 302.8 262 302.8 $	Total energy cost			(240)(242	2) + (245)(254)	1729.85	(255)
Energy cost deflator (Table 12)	11a. SAP rating - Individual heating systems including micro-	СНР					
Energy cost factor (ECF) $[(255) \times (256)] + [(4) + 45.0] = 0.49 (257) (257) (258) + 200 (257) (258) + 200 (258) (25$	Energy cost deflator (Table 12)					0.47	(256)
SAP value 93.21 SAP rating 93 SAP band A 12a. Carbon dioxide emissions - Individual heating systems including micro-CHPEnergy kWh/yearEmissions FactorEmissions (kgCO2/year)Space heating - main system 1 36034.76 x 0.028 $=$ 1008.97 (261Space heating - main system 2 1441.39 x 0.517 $=$ 745.20 (262Space heating - main system 2 1441.39 x 0.008 $=$ 45.76 (263Space heating - secondary 5719.80 x 0.008 $=$ 45.76 (263Water heating 4080.03 x 0.198 $=$ 807.85 (264Space cooling 196.24 x 0.517 $=$ 101.46 (266Pumps, fans and electric keep-hot 6728.16 x 0.517 $=$ 3478.46 (267Lighting 2482.99 x 0.517 $=$ 1283.71 (268Energy saving/generation technologies: P P 0.529 $=$ -7930.56 (269Total carbon dioxide emissions rate $(272) \div (4) =$ -0.28 (273El value 100.37 100.37 100.37 100.37 El hand 400 400 400 400	Energy cost factor (ECF)			[(255) x (256)] ÷ [(4) + 45.0] =	0.49	(257)
SAP rating 93 (258 SAP band A 12a. Carbon dloxide emissions - Individual heating systems including micro-CHP Emissions Emissions 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 cooling 196.24 x 0.517 = 101.46 (266 Pumps, fans and electric keep-hot 6728.16 x 0.517 = 101.46 (268 Energy saving/generation technologies: PV emission savings (negative quantity) -14991.60 x 0.529 = -7930.56 (269 Dvelling carbon dioxide emissions rate (272) + (4) = -0.28 (273 (261)(271) = -459.16 (272 El value 100.37 El value 100.37 El value 1000.37 El value 10	SAP value					93.21]
A A 12a. Carbon dioxide emissions - Individual heating systems including micro-CHP Emissions Emissions KWh/year Emissions Emissions 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) Space heating - secondary 5719.80 x 0.008 $=$ 45.76 (263) Space heating - secondary 5719.80 x 0.008 $=$ 45.76 (263) Space heating - secondary 1048.003 x 0.198 $=$ 807.85 (264) Space heating - secondary 196.24 x 0.517 $=$ 101.46 (267) Space heating second mode demissions avings (negative quantity) -14991.60 x 0.529 $=$ -7930.56 (269) $(272) + (4) =$ 0.2	SAP rating					93	(258)
12a. Carbon dioxide emissions - Individual heating systems including micro-CHPEnergy kWh/yearEmissions FactorEmissions (kgCO2/year)Space heating - main system 1 36034.76 x 0.028 = 1008.97 (261Space heating - main system 2 1441.39 x 0.517 = 745.20 (262Space heating - secondary 5719.80 x 0.008 = 45.76 (263Water heating 4080.03 x 0.198 = 807.85 (264Space and water heating $(261) + (262) + (263) + (264) = 2607.78$ (265Space cooling 196.24 x 0.517 = 101.46 (266Pumps, fans and electric keep-hot 6728.16 x 0.517 = 3478.46 (267Lighting 2482.99 x 0.517 = 1283.71 (268Energy saving/generation technologies:PV emission savings (negative quantity) -14991.60 x 0.529 = -7930.56 (269Develling carbon dioxide emissions rate(272) \div (4) = -0.28 (273)(274El value 100.37 100 (274El value 100.37 100 (274El hand 40 40 40	SAP band				[А]
Energy kwh/yearEmissions FactorEmissions (kgCO2/year)Space heating - main system 1 36034.76 x 0.028 = 1008.97 (261Space heating - main system 2 1441.39 x 0.517 = 745.20 (262Space heating - secondary 5719.80 x 0.008 = 45.76 (263Water heating 4080.03 x 0.198 = 807.85 (264Space and water heating $(261) + (262) + (263) + (264) =$ 2607.78 (265Space cooling 196.24 x 0.517 = 101.46 (266Pumps, fans and electric keep-hot 6728.16 x 0.517 = 3478.46 (267Lighting 2482.99 x 0.517 = 1283.71 (268Energy saving/generation technologies: $2(261)(271) =$ -7930.56 (269Dvelling carbon dioxide emissions rate $(272) \div (4) =$ 0.28 (273El value 100.37 $(272) \div (4) =$ 0.28 (273El hand $5000000000000000000000000000000000000$	12a. Carbon dioxide emissions - Individual heating systems in	ncluding micro-CHP					
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 = 1283.71 (268 Energy saving/generation technologies: PV emission savings (negative quantity) -14991.60 x 0.529 = -7930.56 (269 Total carbon dioxide emissions $(272) \div (4) =$ -0.28 (273 El value 100.37 100.37 100.37 100.37 El value 100.37 100.274 100.274		Energy kWh/year		Emissions Factor		Emissions (kgCO2/year)	
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 $(272) \div (4) =$ -0.28 (272) $(272) \div (4) =$ -0.28 (273) El value 100.37 100 (274) 100 (274) 4	Space heating - main system 1	36034.76	x	0.028] =	1008.97	(261)
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 (267) Pumps, fans and electric keep-hot 6728.16 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 $\sum \{(271) \div (4) \}$ -0.28 (272) $(4) \}$ -0.28 (272) El value 100.37 100 (274) 100 (274) El value 100 (274) 100 (274) 100 (274)	Space heating - main system 2	1441.39	×	0.517] =	745.20	(262)
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 $(272) \div (4) =$ -0.28 (273) El value $(272) \div (4) =$ -0.28 (273) El value 100.37 100 (274) El value 100.37 100 (274)	Space heating - secondary	5719.80	x	0.008] = [45.76	(263)
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: 2482.99 x 0.529 = -7930.56 (269 Total carbon dioxide emissions $2(261)(271) = -459.16$ (272 $2(261)(271) = -459.16$ (272 $(272) \div (4) = -0.28$ (273 El value 100.37 100.37 $100.0(274)$ El rating (see section 14) 1000 (274	Water heating	4080.03	x	0.198] = [807.85	(264)
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 $\sum (261)(271) = -459.16$ (272 Dwelling carbon dioxide emissions rate $(272) \div (4) = -0.28$ (273 El value 100.37 100.37 100.37 El rating (see section 14) 100 (274)	Space and water heating			(261) + (262) -	+ (263) + (264) =	2607.78	(265)
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 $\sum (261)(271) = -459.16$ (272) Dwelling carbon dioxide emissions rate $(272) \div (4) = -0.28$ (273) El value 100.37 100.37 El rating (see section 14) 100 (274) El band 4 4	Space cooling	196.24	x	0.517] = [101.46	(266)
Lighting 2482.99 x 0.517 = 1283.71 (268Energy saving/generation technologies:PV emission savings (negative quantity) -14991.60 x 0.529 = -7930.56 (269Total carbon dioxide emissions $\sum (261)(271) = -459.16$ (272Dwelling carbon dioxide emissions rate $(272) \div (4) = -0.28$ (273El value100.37100(274El rating (see section 14)100(274	Pumps, fans and electric keep-hot	6728.16	x	0.517] = [3478.46	(267)
Energy saving/generation technologies:PV emission savings (negative quantity) -14991.60 x 0.529 = -7930.56 (269)Total carbon dioxide emissions $\sum (261)(271) = -459.16$ (272)Dwelling carbon dioxide emissions rate(272) ÷ (4) = -0.28 (273)El value100.37100(274)El rating (see section 14)100(274)	Lighting	2482.99	x	0.517] = [1283.71	(268)
PV emission savings (negative quantity) -14991.60 x 0.529 = -7930.56 (269)Total carbon dioxide emissions $\Sigma(261)(271) =$ -459.16 (272)Dwelling carbon dioxide emissions rate(272) ÷ (4) = -0.28 (273)El value100.37100(274)El rating (see section 14)100(274)	Energy saving/generation technologies:						
Total carbon dioxide emissions $\Sigma(261)(271) =$ -459.16(272)Dwelling carbon dioxide emissions rate(272) ÷ (4) =-0.28(273)El value100.37100(274)El rating (see section 14)100(274)	PV emission savings (negative quantity)	-14991.60	x	0.529] = [-7930.56	(269)
Dwelling carbon dioxide emissions rate (272) ÷ (4) = (273) El value 100.37 El rating (see section 14) 100 El hand 4	Total carbon dioxide emissions				∑(261)(271) =	-459.16	(272)
El value 100.37 El rating (see section 14) 100 (274	Dwelling carbon dioxide emissions rate				(272) ÷ (4) =	-0.28	(273)
El rating (see section 14)	El value					100.37]
El band	El rating (see section 14)					100	(274)
	El band					А]

13a. Primary	, energy -	- Individual heating	g systems in	cluding micro-CHP
2001111101		mannadanneating	5 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	

	Energy kWh/year		Primary Energ Factor	у	Primary Energy	
Space heating - main system 1	36034.76	x	1.20	=	43241.72	(261*)
Space heating - main system 2	1441.39	х	2.92	=	4208.86	(262*)
Space heating - secondary	5719.80	х	1.05	=	6005.79	(263*)
Water heating	4080.03	x	1.02	=	4161.63	(264*)
Space and water heating		(2	261*) + (262*) +	(263*) + (264*) =	57618.01	(265*)
Space cooling	196.24	х	2.92	=	573.03	(266*)
Pumps, fans and electric keep-hot	6728.16	х	2.92	=	19646.23	(267*)
Lighting	2482.99	х	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			Σ	(261*)(271*) =	41312.12	(272*)
Primary energy kWh/m2/year				(272*) ÷ (4) =	25.43	(273*)