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Energy Strategy

72-80 Leather Lane

Version 1.1

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Contents

Background

This Energy Strategy has been prepared by Verte on behalf of Hatton Garden Properties to provide a commentary on the sustainable energy issues for the proposed development at 72-80 Leather Lane. It sets out the energy efficiency and carbon reduction measures that will be incorporated into a number of the dwellings forming part of the development.

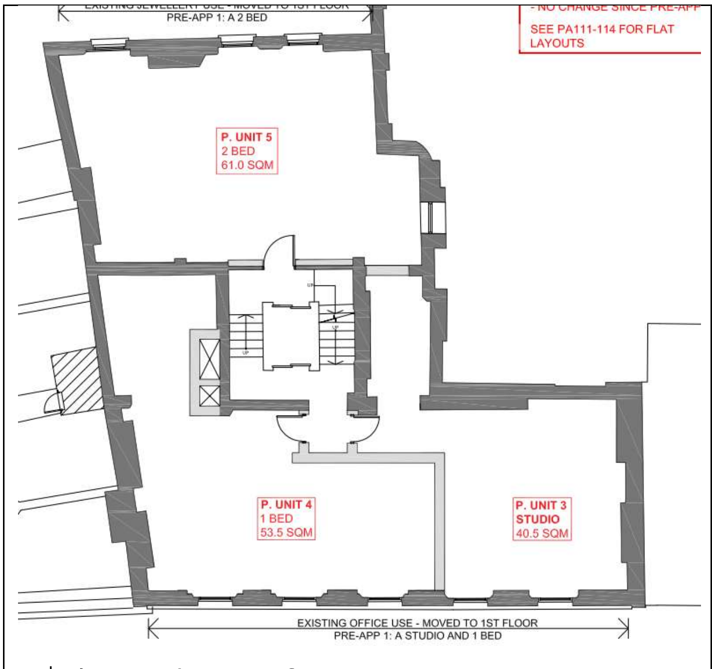
The building

The application site is 72-80 Leather Lane. The building currently has a mix of uses including residential, office and retail. This energy strategy covers the dwellings on the third floor which are formed as a result of a change of use, and the new build dwellings at the rear of the fifth floor, and on the sixth and seventh floor. A total of three new dwellings are formed by change of use, and three by extending the building.

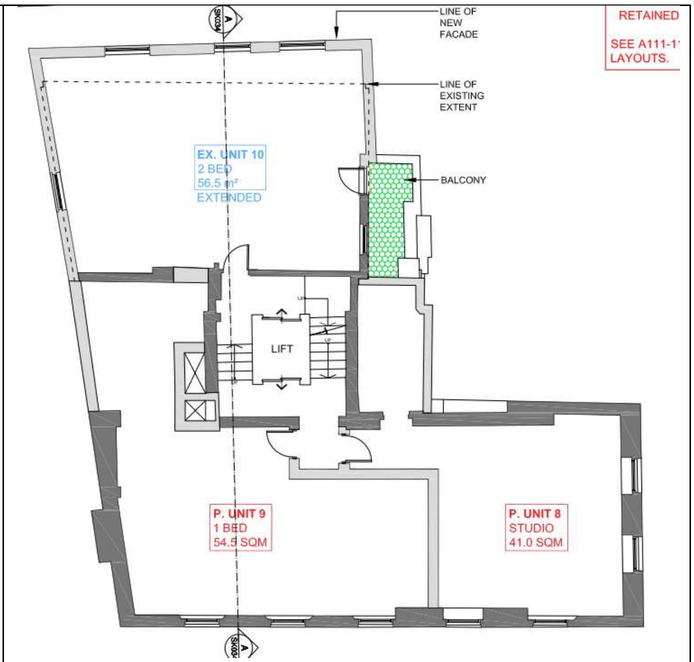
The existing dwellings that are undergoing refurbishment are not included in this Energy Statement.

The total net internal area of the newly dwellings is approximately 363m².

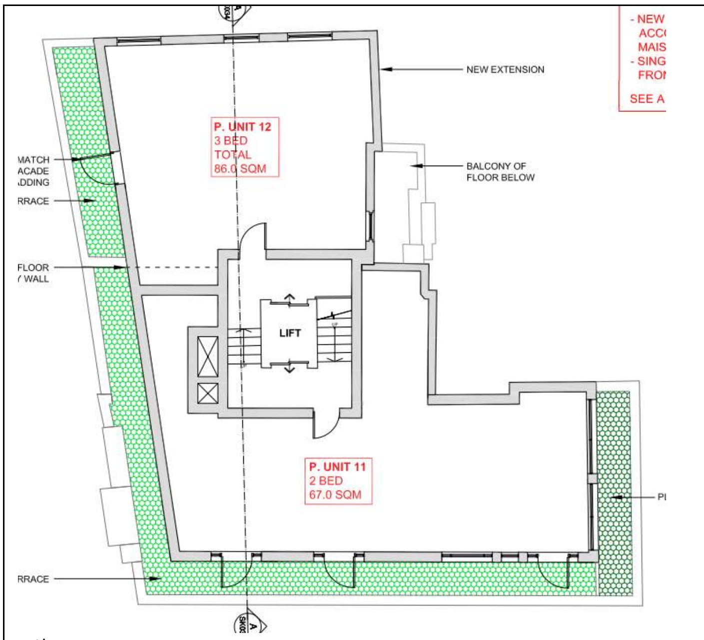
General Arrangement Drawings



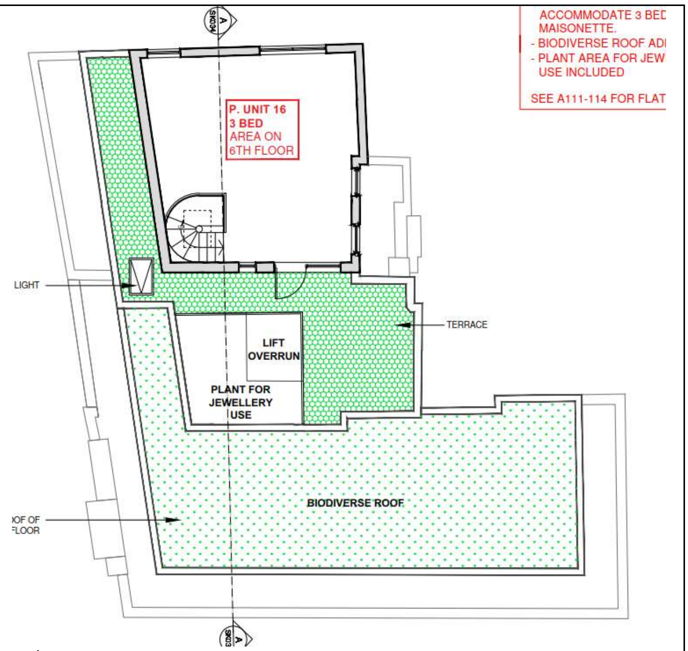
3rd Floor. Change of Use Units



5th Floor – Unit 10 new build



6th Floor – New Build



7th Floor, New Build

Planning Policy

The Pre-application advice from the London Borough of Camden, dated 7th October 2015, stated that *The Council would require development to incorporate sustainable design and construction measures. You are advised to submit a statement demonstrating how relevant measures have been incorporated into the design and proposed implementation as per Policy DP22 - Promoting sustainable design and construction*

Camden's Development Policy 22 - Promoting sustainable design and construction

The parts of DP22 relevant to this document state that:

The Council will require development to incorporate sustainable design and construction measures. Schemes must:

a) demonstrate how sustainable development principles have been incorporated into the design and proposed implementation; and

b) incorporate green or brown roofs and green walls wherever suitable.

The Council will promote and measure sustainable design and construction by:

c) expecting new build housing to meet Code for Sustainable Homes Level 3 by 2010 and Code Level 4 by 2013 and encouraging Code Level 6 (zero carbon) by 2016.;

d) expecting developments (except new build) of 500 sq m of residential floorspace or above or 5 or more dwellings to achieve "very good" in EcoHomes assessments prior to 2013 and encouraging "excellent" from 2013;The Council will require development to be resilient to climate change by ensuring schemes include appropriate climate change adaptation measures, such as:

f) summer shading and planting;

The London Plan

Policies within Chapter 5 of the London Plan (March 2015) set out relevant design and climate change adaptation policies relating to developments, and establish expectations for applicant's commitments in terms of CO_2 savings and measures proposed.

As required by the GLA's Guidance, after establishing the baseline energy demand and profile for the site, the strategy for the project will follow the Mayor's Energy Hierarchy in appraising appropriate measures to reduce carbon emissions and other climate impacts from the development:

- Use Less Energy - 'Be Lean'
- Supply Energy Efficiently - 'Be Clean'
- Use Renewable Energy - 'Be Green'

The Energy Hierarchy

The Mayor's energy hierarchy is central to the climate change policies. The stages of the hierarchy are:

Use Less Energy/Reduce Demand- 'Be Lean'

- Reduce use through behaviour change
- Improve insulation
- Incorporate passive heating and cooling
- Install energy efficient lighting and appliances

Supply Energy Efficiently - 'Be Clean'

- Use CHP and community heating and/or cooling
- Cut transmission losses though local generation

Use Renewable Energy - 'Be Green'

- Install renewables on site
- Import renewable energy

Structure of the Energy Assessment

This statement is structured to respond to the Energy Hierarchy following the GLA's guidance. The statement includes:

- An assessment of the baseline carbon emissions based on the target emission rate for the dwellings.
- A review of the energy efficient features incorporated into the design.
- An assessment of the feasibility of incorporating a combined heat and power system.
- A review of renewable energy technologies and their application for this development.
- Recommendations and commitments

Baseline energy consumption and carbon emissions

Before energy efficiency measures are investigated it is necessary to establish the baseline energy consumption of the scheme. This baseline sets the standard against which the proposed carbon reduction measures are compared and evaluation.

New Dwellings

The baseline case against which carbon savings are assessed for the new build dwellings is the target emission rate (TER) calculated in accordance with Approve Document L1A of Part L (2013) of the Building Regulations. This baseline case represents a typical new build arrangement; where electricity for the development is imported from the grid and space and heating water are provided by natural gas fired boilers.

The on site energy uses associated with non Building Regulations (e.g. cooking, appliances, lighting in areas not covered by Part L) is included in the baseline carbon emission rate.

The following 'regulated' energy uses are considered in the baseline energy analysis:

- Space Heating/Cooling
- Water Heating
- Ventilation
- Fans, Pumps and Controls
- Lighting (internal)

Change of Use Dwellings

The baseline case for the units formed by a change of use is the emission rate if the building is designed to the meet minimum requirements of the Building Regulations Approved Document L1B. Accordingly, the SAP calculations undertaken for this stage of the assessment adopt the minimum standards detailed in Approved Document L1B. This includes limiting standards for the thermal properties of building fabric, as well as building services.

For building services systems the Building Regulations refer to the Domestic Building Services Compliance Guide 2013, and the standards included therein have been followed where appropriate.

The parameters used to determine the CO_2 emissions using SAP calculations have been presented in the Table below.

Element / Service	Parameter	Limiting Values (AD L1B)
External Wall	u-value	0.3 W/m^{2}K
Windows	u-value	1.6 W/m2K
	Construction	Double glazed, argon filled.
	g-value	0.76
Floor		0.25 W/m2K
Roof		0.18 W/m2K
Air Permeability	m^3/hm^2 @ 50Pa	None, SAP default used
Ventilation		Natural Ventilation
Space Heating	Type	Communal boiler with independent controls in each flat
	Fuel	Gas

Element / Service	Parameter	Limiting Values (AD L1B)
	Efficiency Assumed	86% (Part L1B Minimum)
	Controls	Programmer and Room Thermostat
	Flue	Balanced, fan assisted
	Emitter	Underfloor (Timber)
Hot Water	Source	From Main System 110 litre tank in each flat.
Thermal Bridging	y-value	SAP default – 0.15 W/m^2K
Lighting	Standard Fittings	25%
	Energy Efficient Fittings	75%

BE LEAN – reduce energy demand

This section outlines how energy consumption will be reduced through the design of the building.

The energy savings will be achieved by passive measures and the introduction of more energy efficient plant and services. Any improvement achieved at this stage will reduce the extent of measures or size of plant needed to address the subsequent 'be clean' and 'be green' stages.

Dwellings

The dwellings will be constructed to be energy efficient and achieve compliance with Part L1A 2013 without the need for low or zero carbon technologies. This performance will be achieved through the use of energy efficient design, including:

- Better U-values exceeding the requirements of Part L 2013
- Best practice system efficiencies for heating, and ventilation system
- Highly efficient light fittings
- Programmable timeclock, thermostat and thermostatic radiator valves.
- Balanced mechanical ventilation with heat recovery
- The mechanical ventilation units will incorporate the following design features:
  - Heat recovery of at least 90%.
  - Specific Fan Powers of no greater than 0.40 W/l/s.
  - Summer bypass to assist with summertime cooling
  - Variable speed controls with summertime cooling function

Fabric Standards - New Dwellings

The table below details the U-values for the domestic areas of the development in relation to the relevant Building Regulations minimum standards (Parts L1A).

New Build Dwellings (Units 10, 11, 12)	Limiting Values Building Regulations, Part L1A 2013	Proposed values
Air Tightness	5 m^3/hr per m^2	3.5 m^3/hr per m^2
Wall U-Value	0.35 W/m²°C	0.15 W/m²°C
Roof U-Value	0.25 W/m²°C	0.15 W/m²°C
Floor U-Value	0.25 W/m²°C	N/A
Exposed Floor U-Value	0.25 W/m²°C	N/A
Glazing U-Value	2.2 W/m²°C	0.9 W/m²°C
Glazing G-Value		0.40
Thermal Bridging		Accredited Construction Details. Target y-value 0.06W/m²K

The improvements to the thermal efficiency of the building envelope, combined with a high efficiency gas fired boiler and centralised whole house ventilation will result in a considerable reduction in energy required for space heating relative to a dwelling constructed to the limiting standards permitted by the Approved Document.

Fabric Standards - Change of Use Dwellings

Having established the baseline case CO_2 emissions for the building, the next step is to determine the improvement in CO_2 emissions that is achieved through the use of energy efficiency measures and the incorporation of systems and equipment whose performance is better than the limiting requirements of the Building Regulations.

Change of Use (Units 3, 4, 5)	Limiting Values Building Regulations, Part L1B 2013	Proposed values
Air Tightness	None	10 m³/hr per m²
Wall U-Value	0.30 W/m²°C	0.25 W/m²°C
Roof U-Value	N/A	N/A
Floor U-Value	N/A	N/A
Exposed Floor U-Value	N/A	N/A
Glazing U-Value	1.6 W/m²°C	1.9 W/m²°C (Secondary glazing behind existing windows)
Glazing G-Value		0.65
Thermal Bridging		Accredited Construction Details. Target y-value 0.06W/m²K

Heating and Hot Water

The generation of domestic hot water is responsible for approximately 45% of the regulated CO2 emissions from the dwellings. In order to reduce these emissions, the following measures will be implemented:

- Generation of the domestic hot water using high efficiency combi boilers with flue gas heat recovery
- Insulate domestic hot water distribution pipe-work in the dwellings.
- Provide low flow fittings, as required to meet the water use standards set by Part G of the Building Regulations and the Code for Sustainable Homes Wat 01 tool.

Lighting

Lighting accounts for 18% of the regulated CO2 emissions from the dwellings. All of the fixed light fittings will be dedicated low energy lamps. The dwellings benefit from good daylight and this will help to reduce the lighting energy consumption.

Conclusion

The 'Be Lean' measures provide a carbon reduction against the baseline Part L 2013 compliant buildings of 21.9% on regulated loads.

GLA Table 1: Carbon Dioxide Emissions after each stage of the Energy Hierarchy		
Residences	Carbon dioxide emissions (Tonnes CO_2 per annum)	
	Regulated	Unregulated
Building Regulations 2013 Part L Baseline	7.9	6.9
After energy demand reduction	6.2	6.9

GLA Table 2: Carbon Dioxide Emissions from each stage of the Energy Hierarchy		
Residences	Carbon dioxide savings (Tonnes CO_2 per annum)	
Savings from energy demand reduction	1.7	21.9%

BE CLEAN – supply energy efficiently

The next step in the Energy Hierarchy is the 'Be Clean' strategy of supplying the required energy as efficiently as possible.

Potential approaches include connecting the scheme to existing low carbon or CHP-led district energy networks, or if no existing schemes exist, investigating whether such networks are planned in the area and designing systems with the flexibility to connect to these in the future.

With or without a district energy system, the feasibility of CHP (combined heat and power). For larger developments the use of a site wide communal heating system should be provided if considered viable.

District Energy Networks

The London Heat Map has been utilised to check if the development can connect into an existing distribution network. The City Gen network terminates approximately 400m on Charterhouse Street at the southern end of Farringdon Station, but extending the network to serve a small project is not viable.

CHP and Communal Heating

On site communal heating systems serving small developments such as this are not commercially or technically viable and have not been considered.

Conclusion

The development will not be provided with a communal heating system due to the technical and management disadvantages.

The carbon emissions at the end of the 'be clean' stage are identical to those at the end of the 'be lean'.

BE GREEN – renewable energy

The third and final stage of the energy hierarchy - 'Be Green' is to review the potential of a range of renewable energy systems to serve the energy requirements of the site and thereby offset CO^2 emissions.

The following renewable energy technologies have been considered for the development:

- Solar Water Heating
- Wind Power
- Biomass Heating
- Heat Pumps
- Photovoltaics

SOLAR WATER HEATING

Solar thermal domestic hot water consumption is technically viable for this development. A solar thermal system with 2 m² of evacuated tube collector panel on the roof serving a solar domestic hot water tank would provide some carbon savings and the occupier would also benefit from renewable heat incentive payments.

WIND POWER

It is recognised that wind generators are often associated with unacceptable visual and noise implications. Wind technology as a renewable energy source is not considered appropriate for this site.

BIOMASS HEATING

Biomass heating is not considered to be a suitable technology for urban locations. With local boilers in each unit biomass boilers are not a viable solution due fuel distribution problems on the site. In addition, the boilers are often un-used due to maintenance issues, fuel supply issues, and operating costs.

HEAT PUMPS

The use of heat pump technologies has been checked one of the units and was found to give only a marginal improvement over the 'be lean' carbon emission rate, therefore, heat pumps are not considered to be a viable technology for reducing carbon emissions for this development.

PHOTOVOLTAICS

Photovoltaic collectors are compatible with the proposed building services solution. However, the 'be lean' measures achieve a 21.9% carbon emission reduction, which responds to Camden's requirement for sustainable design measures to be incorporated into the development.

Conclusion

The proposed approach of providing an efficient building envelope, providing carbon savings in excess of 21.9%, in preference to renewable technologies is felt to be the best long term solution, and provides the occupants with a robust solution that is not reliant on the operation of a technology.

CONCLUSIONS

Energy efficiency measures will be implemented to provide carbon savings of 21.9% in comparison to a baseline building that is fully compliant with the standard set by Part L 2013. The energy efficiency measures include: improved fabric insulation; improved air tightness; high efficiency fans; heat recovery on ventilation systems.

The development will not be provided with a communal heating system as it is too small for communal heating to be viable.

Renewable technologies will not be provided as the be lean measures result in a sustainable solution that provides the occupants with a robust solution.

GLA tables 6 shows the savings in carbon dioxide achieved by the three steps. The total regulated carbon saving through the combination of energy efficient design and renewable technologies is 21.9%.

Table 6: Site wide regulated carbon dioxide emissions and savings			
Site Total	Total regulated emissions (Tonnes CO_2/year)	CO_2 Savings(Tonnes CO_2/year)	Percentage Saving
	(Tonnes CO_2 per annum)		(%)
Building Regulations 2013 Part L Baseline	7.9		
After energy demand reduction	6.2	1.7	21.9%
After CHP	6.2	0.0	0.0%
After Low or Zero Carbon Technologies	6.2	0.0	0.0%
Total cumulative savings		**1.7**	**21.92%**

For the new build dwellings only the total floor area is 209m². The table below shows the carbon emissions and savings for the new build dwellings only. The carbon savings through energy efficient design for the new build dwellings is 23.2%

Table 6: Site wide regulated carbon dioxide emissions and savings			
New Build Only	Total regulated emissions (Tonnes CO_2/year)	CO_2 Savings(Tonnes CO_2/year)	Percentage Saving
	(Tonnes CO_2 per annum)		(%)
Building Regulations 2013 Part L Baseline	3.9		
After energy demand reduction	3.0	0.9	23.2%
After CHP	3.0	0.0	0.0%
After Low or Zero Carbon Technologies	3.0	0.0	0.0%
Total cumulative savings		**0.9**	**23.23%**

Appendix A –SAP Outputs

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 Barry Redman	Assessor number	1
Client	Hatton Garden Properties	Last modified	
17/10/2016 Address	80 Leather lane 12 Lean, London		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		50.73	(1a)	x	2.85	(2a)	=	144.58	(3a)
+1		37.99	(1b)	x	3.00	(2b)	=	113.97	(3b)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	88.72	(4)						
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =			258.55	(5)

2. Ventilation rate

				m³ per hour	
Number of chimneys		0	x 40 =	0	(6a)
Number of open flues		0	x 20 =	0	(6b)
Number of intermittent fans		0	x 10 =	0	(7a)
Number of passive vents		0	x 10 =	0	(7b)
Number of flueless gas fires		0	x 40 =	0	(7c)
				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	0	÷ (5) =	0.00	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.50	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.18	(18)
Number of sides on which the dwelling is sheltered		1	(19)
Shelter factor	1 - [0.075 x (19)] =	0.93	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.16	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.21	0.20	0.20	0.18	0.17	0.15	0.15	0.15	0.16	0.17	0.18	0.19	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

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

0.31	0.30	0.30	0.28	0.27	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 (25)

0.31	0.30	0.30	0.28	0.27	0.25	0.25	0.25	0.26	0.27	0.28	0.29	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			15.34	x	0.87	=	13.33			(27)
External wall			123.28	x	0.15	=	18.49			(29a)
Party wall			60.00	x	0.00	=	0.00			(32)
Roof			49.85	x	0.12	=	5.98			(30)
Total area of external elements ∑A, m²			188.47							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	37.80	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K		250.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		10.51	(36)
Total fabric heat loss	(33) + (36) =	48.31	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	26.18	25.84	25.49	23.77	23.42	21.70	21.70	21.35	22.39	23.42	24.11	24.80	(38)
Heat transfer coefficient, W/K (37)m + (38)m	74.49	74.15	73.80	72.07	71.73	70.00	70.00	69.66	70.69	71.73	72.42	73.11	
Average = ∑(39)1...12/12 =												71.99	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	0.84	0.84	0.83	0.81	0.81	0.79	0.79	0.79	0.80	0.81	0.82	0.82	
Average = ∑(40)1...12/12 =												0.81	(40)
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.61	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	96.14	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	105.75	101.90	98.06	94.21	90.37	86.52	86.52	90.37	94.21	98.06	101.90	105.75	
∑(44)1...12 =												1153.62	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	156.82	137.16	141.53	123.39	118.40	102.17	94.67	108.64	109.94	128.12	139.86	151.87	
∑(45)1...12 =												1512.58	(45)
Distribution loss 0.15 x (45)m	23.52	20.57	21.23	18.51	17.76	15.33	14.20	16.30	16.49	19.22	20.98	22.78	(46)
Water storage loss calculated for each month (55) x (41)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)
Primary circuit loss for each month from Table 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)
Combi loss for each month from Table 3a, 3b or 3c	50.96	46.03	49.97	46.46	46.05	42.67	44.09	46.05	46.46	49.97	49.32	50.96	(61)
Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m	207.78	183.18	191.50	169.85	164.45	144.84	138.77	154.69	156.40	178.09	189.17	202.83	(62)

Solar DHW input calculated using Appendix G or Appendix H

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

Flue gas heat recovery system 1 input (Appendix G1)

-29.41	-25.65	-25.00	-19.19	-16.84	-14.37	-13.36	-15.21	-15.38	-20.50	-25.59	-28.97	(63)

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

178.37	157.53	166.50	150.66	147.61	130.47	125.40	139.48	141.02	157.59	163.58	173.86

∑(64)1...12 = 1832.08 (64)

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

64.88	57.11	59.55	52.64	50.88	44.64	42.50	47.64	48.17	55.09	58.83	63.24	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	130.39	130.39	130.39	130.39	130.39	130.39	130.39	130.39	130.39	130.39	130.39	130.39	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	22.27	19.78	16.08	12.18	9.10	7.68	8.30	10.79	14.49	18.39	21.47	22.89	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	236.70	239.16	232.97	219.79	203.16	187.53	177.08	174.63	180.82	193.99	210.63	226.26	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.04	36.04	36.04	36.04	36.04	36.04	36.04	36.04	36.04	36.04	36.04	36.04	(69)
Pump and fan gains (Table 5a)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (Table 5)	-104.31	-104.31	-104.31	-104.31	-104.31	-104.31	-104.31	-104.31	-104.31	-104.31	-104.31	-104.31	(71)
Water heating gains (Table 5)	87.21	84.99	80.04	73.12	68.39	62.00	57.13	64.03	66.90	74.05	81.71	85.00	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	411.30	409.04	394.21	370.20	345.77	322.32	307.63	314.56	327.32	351.55	378.92	399.26	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
East	0.77	x	6.30	x	19.64	x 0.9 x	0.64	x	0.70	=	38.41	(76)
South	0.77	x	2.65	x	46.75	x 0.9 x	0.64	x	0.70	=	38.46	(78)
West	0.77	x	4.50	x	19.64	x 0.9 x	0.64	x	0.70	=	27.44	(80)
NorthWest	0.77	x	1.89	x	11.28	x 0.9 x	0.64	x	0.70	=	6.62	(81)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains in watts ∑(74)m...(82)m	110.94	205.30	316.68	439.98	527.31	536.27	511.88	446.36	360.16	237.28	136.04	92.80	(83)
Total gains - internal and solar (73)m + (83)m	522.23	614.34	710.89	810.19	873.07	858.60	819.51	760.93	687.48	588.83	514.96	492.06	(84)

7. Mean internal temperature (heating season)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	1.00	0.99	0.98	0.90	0.73	0.52	0.38	0.42	0.69	0.95	0.99	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	20.19	20.35	20.58	20.84	20.97	21.00	21.00	21.00	20.98	20.79	20.44	20.17	(87)

Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)	20.22	20.22	20.23	20.24	20.25	20.26	20.26	20.27	20.26	20.25	20.24	20.23	(88)
Utilisation factor for gains for rest of dwelling n2,m	1.00	0.99	0.97	0.87	0.68	0.46	0.31	0.35	0.62	0.93	0.99	1.00	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)	19.47	19.63	19.86	20.12	20.23	20.26	20.26	20.27	20.25	20.08	19.74	19.47	(90)

Living area fraction — Living area ÷ (4) = 0.34 (91)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2	19.72	19.87	20.10	20.36	20.48	20.51	20.51	20.51	20.50	20.32	19.98	19.70	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate	19.57	19.72	19.95	20.21	20.33	20.36	20.36	20.36	20.35	20.17	19.83	19.55	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	1.00	0.99	0.97	0.87	0.69	0.47	0.32	0.36	0.63	0.93	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	520.45	608.22	686.42	707.17	599.62	402.04	263.27	275.96	433.58	545.87	510.23	490.88	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	1137.11	1099.01	992.86	815.33	618.74	403.24	263.35	276.12	441.58	686.54	921.85	1122.55	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	458.79	329.81	227.99	77.88	14.22	0.00	0.00	0.00	0.00	104.66	296.36	469.97	

∑(98)1...5, 10...12 = 1979.69 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) 22.31 (99)

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

Space heating

Fraction of space heat from secondary/supplementary system (table 11)		0.00	(201)
Fraction of space heat from main system(s)	1 - (201) =	1.00	(202)
Fraction of space heat from main system 2		0.00	(202)
Fraction of total space heat from main system 1	(202) x [1- (203)] =	1.00	(204)
Fraction of total space heat from main system 2	(202) x (203) =	0.00	(205)
Efficiency of main system 1 (%)		90.90	(206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating fuel (main system 1), kWh/month	504.72	362.83	250.82	85.67	15.65	0.00	0.00	0.00	0.00	115.13	326.03	517.02

∑(211)1...5, 10...12 = 2177.87 (211)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Efficiency of water heater	87.83	87.37	86.34	83.98	81.60	80.80	80.80	80.80	80.80	84.55	87.03	87.93	(217)
Water heating fuel, kWh/month	203.09	180.31	192.83	179.40	180.90	161.47	155.20	172.62	174.53	186.39	187.96	197.72	

∑(219a)1...12 = 2172.43 (219)

Annual totals

Space heating fuel - main system 1	2177.87
Water heating fuel	2172.43

Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	169.54		(230a)
central heating pump or water pump within warm air heating unit	30.00		(230c)
boiler flue fan	45.00		(230e)
Total electricity for the above, kWh/year		244.54	(231)
Electricity for lighting (Appendix L)		393.25	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	4988.10	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2177.87	x	3.48	x 0.01 =	75.79	(240)
Water heating	2172.43	x	3.48	x 0.01 =	75.60	(247)
Pumps and fans	244.54	x	13.19	x 0.01 =	32.26	(249)
Electricity for lighting	393.25	x	13.19	x 0.01 =	51.87	(250)
Additional standing charges					120.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	355.52	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.12	(257)
SAP value	84.42	
SAP rating (section 13)	84	(258)
SAP band	B	

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

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	2177.87	x	0.22	=	470.42	(261)
Water heating	2172.43	x	0.22	=	469.25	(264)
Space and water heating				(261) + (262) + (263) + (264) =	939.67	(265)
Pumps and fans	244.54	x	0.52	=	126.92	(267)
Electricity for lighting	393.25	x	0.52	=	204.09	(268)
Total CO_2, kg/year				(265)...(271) =	1270.68	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	14.32	(273)
EI value					87.27	
EI rating (section 14)					87	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	2177.87	x	1.22	=	2657.01	(261)
Water heating	2172.43	x	1.22	=	2650.37	(264)
Space and water heating				(261) + (262) + (263) + (264) =	5307.37	(265)
Pumps and fans	244.54	x	3.07	=	750.75	(267)
Electricity for lighting	393.25	x	3.07	=	1207.27	(268)
Primary energy kWh/year					7265.39	(272)
Dwelling primary energy rate kWh/m2/year					81.89	(273)

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 Barry Redman	Assessor number	1
Client	Hatton Garden Properties	Last modified	
17/10/2016 Address	80 Leather Lane 4 Lean, London		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		60.91	(1a)	x	2.85	(2a)	=	173.59	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	60.91	(4)						
Dwelling volume							(3a) + (3b) + (3c) + (3d)...(3n) =	173.59	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	0	x 10 =	0	(7a)
Number of passive vents	0	x 10 =	0	(7b)
Number of flueless gas fires	0	x 40 =	0	(7c)

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

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		10.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.50	(18)
Number of sides on which the dwelling is sheltered		2	(19)
Shelter factor	1 - [0.075 x (19)] =	0.85	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.43	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table U2	5.10	5.00	4.90	4.40	4.30	3.80	3.80	3.70	4.00	4.30	4.50	4.70	(22)
Wind factor (22)m ÷ 4	1.28	1.25	1.23	1.10	1.08	0.95	0.95	0.93	1.00	1.08	1.13	1.18	(22a)
Adjusted infiltration rate (allowing for shelter and wind factor) (21) x (22a)m	0.54	0.53	0.52	0.47	0.46	0.40	0.40	0.39	0.43	0.46	0.48	0.50	(22b)

Calculate effective air change rate for the applicable case:

If mechanical ventilation: air change rate through system	0.50	(23a)
If balanced with heat recovery: efficiency in % allowing for in-use factor from Table 4h	79.90	(23c)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
a) If balanced mechanical ventilation with heat recovery (MVHR) (22b)m + (23b) x [1 - (23c) ÷ 100]	0.64	0.63	0.62	0.57	0.56	0.50	0.50	0.49	0.53	0.56	0.58	0.60	(24a)
Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)	0.64	0.63	0.62	0.57	0.56	0.50	0.50	0.49	0.53	0.56	0.58	0.60	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m^2	Openings m^2	Net area A, m^2		U-value W/m^2K		A x U W/K	κ-value, $kJ/m^2.K$	A x κ, kJ/K	
Window			4.80	x	1.50	=	7.22			(27)
External wall			48.76	x	0.35	=	17.07			(29a)
Party wall			50.00	x	0.00	=	0.00			(32)
Total area of external elements ∑A, m^2			53.56							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	24.28	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m^2K		250.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		2.80	(36)
Total fabric heat loss	(33) + (36) =	27.08	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	36.80	36.19	35.58	32.54	31.93	28.89	28.89	28.28	30.10	31.93	33.15	34.36	(38)
Heat transfer coefficient, W/K (37)m + (38)m	63.88	63.27	62.67	59.62	59.01	55.97	55.97	55.36	57.19	59.01	60.23	61.45	

Average = ∑(39)1...12/12 = 59.47 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss parameter (HLP), W/m^2K (39)m ÷ (4)	1.05	1.04	1.03	0.98	0.97	0.92	0.92	0.91	0.94	0.97	0.99	1.01	

Average = ∑(40)1...12/12 = 0.98 (40)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.01	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	81.87	(43)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Hot water usage in litres per day for each month Vd,m = factor from Table 1c x (43)	90.06	86.78	83.51	80.23	76.96	73.68	73.68	76.96	80.23	83.51	86.78	90.06	

∑(44)1...12 = 982.46 (44)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	133.56	116.81	120.54	105.09	100.83	87.01	80.63	92.52	93.63	109.11	119.11	129.34	

∑(45)1...12 = 1288.17 (45)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Distribution loss 0.15 x (45)m	20.03	17.52	18.08	15.76	15.12	13.05	12.09	13.88	14.04	16.37	17.87	19.40	(46)
Water storage loss calculated for each month (55) x (41)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)
Primary circuit loss for each month from Table 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)
Combi loss for each month from Table 3a, 3b or 3c	45.89	39.94	42.56	39.57	39.22	36.34	37.55	39.22	39.57	42.56	42.80	45.89	(61)
Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m	179.45	156.75	163.09	144.65	140.05	123.35	118.18	131.74	133.19	151.67	161.90	175.23	(62)
Solar DHW input calculated using Appendix G or Appendix H	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)

Flue gas heat recovery system 1 input (Appendix G1)

-26.54	-23.45	-23.32	-19.19	-16.00	-12.29	-11.37	-13.07	-13.22	-19.51	-23.10	-25.91	(63)

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

152.91	133.30	139.77	125.47	124.05	111.06	106.81	118.67	119.98	132.16	138.81	149.33	

∑(64)1...12 = 1552.31 (64)

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

55.88	48.82	50.72	44.83	43.33	38.02	36.20	40.57	41.02	46.92	50.30	54.48	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	100.36	100.36	100.36	100.36	100.36	100.36	100.36	100.36	100.36	100.36	100.36	100.36	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	18.91	16.80	13.66	10.34	7.73	6.53	7.05	9.17	12.30	15.62	18.23	19.44	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	175.24	177.05	172.47	162.72	150.40	138.83	131.10	129.28	133.86	143.62	155.93	167.50	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	33.04	33.04	33.04	33.04	33.04	33.04	33.04	33.04	33.04	33.04	33.04	33.04	(69)
Pump and fan gains (Table 5a)	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	(70)
Losses e.g. evaporation (Table 5)	-80.29	-80.29	-80.29	-80.29	-80.29	-80.29	-80.29	-80.29	-80.29	-80.29	-80.29	-80.29	(71)
Water heating gains (Table 5)	75.11	72.66	68.17	62.27	58.24	52.80	48.65	54.53	56.98	63.06	69.86	73.22	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	325.36	322.62	310.41	291.43	272.48	254.26	242.91	249.08	259.25	278.41	300.14	316.27	(73)

6. Solar gains

	Access factor Table 6d		Area m²		Solar flux W/m²		g specific data or Table 6b		FF specific data or Table 6c		Gains W	
West	0.77	x	4.80	x	19.64	x 0.9 x	0.76	x	0.70	=	34.76	(80)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Solar gains in watts ∑(74)m...(82)m	34.76	67.99	111.97	163.30	200.13	204.87	195.05	167.54	130.23	80.68	43.34	28.58	(83)
Total gains - internal and solar (73)m + (83)m	360.12	390.61	422.38	454.74	472.62	459.14	437.96	416.62	389.48	359.09	343.47	344.86	(84)

7. Mean internal temperature (heating season)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	1.00	1.00	0.99	0.97	0.91	0.73	0.55	0.60	0.86	0.98	1.00	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.89	20.01	20.23	20.56	20.81	20.97	20.99	20.99	20.91	20.58	20.21	19.91	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	20.04	20.05	20.06	20.10	20.11	20.15	20.15	20.16	20.13	20.11	20.09	20.08	(88)
Utilisation factor for gains for rest of dwelling n2,m	1.00	1.00	0.99	0.96	0.87	0.65	0.45	0.50	0.80	0.97	0.99	1.00	(89)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	19.03	19.15	19.38	19.73	19.98	20.14	20.15	20.16	20.08	19.77	19.39	19.08	(90)

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

Mean internal temperature for the whole dwelling fLA x T1 +(1 - fLA) x T2	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	19.45	19.58	19.80	20.14	20.39	20.54	20.57	20.57	20.49	20.17	19.80	19.49	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate	19.30	19.43	19.65	19.99	20.24	20.39	20.42	20.42	20.34	20.02	19.65	19.34	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	1.00	0.99	0.99	0.96	0.88	0.68	0.48	0.53	0.82	0.97	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	358.99	388.49	417.09	436.65	415.07	311.53	212.14	220.17	317.62	348.36	341.34	344.01	(95)
Monthly average external temperature from Table U1	4.30	4.90	6.50	8.90	11.70	14.60	16.60	16.40	14.10	10.60	7.10	4.20	(96)
Heat loss rate for mean internal temperature, Lm, W [(39)m x [(93)m - (96)m]	958.35	919.09	823.86	661.14	503.75	324.30	213.58	222.47	356.66	555.95	755.71	930.19	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	445.92	356.57	302.63	161.63	65.98	0.00	0.00	0.00	0.00	154.45	298.35	436.12	

∑(98)1...5, 10...12 = 2221.65 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) 36.47 (99)

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

Space heating

Fraction of space heat from secondary/supplementary system (table 11)		0.00	(201)
Fraction of space heat from main system(s)	1 - (201) =	1.00	(202)
Fraction of space heat from main system 2		0.00	(202)
Fraction of total space heat from main system 1	(202) x [1- (203)] =	1.00	(204)
Fraction of total space heat from main system 2	(202) x (203) =	0.00	(205)
Efficiency of main system 1 (%)		90.90	(206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating fuel (main system 1), kWh/month	490.56	392.26	332.93	177.82	72.58	0.00	0.00	0.00	0.00	169.91	328.21	479.78

∑(211)1...5, 10...12 = 2444.06 (211)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Efficiency of water heater	88.09	87.91	87.45	86.19	84.04	80.80	80.80	80.80	80.80	85.95	87.43	88.09	(217)
Water heating fuel, kWh/month	173.59	151.63	159.83	145.57	147.60	137.45	132.19	146.87	148.49	153.77	158.76	169.51	

∑(219a)1...12 = 1825.27 (219)

Annual totals

Space heating fuel - main system 1		2444.06	
Water heating fuel		1825.27	
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	105.89		(230a)
central heating pump or water pump within warm air heating unit	30.00		(230c)
boiler flue fan	45.00		(230e)
Total electricity for the above, kWh/year		180.89	(231)

Electricity for lighting (Appendix L)		333.96	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	4784.19	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2444.06	x	3.48	x 0.01 =	85.05	(240)
Water heating	1825.27	x	3.48	x 0.01 =	63.52	(247)
Pumps and fans	180.89	x	13.19	x 0.01 =	23.86	(249)
Electricity for lighting	333.96	x	13.19	x 0.01 =	44.05	(250)
Additional standing charges					120.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	336.48	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.33	(257)
SAP value	81.39	
SAP rating (section 13)	81	(258)
SAP band	B	

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

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	2444.06	x	0.22	=	527.92	(261)
Water heating	1825.27	x	0.22	=	394.26	(264)
Space and water heating				(261) + (262) + (263) + (264) =	922.18	(265)
Pumps and fans	180.89	x	0.52	=	93.88	(267)
Electricity for lighting	333.96	x	0.52	=	173.33	(268)
Total CO_2, kg/year				(265)...(271) =	1189.39	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	19.53	(273)
EI value					84.95	
EI rating (section 14)					85	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	2444.06	x	1.22	=	2981.76	(261)
Water heating	1825.27	x	1.22	=	2226.83	(264)
Space and water heating				(261) + (262) + (263) + (264) =	5208.59	(265)
Pumps and fans	180.89	x	3.07	=	555.34	(267)
Electricity for lighting	333.96	x	3.07	=	1025.27	(268)
Primary energy kWh/year					6789.20	(272)
Dwelling primary energy rate kWh/m2/year					111.46	(273)