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15 Lyndhurst Terrace

Energy Statement

Mar-17

Project	15 Lyndhurst Terrace
MW Reference	J2229- 15 Lyndhurst Terrace
Location	Camden
Local Authority	London Borough of Camden
Report Scope	Energy Statement
Quantity of Residential Units	1
Other	N/A

Issue 01 For Planning

Date 21/03/2017

Author Alex Mozaffari

Checked by Fergus Traynor

Contents

Executive Summary

15 Lyndhurst Terrace development comprises one residential detached house and is located in Camden.
Mendick Waring have been appointed to produce an Energy Strategy identifying how the development will address the policies and targets set out by London Borough of Camden.

In line with Camden Policy, mitigation against climate change includes carbon reduction targets for residential buildings; Policy CC1 seeks the fullest contribution to minimising carbon dioxide emissions in accordance with a three-part energy hierarchy; be lean, be clean and be green. The policy seeks for a 19% improvement on Part L1A 2013 building regulations in terms of minimising CO_2 emissions. In light of this, the enclosed strategy seeks to demonstrate and incorporate feasible design elements to maximise CO_2 saving associated with this development.
This strategy also demonstrates that the development will achieve compliance with 2013 Building Regulations through Energy efficiency and FEE (fabric energy efficiency).

Passive design measures and 2 kWp of photovoltaic panels have been proposed for this development. This will result in 29.3% of CO_2 reduction compared to the Baseline building regulation. The PV panels will be installed on the roof. This is subject to further detailed investigation and calculation. The CO_2 reduction by photovoltaic panels is 20.4% of the total Carbon Dioxide reduction of the development. As the result, the development complies with Policy CC1, Supplementary Planning Guidance and Building Regulations Part L 2013.

- It should be noted that this strategy has been completed as follows:
  - All new fabric elements proposed will be designed to achieve average fabric performance 30% or more above minimum standard as defined under AD Part L1A 2013.

Table 1. Building fabric specifications

Building Element	New Elements Part L minimum standard U-value	Design U-values	% improvement
Floors	0.25 W/m²K	0.10 W/m²K	60%
Roofs	0.20 W/m²K	0.11 W/m²K	45%
External Walls	0.30 W/m²K	0.15 W/m²K	50%
Glazing	2.00 W/m²K	1.5 W/m²K	25%
Doors	2.00 W/m²K	1.4 W/m²K	30%
Air permeability	10.0 m³/(h*m²)	4.00 m³/(h*m²)	60%

1 Introduction

The proposed development is one residential detached house. The building comprises basement, ground floor, upper ground floor and first floor. The plans and layouts are shown in Figures 1-3.

Proposed Development

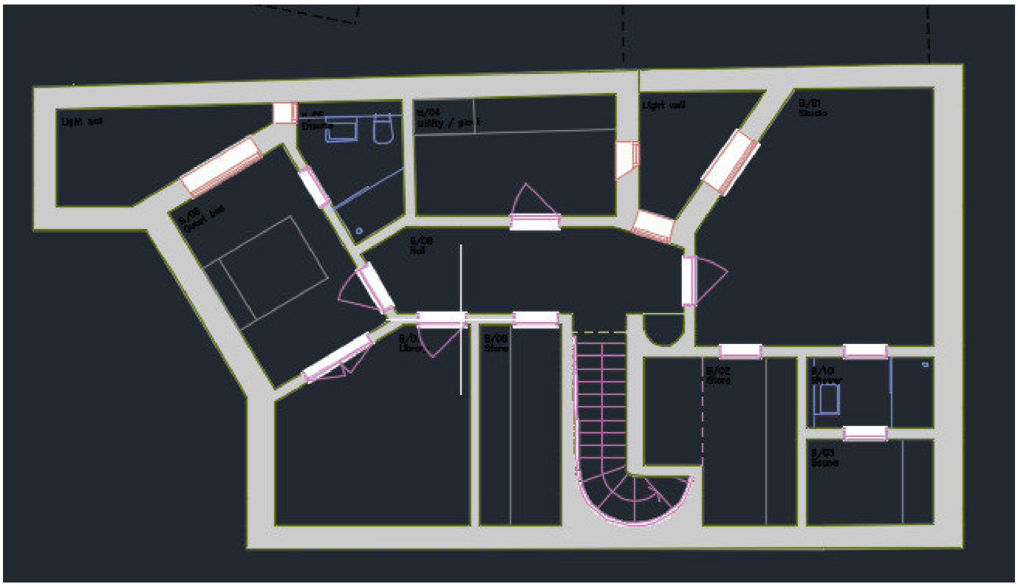


Figure 1 – Proposed basement floor plan

Figure 2 – Proposed Upper Ground floor plan

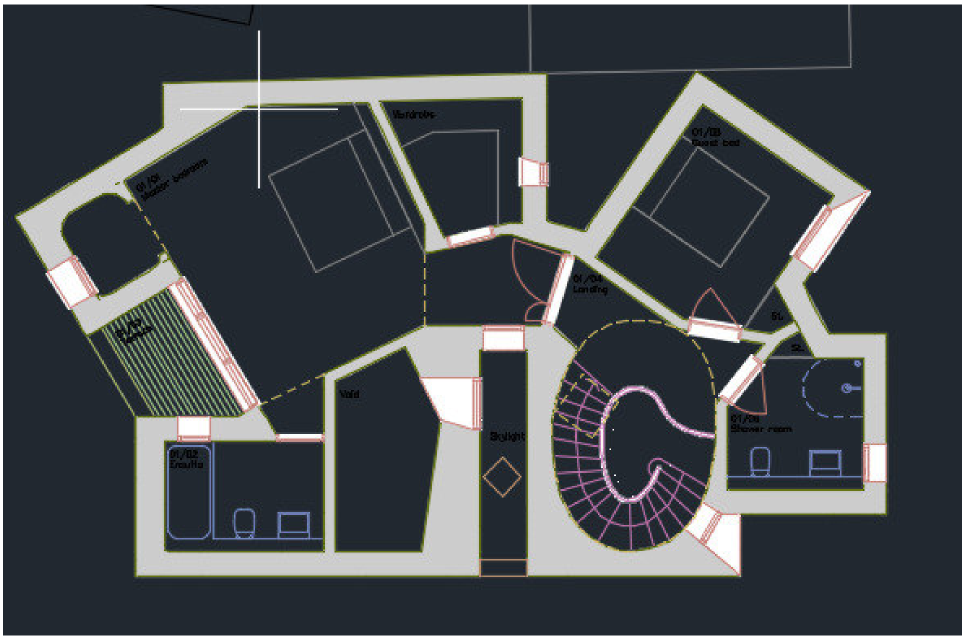


Figure 3 – Proposed first floor plan

2 Planning Policy Guidance and Legislation

London Borough of Camden Policy, Climate Change Mitigation and Sustainable Design, June 2016, requires the following policies to be addressed for residential buildings:

- **Local Plan approach**

  The Camden Local Plan seeks to adopt pro-active strategies to mitigate and adapt to climate change in accordance with the NPPF and London Plan. This section outlines the approach in the Local Plan to climate change mitigation (specifically carbon dioxide reduction) and sustainable design.

- **Climate change mitigation**

  Local Plan Policy CS13 Tackling climate change through promoting higher environmental Standards

  The Council will require all development to take measures to minimise the effects of, and adapt to, climate change and encourage all development to meet the highest feasible environmental standards that are financially viable during construction and occupation by:

  a) ensuring patterns of land use that minimise the need to travel by car and help support local energy networks;

  b) promoting the efficient use of land and buildings;

  c) minimising carbon emissions from the redevelopment, construction and occupation of buildings by implementing, in order, all the elements of the following energy hierarchy:

  - ensuring developments use less energy,
  - generating renewable energy on-site; and

  d) ensuring buildings and spaces are designed to cope with, and minimise the effects of, climate change.

  Sustainable Design and Construction DP22

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

  a) demonstrate how sustainable development principles, including the relevant measures set out in paragraph 22.5, have been incorporated into the design and proposed implementation; and

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

In addition to above, London Borough of Camden Supplementary Planning Guidance also requires the following:

Policy 6. Renewable energy

- All developments are to target at least **a 20% reduction in carbon dioxide emissions through the installation of on-site renewable energy** technologies. Special consideration will be given to heritage buildings and features to ensure that their historic and architectural features are preserved.

3 Low and Zero Carbon Technologies

- Given the requirement to achieve a number of Building standards and requirements, design development has been undertaken as part of the RIBA Stage 1 / 2 process. As part of this process, a number of technologies have been considered, with feasibility / viability and practicality considered given the various design considerations.
- In light of this, a feasibility study has been undertaken, identifying the following:

a) Appropriate technologies

b) Energy generated from Low and Zero Carbon Technologies per annum

c) Available funding grants

d) Life cycle cost of specification (including allowances for payback)

e) Local planning criteria (inc preferred solutions)

f) Feasibility of exporting heat / electricity from chosen system

- In order to fully identify appropriate technologies, an initial evaluation has been undertaken based on the expected baseline energy demand. Baseline Energy is calculated on a development with identical geometry built to meet Building Regulations, thus using standard building fabric parameters and notional heating systems.

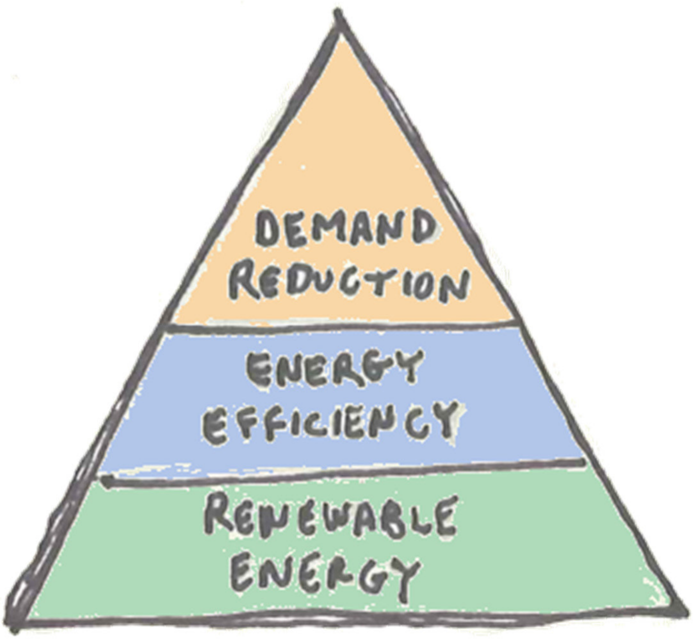


Figure 4 – *Energy Hierarchy*

3.1 Combined Heat & Power (CHP) Technology

CHP effectively uses waste heat from the electricity generation process to provide useful heat for space and water heating; the advantage of this system is that it leads to higher system efficiencies when compared to a typical supply arrangement of grid-imported electricity and conventional boilers. A further advantage is that because electricity is generated close to the point of use, the losses incurred in High Voltage (HV) transmission are avoided. CHP is considered as a low carbon technology when fired by gas or fuel oil to generate electricity and provide heating and hot water. At this scale, a gas-fired reciprocating engine CHP is the preferred technology due to efficiency, maintenance and plant space considerations, and is well-proven with many successful installations in UK. CHP systems offer optimum carbon and cost savings when matched to the site electricity and heat load profiles such that the units see a high utilisation and make a significant contribution to the site's annual energy demands.

CHP units should be replaced every 15-17 years, with replacement timeframes subject to alteration pending regular maintenance and part failure.

Given that 15 Lyndhurst Terrace is a single detached House and the scheme will have efficient boilers, the use of CHP is not a viable solution.

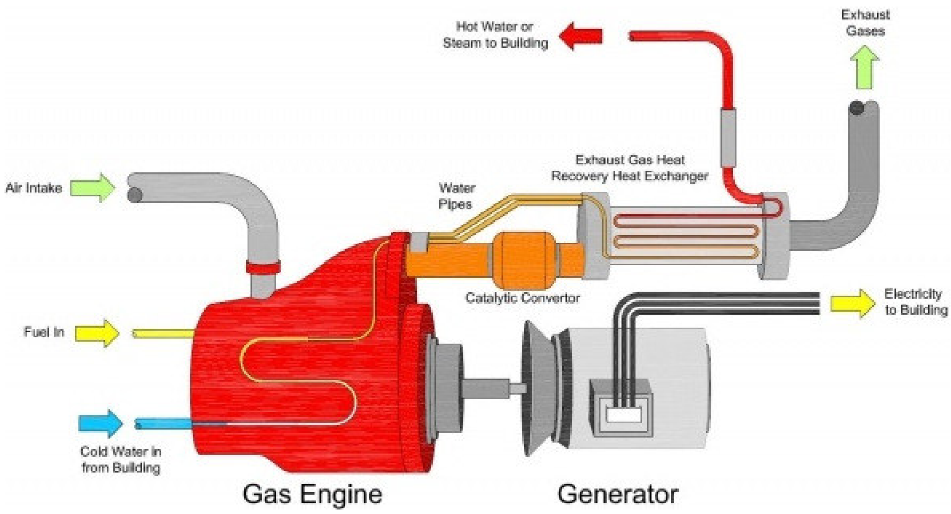


Figure 5 – *CHP Technology*

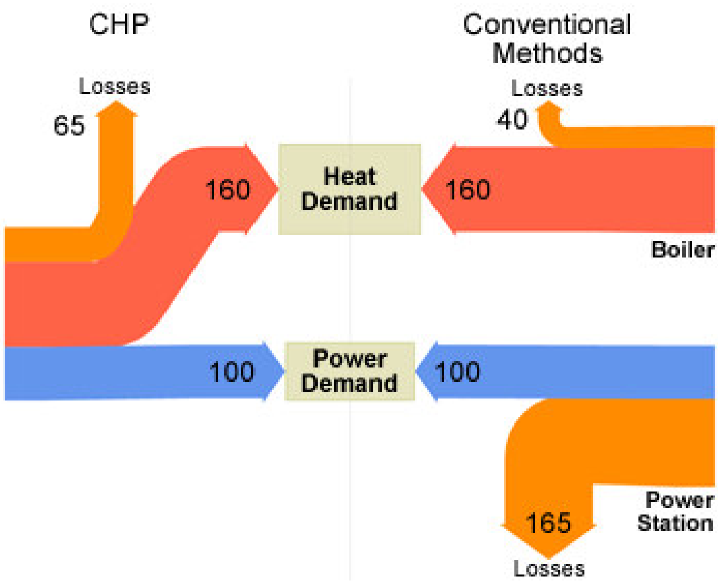


Figure 6 – CHP System Schematic

3.2 Wind Energy

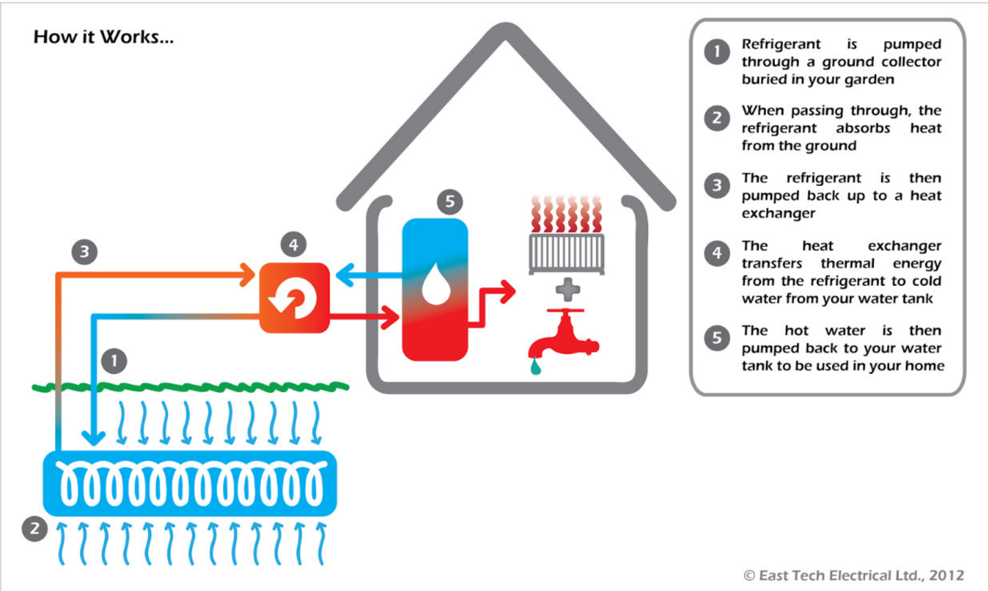
Although wind turbines can generate up to 3MW of electricity, smaller units are available generating between 0.5 kW to 6.0 kW. The area would need to be accessed to establish the practicality of installing a wind turbine. Electricity is generated in DC and requires an inverter to convert to AC to operate domestic appliances. Where electricity is generated but not required, it can be sold to the local electricity company,

Given the location and the wind speed available provides minimal feasible electrical generation and as such has been discounted. It should also be noted, the proposed extension is surrounded by the other buildings the incorporation of wind turbine will likely to operate at low capacity, subject to periods of non-operation, grid connection, noise and take long time before achieving payback on the initial costs.

3.3 Ground Source Heat Pump

A Ground Source Heat Pump (GSHP) transfers energy from the ground to the building to provide space heating or pre-heating of domestic hot water. Unlike wind and solar heating it requires an electrical input, however, the heat recovered is three to four times the required electrical input. Heat is transferred from the ground using a ground loop, which can either be within a vertical borehole arrangement or laid as coils in a horizontal trench. The heat pump works in the same way as a domestic refrigerator in reverse, by extracting heat from the borehole/trench to evaporate the refrigerant on the heat pump circuit. Heat is then input to the building as the refrigerant condenses.

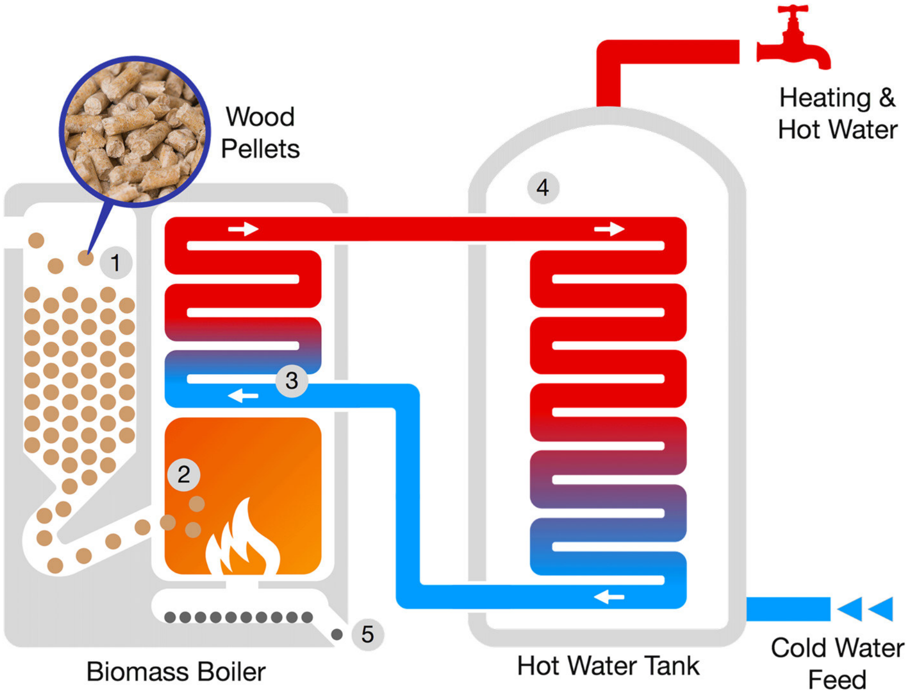
Any proposed GSHP would require the use of a large number of vertical boreholes across the site. Given the small foot print of the development site, the piling of the foundations that run below ground, this has been discounted owing to practical constraints associated with GSHP.



3.4 Biomass

Biomass boilers burn renewable fuel to generate hot water for direct use, or for heating purposes. The fuel they burn is renewable because it is in a constant carbon cycle. There are three main forms of biomass boilers available, namely those using wood chips as fuel, those using wood pellets as fuel and those using wood logs

The operation and installation of Biomass requires additional plant space for the storage of solid fuel and design of access routes for delivery of fuel. Given the urban location of the development, this has been discounted owing to practical constraints associated with Biomass.



3.5 Air Source Heat Pumps

Air Source Heat Pumps (ASHP) provides an efficient method of heating and cooling requirements. Heat is absorbed from the air into liquid via a heat exchanger where *'useful'* heat is extracted and absorbed. Low grade heat is then extracted by a refrigeration system, compressed and concentrated to temperatures suitable for space heating and hot water requirements.

While ASHP utilise electricity to generate this process, the heat gained is taken directly from the available air and produces fewer greenhouse gases when compared to a conventional gas system.

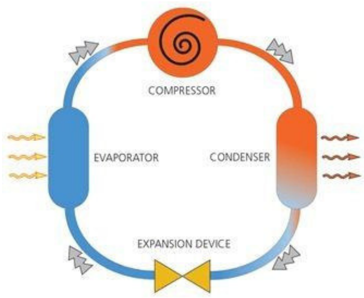
ASHP have been classified as a renewable system under the European Directive on '*Promotion of Renewable Energy Sources'* and Policy 5.7 *'Renewable Energy'* of the London Plan 2015.

ASHP and associated plant require annual maintenance and adequate space for condensing units. Expected lifetimes range from 7-10 years, however, this will be subject to maintenance programmes and information provided at detailed design stage.

ASHP do generate noise as a result of operation, however, with careful consideration during design proposals, can be mitigated through the use of acoustic attenuation.

ASHP provide the most efficient method of providing the cooling requirements in hotels because of heat pumps high efficiency. They produce less CO_2 emissions than other systems that run on Gas, LPG or Oil. Air source heat pumps work in reverse cycle to provide cooling. Therefore, cooling and heating can be provided simultaneously.

This technology has been considered to be unviable for this scheme due to cost and technical requirement to provide 100% of the heating and hot water demand.



3.6 Photovoltaics

Photovoltaic (PV) panels create electricity from solar radiation with efficiency ranging between 5 and 19%. PV modules generally require minimal maintenance, usually consisting of a visual inspection and associated electrical testing. They have no moving parts and an expected lifetime of over 30-40 years. Manufacturers typically offer a warranty on power output of 20-25 years. PV modules have no operating emissions and produce no noise, making them the most benign zero-carbon technology.

Following a review of available roof area, the provision of PV placement should be considered in context, noting any issues resulting from external plant, access and architectural aesthetics. An initial investigation has been carried out in conjunction with the architect, in order to identify a suitable position for installation of PV arrays at roof level.

2 kWp of photovoltaic panels are proposed to provide approximately 1,647 kWh of electricity for the development.

3.7 Solar Thermal Collectors

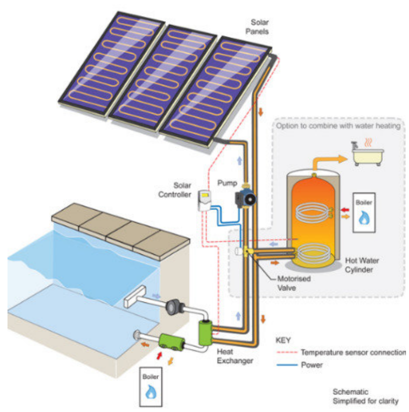
Solar thermal collectors utilise solar radiation to heat water for use in water heating of a building. The radiation is converted using a solar collector, of which there are two main types available: Flat Plate and Evacuated Tube collectors. Evacuated tube systems occupy a smaller area and are more efficient, but also generally more expensive. Flat plate systems are cheaper to install but generally less efficient.

The solar coverage indicates what percentage of the annual domestic hot water energy requirement can be covered by a solar water heating system. The higher the solar coverage, the more conventional energy usage can be offset, but can cause excess heat generation in the peak summer months and generally lower the average collector efficiency. Therefore, solar coverage's of 40-70% are recommended for most domestic applications and up to 40% in non-domestic buildings.

Solar thermal systems in the UK normally operate with a back-up fuel source, such as gas or electricity. The solar system pre-heats the water up to a maximum hot water temperature. If there is not enough solar power available to fully meet the required hot water load, then the back-up fuel system fires up to meet this short fall. The optimum orientation for a solar collector in the UK is a south facing surface, tilted at an angle of 30º from the horizontal. However, orientation is not critical, with azimuths of +/-30o from South and angles of +/-20° from 30° still achieve reasonable outputs.

In order for the solar water heating system to run safely and efficiently, a series of temperature sensors are connected to a digital solar controller to switch the system on or off according to the solar energy available. The roof area required depends on the efficiency of the modules specified and will vary depending on the product selected. This will be determined by the relevant contractor.

The limited available roof area of the development will be used to install photovoltaic panels.



4 Energy Modelling

The proposed development looks to integrate low U-values, a high performance building thermal envelope for the built fabric and provide the necessary improvements to minimise CO_2 of the scheme.

The internal lighting should be designed to have luminous efficacy of ≥ 45 lumens/watt in all domestic spaces.

The scheme's water use should be ≤125 litres/person/day.

Government approved software (NHER Plan Assessor 6.2.1) has been used to calculate energy consumption based on SAP methodology (2012) and Part L1A 2013.

4.1 Specifications

The following specification has been used to model energy efficiency for the development:

Project:	15 Lyndhurst Terrace	MENDICK WARING LTD consulting engineers
Project No:	J2229	
Engineer:	Alex Mozaffari	
Date:	07/03/2016	
Building Regs:	2013 Part L1A	
Status:	As Designed	
Element	**U-Value (W/m²K)**	**Construction**
Ground Floor	0.10	Solid
Exposed Floor	N/A	Solid
Exposed Wall & Semi-exposed Wall	0.15	Cavity
Party Wall	0.00	
Exposed Roof & Semi-exposed Roof	0.11	Flat
Doors	1.50	draught proofing.
Windows	1.40	Double Glazed (low-e), soft coating, argon filled, gap of 16mm or more, draught proofing, G-Value of 0.63

Fabric Efficiency	**Details**
Thermal Mass Parameter	Medium
Thermal Bridging	ACD used
Design air permeability	4 m³/hm²

Building Service	Details
Ventilation	MEV
Dwelling Heating System	Boiler, Regular, Mains Gas (efficiency 93.4%)
Heat Distribution System	Pre-insulated medium temp variable flow (1991 or later)
Heating Controls	Time and temperature zone control - plumbing circuit
Secondary Heating	None
Hot water	From main
PV	2 kWp
Solar Water Heating	N/A
Other Renewables	N/A
Internal Lighting	100% have luminous efficacy of ≥ 45 lumens/watt

5 Calculation Results

This section of the report presents the calculation results following the Energy Hierarchy:

- Be Lean: Energy Efficiency
- Be Clean: N/A
- Be Green: Use Renewable Technology

5.1 Be Lean

The impact of passive design strategy, including insulation, low air permeability and energy efficient windows is shown in Figure 7 below. The Dwelling Emissions Rate (DER) is 3.9% below the Target Emissions Rate (TER). This is prior to inclusion of any renewable technologies.

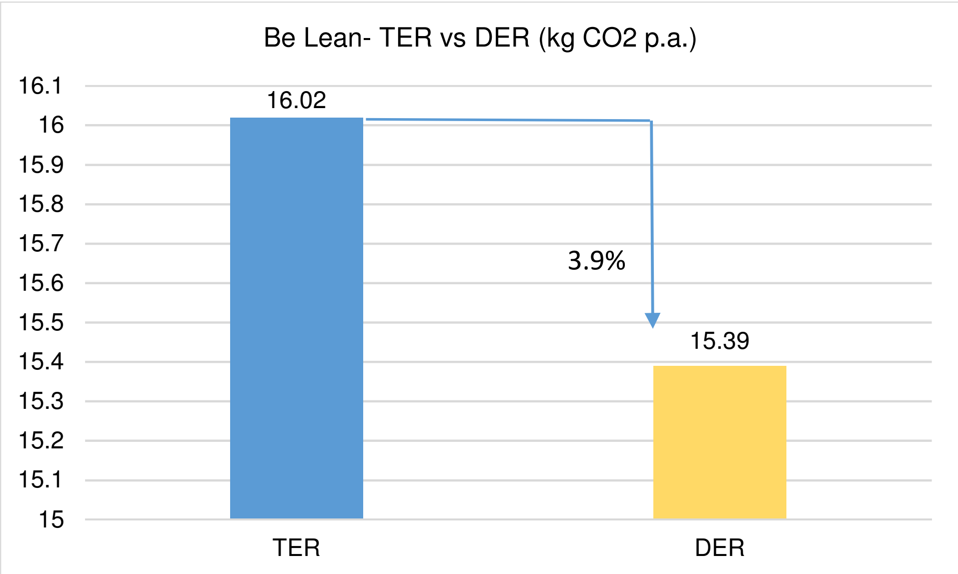


Figure 7. Be Lean- TER vs DER.

5.2 Be Green

The final step in the Energy Hierarchy methodology, is to include renewable technology. A feasibility study of all renewable technologies has been carried out. Photovoltaic panels have been considered most viable to provide electricity demand of the development. <u>As the result,</u> *<u>The CO_2 emissions of the scheme has been reduced by over 29.3% compared to the Notional Building. This is shown in Figure 10. The scheme exceeds the 19% CO_2 reduction required in Policy CC1 of Camden Climate Change Mitigation Policy.</u>*

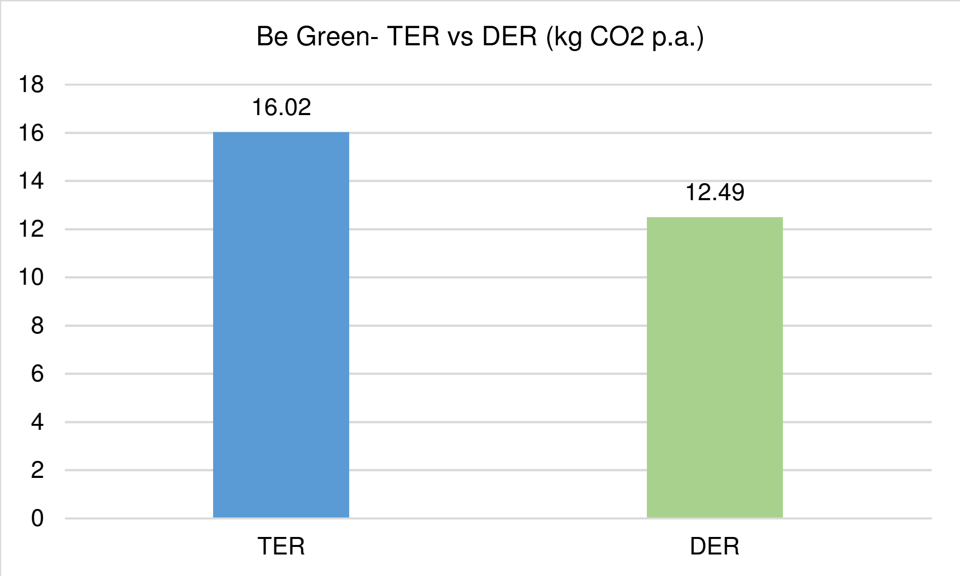


Figure 8. Be Green- TER vs DER.

5.3 Total Energy Demand and CO_2 Analysis

Space heating and hot water stand for 94% of the total energy demand of this development, as shown in Figure 9.

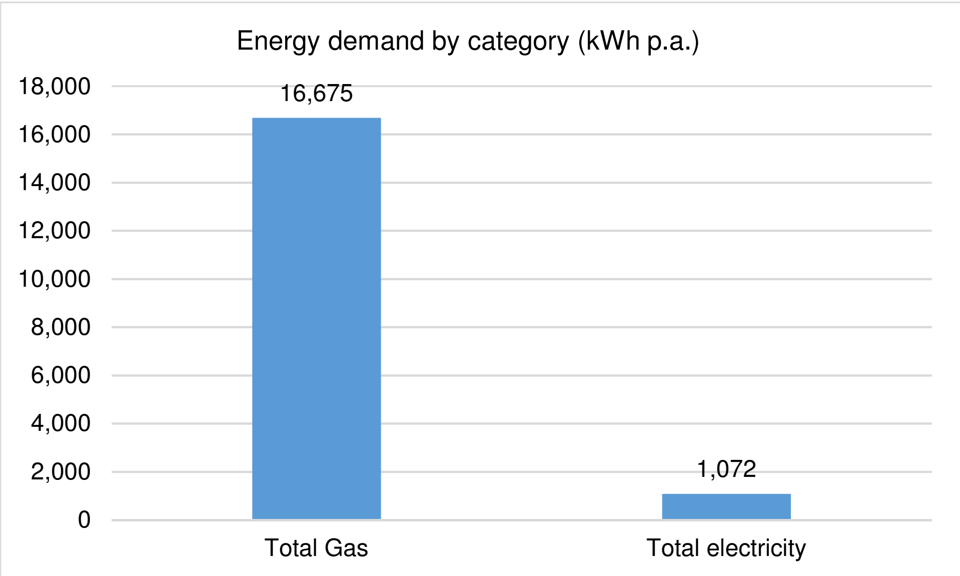


Figure 9. Be Green- TER vs DER.

In Be Green Scenario, 2 kWp of PV panels have been proposed to be installed on the available roof area. This amount of PV will generate 1,647 kWh of electricity which is 54% more than the electricity demand per year for lighting, fans and control. *The total CO_2 reduction of the PV panels is calculated to 855 kg p.a. This is 20.4% of the total Carbon Dioxide reduction of the development.*

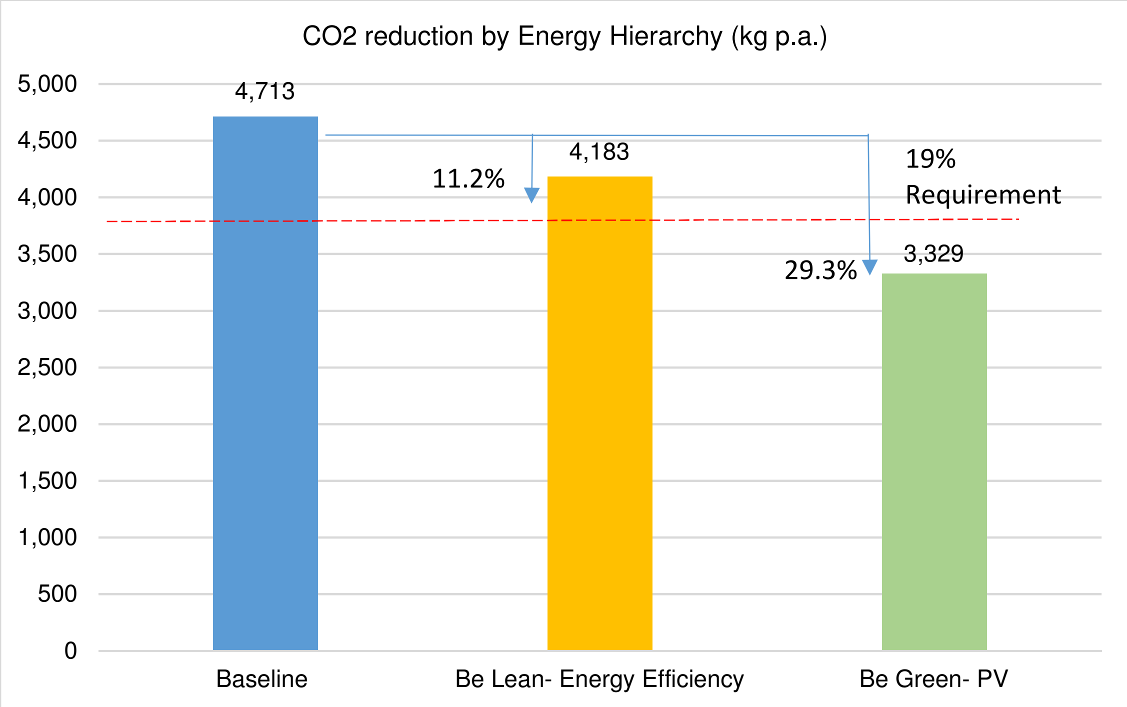


Figure 10. Total CO_2 reduction of the development.

The total CO_2 reduction of the development after energy efficiency and inclusion of 2 kWp of PV panels is 1,038 kg per year. This is equivalent to 29.3% Carbon Dioxide reduction, compared to the baseline.

5.4 Comparison of the Existing- and the Proposed Building

As presented in section 5.1 of this report, the proposed 15 Lyndhurst building is incorporating passive design measures and photovoltaic panels to reduce its CO_2 emissions. SAP calculation has also been carried out for the existing building to quantify the improvement, shown in Figure 11. The thermal performance of the proposed building has improvement significantly.

For instance, the solid wall with a typical U-value of 2.7 W/m^{2}K has been replaced with a fabric value of 0.15 W/m^{2}K, an employment by 170%.

As the result, compared to the the existing building, the total CO_2 emissions of the proposed building is reduced from 11,595 kg p.a. to 3,329 kg p.a,

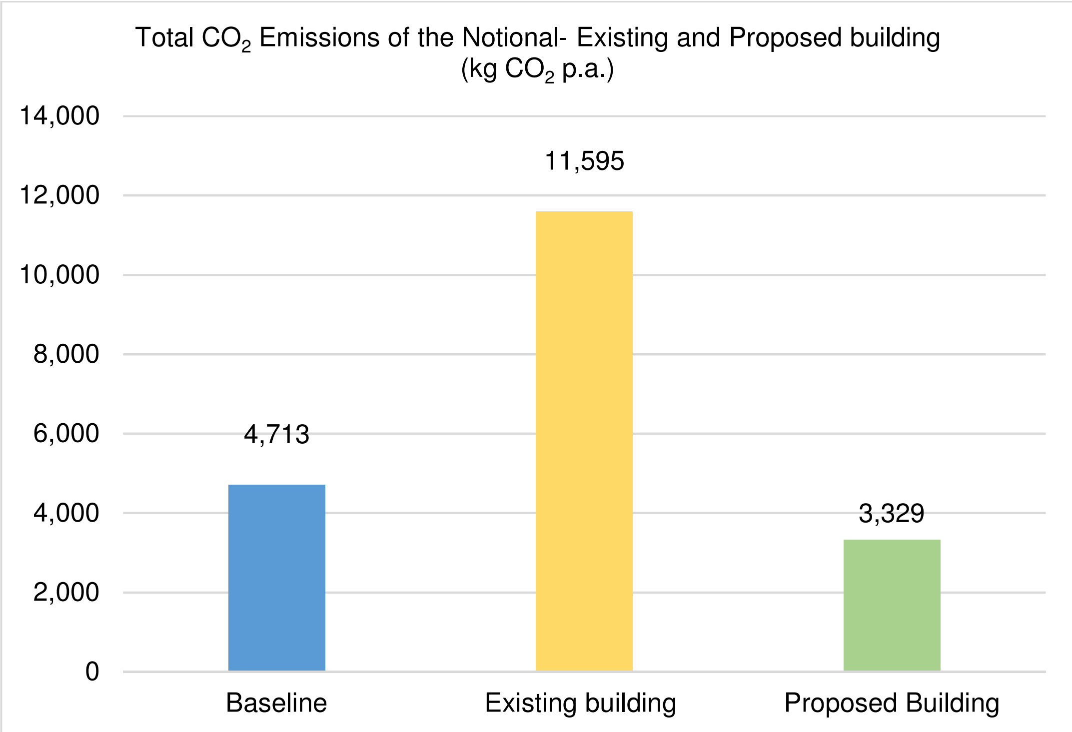


Figure 11. Total CO_2 emissions of the existing- and proposed building

6 Conclusion

The strategy is based on the Mayor of London's Energy Hierarchy, as follows:

- Use less energy (be lean)
- Use Renewable Technology (Be Green)

Improving the building fabric efficiency on the thermal envelope and incorporating 2 kWp of photovoltaic panels, results in a *reduction in CO_2 emissions of approximately 29.3% when measured against Part L1A 2013 Building Regulations.* *PV panels stand for 20.4% of the Carbon Dioxide reduction.*

Compared to the existing building, the proposed 15 Lyndhurst Terrace has reduced its CO_2 emissions by over 245%.

In line with Building Control the strategy demonstrates that the development will achieve compliance with 2013 Building Regulations through Energy efficiency and FEE (fabric energy efficiency) including thermal bridging calculations.

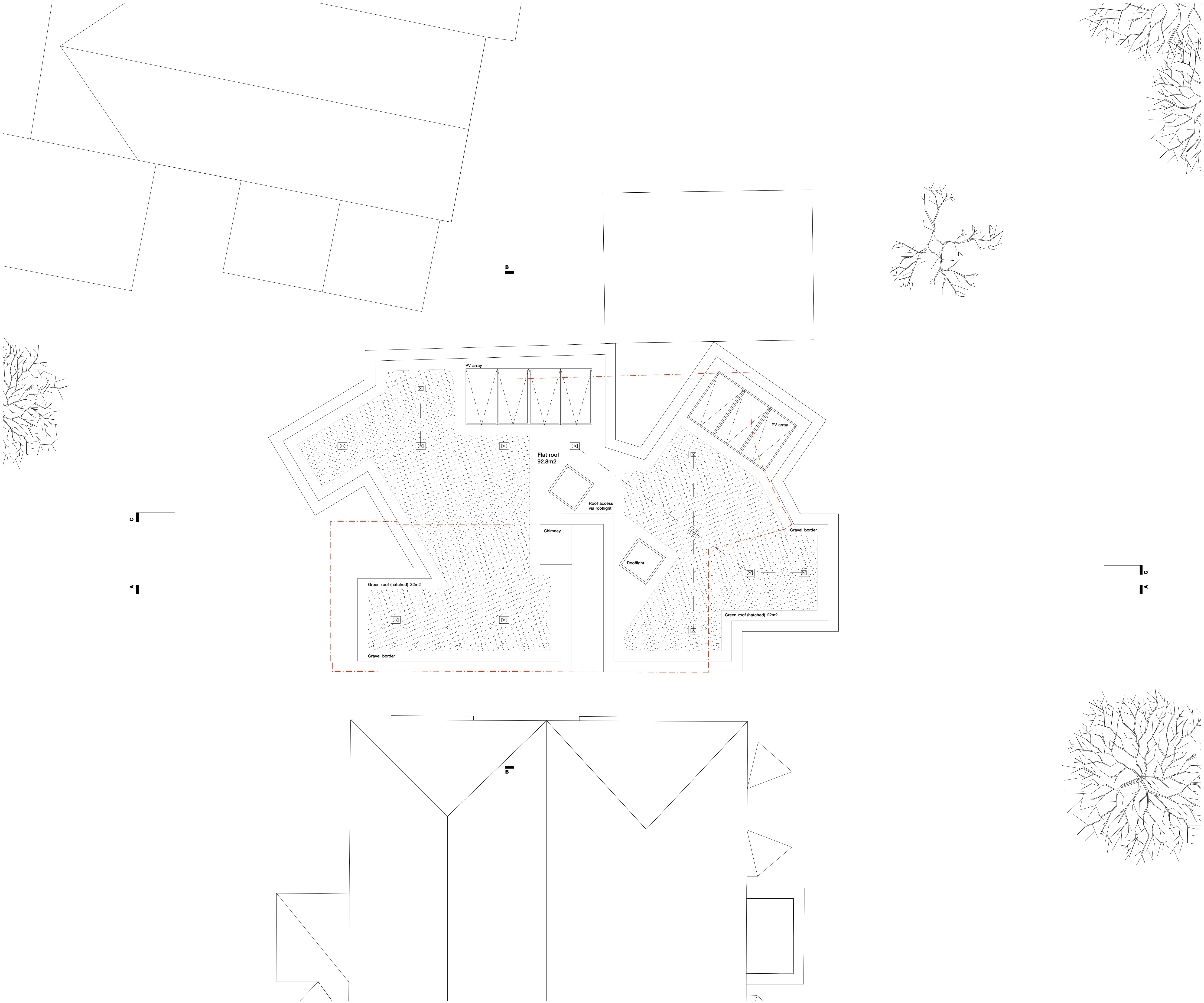
- The following table and chart detail the reductions in CO_2 emission reductions as a result of following the energy hierarchy.

Table 2 – Energy Hierarchy Chart

ENERGY HIERARCHY	CO2 EMISSIONS / ANNUM (kg p.a.)	% IMPROVEMENTS
Baseline	4,713	-
Be Lean	4,183	11.2%
Be Green	3,329	29.3%
Overall Saving (kg p.a.)		1,384

It can be concluded that the London Borough of Camden's planning policy CC1 of the Climate Change Mitigation and Sustainable Design and policy 6 of the Supplementary Planning Guidance have been met.

Appendix 1- PV layout



Existing building
Mansafe system

2m
1
0.5
0 0.5 1 2m

Sergison Bates architects LLP
Proposed Roof Plan

15 Lyndhurst Terrace, NW3
Issued for planning

Architects	Date	Scale
Sergison Bates architects 34 Clerkenwell Close London EC1R 0AU United Kingdom	Nov 2016	1:100@A3

Tel +44 (0)20 7255 1564
e-mail studio
@sergisonbates.co.uk

305/4203a

Revision
A 02/03/17 Green roof, PVs and mansafe added

Do not scale from this drawing
All dimensions to be verified on site
Limited Liability Partnership Registered in England & Wales No. OC317501 Registered office as above

Appendix 2- Be Lean

L1A 2013 - Regulations Compliance Report

Design - Draft

This design draft submission provides evidence towards compliance with Part L of the Building Regulations, in accordance with Appendix C of AD L1A. It has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the 'as built' property. This report covers only items included within the SAP and is not a complete report of regulations compliance.

Assessor name	Ms Rachell wootliff	Assessor number	8847
Client		Last modified	13/03/2017
Address	1, London		

Check	Evidence	Produced by	OK?
Criterion 1: predicted carbon dioxide emission from proposed dwelling does not exceed the target			
TER (kg CO_2/m^2.a)	Fuel = N/A Fuel factor = 1.00 TER = 16.02	Authorised SAP Assessor	
DER for dwelling as designed (kg CO_2/m^2.a)	DER = 15.39	Authorised SAP Assessor	
Are emissions from dwelling as designed less than or equal to the target?	DER 15.39 < TER 16.02	Authorised SAP Assessor	Passed
Is the fabric energy efficiency of the dwellling as designed less than or equal to the target?	DFEE 53.33 < TFEE 68.06	Authorised SAP Assessor	Passed
Criterion 2: the performance of the building fabric and the heating, hot water and fixed lighting systems should be no worse than the design limits			
Fabric U-values			
Are all U-values better than the design limits in Table 2?	**Element** / **Weighted average** / **Highest** Wall: 0.15 (max 0.30) / 0.15 (max 0.70) Party wall: (no party wall) Floor: 0.10 (max 0.25) / 0.10 (max 0.70) Roof: 0.11 (max 0.20) / 0.11 (max 0.35) Openings: 1.41 (max 2.00) / 1.50 (max 3.30)	Authorised SAP Assessor	Passed
Thermal bridging			
How has the loss from thermal bridges been calculated?	Thermal bridging calculated from linear thermal transmittances for each junction	Authorised SAP Assessor	
Heating and hot water systems			
Does the efficiency of the heating systems meet the minimum value set out in the Domestic Heating Compliance Guide?	Main heating system: Mains gas, Regular boiler from database Ravenheat CSI System A Efficiency = 90.10% - SEDBUK 2009 Minimum = 88.00% Secondary heating system: None	Authorised SAP Assessor	Passed
Does the insulation of the hot water cylinder meet the standards set out in the Domestic Heating Compliance Guide?	Cylinder volume = 300.00 litres Declared cylinder loss = 0.17kWh/day Maximum permitted cylinder loss = 3.18kWh/day Primary hot water pipes are not insulated	Authorised SAP Assessor	Passed
Do controls meet the minimum controls provision set out in the Domestic Heating Compliance Guide?	Space heating control: Time and temperature zone control - plumbing circuit Hot water control: Boiler interlock (main system 1) Cylinder thermostat Separate water control	Authorised SAP Assessor	Passed

Check	Evidence	Produced by	OK?
Fixed internal lighting			
Does fixed internal lighting comply with paragraphs 42 to 44?	Schedule of installed fixed internal lighting Standard lights = 0 Low energy lights = 20 Percentage of low energy lights = 100% Minimum = 75 %	Authorised SAP Assessor	Passed
Criterion 3: the dwelling has appropriate passive control measures to limit solar gains			
Does the dwelling have a strong tendency to high summertime temperatures?	Overheating risk (June) = Not significant (19.25°) Overheating risk (July) = Slight (21°) Overheating risk (August) = Slight (20.69°) Region = Thames Thermal mass parameter = 250.00 Ventilation rate in hot weather = 2.50 ach Blinds/curtains = None	Authorised SAP Assessor	Passed
Criterion 4: the performance of the dwelling, as designed, is consistent with the DER			
Design air permeability ($m^3/(h.m^2)$ at 50Pa)	Design air permeability = 4.00 Max air permeability = 10.00	Authorised SAP Assessor	Passed
Mechanical ventilation system Specific fan power (SFP)	Mechanical extract ventilation: SFP = 0.18 W/(litre/sec) Max SFP = 0.7 W/(litre/sec)	Authorised SAP Assessor	Passed
Have the key features of the design been included (or bettered) in practice?	The following floors have a U-value less than $0.13W/m^2K$: • Floor 1 (0.10) The following roofs have a U-value less than $0.13W/m^2K$: • Roof 1 (0.11) • Roof 2 (0.11) • Roof 3 (0.11) Thermal bridging y value (0.033) is less than 0.04 Space cooling is specified	Authorised SAP Assessor	

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	Ms Rachell wootliff	Assessor number	8847
Client		Last modified	13/03/2017
Address	1, London		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		120.21	(1a)	x	3.00	(2a)	=	360.63	(3a)
+1		94.70	(1b)	x	3.50	(2b)	=	331.45	(3b)
+2		79.35	(1c)	x	2.70	(2c)	=	214.25	(3c)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	294.26	(4)						
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =			906.33	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys	1	x 40 =	40	(6a)
Number of open flues	1	x 20 =	20	(6b)
Number of intermittent fans	0	x 10 =	0	(7a)
Number of passive vents	0	x 10 =	0	(7b)
Number of flueless gas fires	1	x 40 =	40	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	100	÷ (5) =	0.11	(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		4.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.31	(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) =	0.26	(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	0.34	0.33	0.32	0.29	0.28	0.25	0.25	0.24	0.26	0.28	0.30	0.31	(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	N/A	(23c)

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

0.59	0.58	0.57	0.54	0.53	0.50	0.50	0.50	0.51	0.53	0.55	0.56	(24c)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.59	0.58	0.57	0.54	0.53	0.50	0.50	0.50	0.51	0.53	0.55	0.56	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Door			3.60	x	1.50	=	5.40			(26)
Window			43.36	x	1.33	=	57.48			(27)
Basement floor			120.12	x	0.10	=	12.01			(28)
External wall			482.29	x	0.15	=	72.34			(29a)
Roof			120.21	x	0.11	=	13.22			(30)
Total area of external elements ∑A, m²			769.58							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	160.46	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K		250.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		9.22	(36)
Total fabric heat loss	(33) + (36) =	169.68	(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)	175.36	173.39	171.42	161.56	159.58	149.72	149.72	149.54	153.67	159.58	163.53	167.47	(38)
Heat transfer coefficient, W/K (37)m + (38)m	345.04	343.07	341.10	331.24	329.26	319.40	319.40	319.22	323.35	329.26	333.21	337.15	
Average = ∑(39)1...12/12 =												330.89	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.17	1.17	1.16	1.13	1.12	1.09	1.09	1.08	1.10	1.12	1.13	1.15	
Average = ∑(40)1...12/12 =												1.12	(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	3.12	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	108.41	(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)	119.25	114.91	110.57	106.24	101.90	97.57	97.57	101.90	106.24	110.57	114.91	119.25	
∑(44)1...12 =												1300.87	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	176.84	154.66	159.60	139.14	133.51	115.21	106.76	122.51	123.97	144.48	157.71	171.26	
∑(45)1...12 =												1705.65	(45)
Distribution loss 0.15 x (45)m	26.53	23.20	23.94	20.87	20.03	17.28	16.01	18.38	18.60	21.67	23.66	25.69	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	300.00	(47)
Water storage loss:		
a) If manufacturer's declared loss factor is known (kWh/day)	0.17	(48)
Temperature factor from Table 2b	0.72	(49)
Energy lost from water storage (kWh/day) (48) x (49)	0.12	(50)
Enter (50) or (54) in (55)	0.12	(55)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
3.80	3.43	3.80	3.68	3.80	3.68	3.80	3.80	3.68	3.80	3.68	3.80	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

3.80	3.43	3.80	3.68	3.80	3.68	3.80	3.80	3.68	3.80	3.68	3.80	(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

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

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

180.64	158.10	163.40	142.82	137.31	118.89	110.56	126.31	127.65	148.28	161.38	175.06	(62)

Solar DHW input calculated using Appendix G or Appendix H

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

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

180.64	158.10	163.40	142.82	137.31	118.89	110.56	126.31	127.65	148.28	161.38	175.06

∑(64)1...12 = 1750.38 (64)

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

61.84	54.17	56.11	49.21	47.43	41.25	38.54	43.77	44.16	51.08	55.38	59.98	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	187.47	187.47	187.47	187.47	187.47	187.47	187.47	187.47	187.47	187.47	187.47	187.47	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	104.45	92.77	75.44	57.12	42.70	36.05	38.95	50.63	67.95	86.28	100.70	107.35	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	677.01	684.04	666.34	628.65	581.07	536.36	506.49	499.46	517.17	554.85	602.43	647.14	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	56.87	56.87	56.87	56.87	56.87	56.87	56.87	56.87	56.87	56.87	56.87	56.87	(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)	-124.98	-124.98	-124.98	-124.98	-124.98	-124.98	-124.98	-124.98	-124.98	-124.98	-124.98	-124.98	(71)
Water heating gains (Table 5)	83.12	80.61	75.41	68.34	63.75	57.29	51.80	58.83	61.34	68.65	76.92	80.62	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	986.94	979.78	939.55	876.47	809.88	752.05	719.59	731.28	768.81	832.15	902.40	957.48	(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	
NorthEast	0.77	x	5.43	x	11.28	x 0.9 x	0.60	x	0.80	=	20.38	(75)
SouthEast	0.77	x	7.18	x	36.79	x 0.9 x	0.60	x	0.80	=	87.88	(77)
NorthWest	0.77	x	2.40	x	11.28	x 0.9 x	0.60	x	0.80	=	9.01	(81)
SouthWest	0.77	x	15.53	x	36.79	x 0.9 x	0.60	x	0.80	=	190.07	(79)
West	0.77	x	3.60	x	19.64	x 0.9 x	0.60	x	0.80	=	23.52	(80)
East	0.77	x	5.57	x	19.64	x 0.9 x	0.60	x	0.80	=	36.39	(76)
North	0.77	x	3.65	x	10.63	x 0.9 x	0.60	x	0.80	=	12.91	(74)

Solar gains in watts ∑(74)m...(82)m

380.16	675.14	990.50	1328.47	1572.64	1596.43	1524.65	1338.48	1107.63	764.80	460.52	321.90	(83)

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

1367.10	1654.92	1930.05	2204.94	2382.52	2348.48	2244.24	2069.76	1876.44	1596.94	1362.93	1279.37	(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	0.98	0.92	0.78	0.61	0.67	0.90	0.99	1.00	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.90	20.02	20.22	20.50	20.74	20.90	20.94	20.93	20.82	20.50	20.16	19.90	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	19.94	19.95	19.95	19.98	19.99	20.01	20.01	20.01	20.00	19.99	19.97	19.96	(88)
Utilisation factor for gains for rest of dwelling n2,m	1.00	1.00	0.99	0.97	0.89	0.69	0.48	0.55	0.85	0.98	1.00	1.00	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)	18.45	18.64	18.94	19.36	19.69	19.90	19.93	19.93	19.81	19.37	18.87	18.47	(90)

Living area fraction — Living area ÷ (4) = 0.16 (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	18.69	18.87	19.15	19.55	19.86	20.06	20.10	20.09	19.98	19.56	19.08	18.70	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate	18.54	18.72	19.00	19.40	19.71	19.91	19.95	19.94	19.83	19.41	18.93	18.55	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	1.00	1.00	0.99	0.96	0.88	0.68	0.47	0.54	0.83	0.98	1.00	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	1365.34	1649.15	1909.69	2121.26	2088.64	1599.14	1057.89	1109.42	1563.98	1562.60	1358.91	1278.22	(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]	4913.89	4740.22	4263.27	3477.84	2638.79	1697.01	1069.29	1131.19	1851.91	2900.18	3941.48	4839.24	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	2640.12	2077.20	1751.07	976.74	409.32	0.00	0.00	0.00	0.00	995.16	1859.45	2649.40	

∑(98)1...5, 10...12 = 13358.45 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) 45.40 (99)

8c. Space cooling requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm	0.00	0.00	0.00	0.00	0.00	3002.38	2363.58	2426.10	0.00	0.00	0.00	0.00	(100)
Utilisation factor for loss ηm	0.00	0.00	0.00	0.00	0.00	0.78	0.86	0.82	0.00	0.00	0.00	0.00	(101)
Useful loss ηmLm (watts) (100)m x (101)m	0.00	0.00	0.00	0.00	0.00	2333.51	2039.27	1979.14	0.00	0.00	0.00	0.00	(102)
Gains	0.00	0.00	0.00	0.00	0.00	2615.01	2498.65	2292.74	0.00	0.00	0.00	0.00	(103)
Space cooling requirement, whole dwelling, continuous (kWh) 0.024 x [(103)m - (102)m] x (41)m	0.00	0.00	0.00	0.00	0.00	202.68	341.78	233.32	0.00	0.00	0.00	0.00	

∑(104)6...8 = 777.77 (104)

Cooled fraction	cooled area ÷ (4) = 0.85	(105)

Intermittency factor (Table 10)

0.00	0.00	0.00	0.00	0.00	0.25	0.25	0.25	0.00	0.00	0.00	0.00

∑(106)6...8 = 0.75 (106)

Space cooling requirement (104)m x (105) x (106)m

0.00	0.00	0.00	0.00	0.00	43.05	72.59	49.56	0.00	0.00	0.00	0.00

∑(107)6...8 = 165.20 (107)

Space cooling requirement kWh/m²/year (107) ÷ (4) = 0.56 (108)

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 (%)		91.10	(206)
Cooling system energy efficiency ratio (Table 10c)		3.38	(209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating fuel (main system 1), kWh/month	2898.05	2280.13	1922.14	1072.17	449.31	0.00	0.00	0.00	0.00	1092.38	2041.11	2908.23

∑(211)1...5, 10...12 = 14663.50 (211)

Water heating

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Efficiency of water heater	90.33	90.25	90.08	89.58	88.15	80.40	80.40	80.40	80.40	89.55	90.14	90.35	(217)
Water heating fuel, kWh/month	199.98	175.18	181.40	159.43	155.76	147.87	137.51	157.10	158.77	165.57	179.03	193.75	

∑(219a)1...12 = 2011.34 (219)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space cooling fuel, kWh/month	0.00	0.00	0.00	0.00	0.00	12.76	21.51	14.68	0.00	0.00	0.00	0.00

∑(221)6...8 = 48.95 (221)

Annual totals

Space heating fuel - main system 1		14663.50	
Water heating fuel		2011.34	
Space cooling fuel		48.95	
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	258.74		(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		333.74	(231)
Electricity for lighting (Appendix L)		737.83	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	17795.36	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	14663.50	x	3.48	x 0.01 =	510.29	(240)
Water heating	2011.34	x	3.48	x 0.01 =	69.99	(247)
Space cooling	48.95	x	13.19	x 0.01 =	6.46	(248)

Pumps and fans	333.74	x	13.19	x 0.01 =	44.02	(249)
Electricity for lighting	737.83	x	13.19	x 0.01 =	97.32	(250)
Additional standing charges					120.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	848.08	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.05	(257)
SAP value	85.35	
SAP rating (section 13)	85	(258)
SAP band	B	

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

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	14663.50	x	0.22	=	3167.32	(261)
Water heating	2011.34	x	0.22	=	434.45	(264)
Space and water heating				(261) + (262) + (263) + (264) =	3601.77	(265)
Space cooling	48.95	x	0.52	=	25.40	(266)
Pumps and fans	333.74	x	0.52	=	173.21	(267)
Electricity for lighting	737.83	x	0.52	=	382.93	(268)
Total CO_2, kg/year				(265)...(271) =	4183.31	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	14.22	(273)
EI value					83.48	
EI rating (section 14)					83	(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	14663.50	x	1.22	=	17889.48	(261)
Water heating	2011.34	x	1.22	=	2453.84	(264)
Space and water heating				(261) + (262) + (263) + (264) =	20343.31	(265)
Space cooling	48.95	x	3.07	=	150.27	(266)
Pumps and fans	333.74	x	3.07	=	1024.57	(267)
Electricity for lighting	737.83	x	3.07	=	2265.14	(268)
Primary energy kWh/year					23783.29	(272)
Dwelling primary energy rate kWh/m2/year					80.82	(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	Ms Rachell wootliff	Assessor number	8847
Client		Last modified	13/03/2017
Address	1, London		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		120.21	(1a)	x	3.00	(2a)	=	360.63	(3a)
+1		94.70	(1b)	x	3.50	(2b)	=	331.45	(3b)
+2		79.35	(1c)	x	2.70	(2c)	=	214.25	(3c)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	294.26	(4)						
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =			906.33	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys	1	x 40 =	40	(6a)
Number of open flues	1	x 20 =	20	(6b)
Number of intermittent fans	4	x 10 =	40	(7a)
Number of passive vents	0	x 10 =	0	(7b)
Number of flueless gas fires	1	x 40 =	40	(7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs (6a) + (6b) + (7a) + (7b) + (7c) =	140	÷ (5) =	0.15	(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		4.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.35	(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) =	0.30	(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	0.38	0.38	0.37	0.33	0.32	0.29	0.29	0.28	0.30	0.32	0.34	0.35	(22b)

Calculate effective air change rate for the applicable case:

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.55	0.55	0.56	0.56	(24d)

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

0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.55	0.55	0.56	0.56	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Door			3.60	x	1.50	=	5.40			(26)
Window			43.36	x	1.33	=	57.48			(27)
Basement floor			120.12	x	0.10	=	12.01			(28)
External wall			482.29	x	0.15	=	72.34			(29a)
Roof			120.21	x	0.11	=	13.22			(30)
Total area of external elements ∑A, m²			769.58							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	160.46	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K		250.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		9.22	(36)
Total fabric heat loss	(33) + (36) =	169.68	(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)	171.61	170.76	169.92	165.97	165.23	161.80	161.80	161.16	163.12	165.23	166.73	168.29	(38)
Heat transfer coefficient, W/K (37)m + (38)m	341.29	340.44	339.60	335.65	334.91	331.48	331.48	330.84	332.80	334.91	336.41	337.97	
Average = ∑(39)1...12/12 =												335.65	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.16	1.16	1.15	1.14	1.14	1.13	1.13	1.12	1.13	1.14	1.14	1.15	
Average = ∑(40)1...12/12 =												1.14	(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	3.12	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	108.41	(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)	119.25	114.91	110.57	106.24	101.90	97.57	97.57	101.90	106.24	110.57	114.91	119.25	
∑(44)1...12 =												1300.87	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	176.84	154.66	159.60	139.14	133.51	115.21	106.76	122.51	123.97	144.48	157.71	171.26	
∑(45)1...12 =												1705.65	(45)
Distribution loss 0.15 x (45)m	26.53	23.20	23.94	20.87	20.03	17.28	16.01	18.38	18.60	21.67	23.66	25.69	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	300.00	(47)
Water storage loss:		
a) If manufacturer's declared loss factor is known (kWh/day)	0.17	(48)
Temperature factor from Table 2b	0.72	(49)
Energy lost from water storage (kWh/day) (48) x (49)	0.12	(50)
Enter (50) or (54) in (55)	0.12	(55)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
3.80	3.43	3.80	3.68	3.80	3.68	3.80	3.80	3.68	3.80	3.68	3.80	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

3.80	3.43	3.80	3.68	3.80	3.68	3.80	3.80	3.68	3.80	3.68	3.80	(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

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

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

180.64	158.10	163.40	142.82	137.31	118.89	110.56	126.31	127.65	148.28	161.38	175.06	(62)

Solar DHW input calculated using Appendix G or Appendix H

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

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

176.84	154.66	159.60	139.14	133.51	115.21	106.76	122.51	123.97	144.48	157.71	171.26	

∑(64)1...12 = 1705.65 (64)

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

37.58	32.87	33.92	29.57	28.37	24.48	22.69	26.03	26.34	30.70	33.51	36.39	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	156.22	156.22	156.22	156.22	156.22	156.22	156.22	156.22	156.22	156.22	156.22	156.22	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	41.78	37.11	30.18	22.85	17.08	14.42	15.58	20.25	27.18	34.51	40.28	42.94	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	453.60	458.31	446.45	421.19	389.32	359.36	339.35	334.64	346.50	371.75	403.63	433.59	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.62	38.62	38.62	38.62	38.62	38.62	38.62	38.62	38.62	38.62	38.62	38.62	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-124.98	-124.98	-124.98	-124.98	-124.98	-124.98	-124.98	-124.98	-124.98	-124.98	-124.98	-124.98	(71)
Water heating gains (Table 5)	50.51	48.91	45.58	41.07	38.13	34.00	30.49	34.99	36.59	41.27	46.55	48.91	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	615.75	614.19	592.08	554.97	514.40	477.65	455.28	459.75	480.14	517.40	560.32	595.31	(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	
NorthEast	0.77	x	5.43	x	11.28	x 0.9 x	0.60	x	0.80	=	20.38	(75)
SouthEast	0.77	x	7.18	x	36.79	x 0.9 x	0.60	x	0.80	=	87.88	(77)
NorthWest	0.77	x	2.40	x	11.28	x 0.9 x	0.60	x	0.80	=	9.01	(81)
SouthWest	0.77	x	15.53	x	36.79	x 0.9 x	0.60	x	0.80	=	190.07	(79)
West	0.77	x	3.60	x	19.64	x 0.9 x	0.60	x	0.80	=	23.52	(80)
East	0.77	x	5.57	x	19.64	x 0.9 x	0.60	x	0.80	=	36.39	(76)
North	0.77	x	3.65	x	10.63	x 0.9 x	0.60	x	0.80	=	12.91	(74)

Solar gains in watts ∑(74)m...(82)m

380.16	675.14	990.50	1328.47	1572.64	1596.43	1524.65	1338.48	1107.63	764.80	460.52	321.90	(83)

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

995.91	1289.33	1582.57	1883.45	2087.03	2074.08	1979.93	1798.23	1587.76	1282.19	1020.84	917.20	(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	1.00	0.99	0.95	0.85	0.69	0.76	0.95	1.00	1.00	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.50	19.66	19.93	20.30	20.64	20.88	20.97	20.95	20.75	20.29	19.83	19.48	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)	19.95	19.95	19.96	19.97	19.97	19.98	19.98	19.98	19.98	19.97	19.97	19.96	(88)
Utilisation factor for gains for rest of dwelling n2,m	1.00	1.00	1.00	0.98	0.93	0.77	0.55	0.63	0.91	0.99	1.00	1.00	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)	18.57	18.73	19.00	19.37	19.70	19.92	19.97	19.96	19.81	19.37	18.91	18.55	(90)

Living area fraction — Living area ÷ (4) = 0.16 (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	18.72	18.88	19.16	19.52	19.86	20.08	20.13	20.13	19.97	19.52	19.06	18.71	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate	18.72	18.88	19.16	19.52	19.86	20.08	20.13	20.13	19.97	19.52	19.06	18.71	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	1.00	1.00	1.00	0.98	0.93	0.78	0.57	0.65	0.91	0.99	1.00	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	995.64	1287.96	1575.87	1847.52	1930.66	1609.49	1137.52	1170.50	1443.23	1272.09	1020.09	917.04	(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]	4921.82	4760.94	4297.77	3566.12	2732.05	1815.28	1171.68	1232.86	1952.02	2989.08	4023.56	4902.52	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	2921.08	2333.84	2025.10	1237.39	596.24	0.00	0.00	0.00	0.00	1277.44	2162.49	2965.20	

∑(98)1...5, 10...12 = 15518.78 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) 52.74 (99)

8c. Space cooling requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm	0.00	0.00	0.00	0.00	0.00	3115.88	2452.92	2514.38	0.00	0.00	0.00	0.00	(100)
Utilisation factor for loss ηm	0.00	0.00	0.00	0.00	0.00	0.75	0.84	0.79	0.00	0.00	0.00	0.00	(101)
Useful loss ηmLm (watts) (100)m x (101)m	0.00	0.00	0.00	0.00	0.00	2339.89	2061.54	1988.27	0.00	0.00	0.00	0.00	(102)
Gains	0.00	0.00	0.00	0.00	0.00	2591.72	2477.34	2268.89	0.00	0.00	0.00	0.00	(103)
Space cooling requirement, whole dwelling, continuous (kWh) 0.024 x [(103)m - (102)m] x (41)m	0.00	0.00	0.00	0.00	0.00	181.32	309.35	208.78	0.00	0.00	0.00	0.00	

∑(104)6...8 = 699.46 (104)

Cooled fraction cooled area ÷ (4) = 1.00 (105)

Intermittency factor (Table 10)

0.00	0.00	0.00	0.00	0.00	0.25	0.25	0.25	0.00	0.00	0.00	0.00

∑(106)6...8 = 0.75 (106)

Space cooling requirement (104)m x (105) x (106)m

0.00	0.00	0.00	0.00	0.00	45.33	77.34	52.20	0.00	0.00	0.00	0.00

∑(107)6...8 = 174.86 (107)

Space cooling requirement kWh/m²/year (107) ÷ (4) = 0.59 (108)

8f. Fabric energy efficiency

Dwelling Fabric Energy Efficiency (DFEE) (99) + (108) = 53.33 (109)

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	Ms Rachell wootliff	Assessor number	8847
Client		Last modified	13/03/2017
Address	1, London		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		120.21	(1a)	x	3.00	(2a)	=	360.63	(3a)
+1		94.70	(1b)	x	3.50	(2b)	=	331.45	(3b)
+2		79.35	(1c)	x	2.70	(2c)	=	214.25	(3c)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	294.26	(4)						
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =			906.33	(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	4	x 10 =	40	(7a)
Number of passive vents	0	x 10 =	0	(7b)
Number of flueless gas fires	0	x 40 =	0	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	40	÷ (5) =	0.04	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.29	(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) =	0.25	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table 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	0.32	0.31	0.31	0.28	0.27	0.24	0.24	0.23	0.25	0.27	0.28	0.29	(22b)

Calculate effective air change rate for the applicable case:

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

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

0.55	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.54	0.54	0.54	(24d)

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

0.55	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.54	0.54	0.54	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Door			3.60	x	1.00	=	3.60			(26)
Window			43.36	x	1.33	=	57.48			(27)
Basement floor			120.12	x	0.13	=	15.62			(28)
External wall			482.29	x	0.18	=	86.81			(29a)
Roof			120.21	x	0.13	=	15.63			(30)
Total area of external elements ∑A, m²			769.58							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	179.14	(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		22.06	(36)
Total fabric heat loss	(33) + (36) =	201.20	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	164.74	164.15	163.57	160.85	160.35	157.98	157.98	157.54	158.89	160.35	161.37	162.45	(38)
Heat transfer coefficient, W/K (37)m + (38)m	365.94	365.35	364.77	362.05	361.54	359.18	359.18	358.74	360.09	361.54	362.57	363.65	
Average = ∑(39)1...12/12 =												362.05	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.24	1.24	1.24	1.23	1.23	1.22	1.22	1.22	1.22	1.23	1.23	1.24	
Average = ∑(40)1...12/12 =												1.23	(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	3.12	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	108.41	(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)	119.25	114.91	110.57	106.24	101.90	97.57	97.57	101.90	106.24	110.57	114.91	119.25	
∑(44)1...12 =												1300.87	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	176.84	154.66	159.60	139.14	133.51	115.21	106.76	122.51	123.97	144.48	157.71	171.26	
∑(45)1...12 =												1705.65	(45)
Distribution loss 0.15 x (45)m	26.53	23.20	23.94	20.87	20.03	17.28	16.01	18.38	18.60	21.67	23.66	25.69	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	150.00	(47)
Water storage loss:		
a) If manufacturer's declared loss factor is known (kWh/day)	1.39	(48)
Temperature factor from Table 2b	0.54	(49)
Energy lost from water storage (kWh/day) (48) x (49)	0.75	(50)
Enter (50) or (54) in (55)	0.75	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water storage loss calculated for each month (55) x (41)m	23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

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

223.43	196.75	206.20	184.24	180.11	160.30	153.35	169.10	169.06	191.07	202.80	217.85	(62)

Solar DHW input calculated using Appendix G or Appendix H

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

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

176.84	154.66	159.60	139.14	133.51	115.21	106.76	122.51	123.97	144.48	157.71	171.26

∑(64)1...12 = 1705.65 (64)

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

37.58	32.87	33.92	29.57	28.37	24.48	22.69	26.03	26.34	30.70	33.51	36.39	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	156.22	156.22	156.22	156.22	156.22	156.22	156.22	156.22	156.22	156.22	156.22	156.22	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	42.91	38.11	30.99	23.46	17.54	14.81	16.00	20.80	27.92	35.44	41.37	44.10	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	453.60	458.31	446.45	421.19	389.32	359.36	339.35	334.64	346.50	371.75	403.63	433.59	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.62	38.62	38.62	38.62	38.62	38.62	38.62	38.62	38.62	38.62	38.62	38.62	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-124.98	-124.98	-124.98	-124.98	-124.98	-124.98	-124.98	-124.98	-124.98	-124.98	-124.98	-124.98	(71)
Water heating gains (Table 5)	50.51	48.91	45.58	41.07	38.13	34.00	30.49	34.99	36.59	41.27	46.55	48.91	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	616.88	615.19	592.89	555.59	514.86	478.04	455.71	460.29	480.87	518.33	561.41	596.47	(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	
NorthEast	0.77	x	5.43	x	11.28	x 0.9 x	0.63	x	0.70	=	18.72	(75)
SouthEast	0.77	x	7.18	x	36.79	x 0.9 x	0.63	x	0.70	=	80.74	(77)
NorthWest	0.77	x	2.40	x	11.28	x 0.9 x	0.63	x	0.70	=	8.28	(81)
SouthWest	0.77	x	15.53	x	36.79	x 0.9 x	0.63	x	0.70	=	174.63	(79)
West	0.77	x	3.60	x	19.64	x 0.9 x	0.63	x	0.70	=	21.61	(80)
East	0.77	x	5.57	x	19.64	x 0.9 x	0.63	x	0.70	=	33.43	(76)
North	0.77	x	3.65	x	10.63	x 0.9 x	0.63	x	0.70	=	11.86	(74)

Solar gains in watts ∑(74)m...(82)m

349.27	620.28	910.02	1220.53	1444.86	1466.72	1400.77	1229.73	1017.63	702.66	423.11	295.74	(83)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	966.15	1235.47	1502.91	1776.13	1959.72	1944.76	1856.48	1690.02	1498.50	1220.99	984.51	892.21	(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	1.00	0.99	0.97	0.89	0.75	0.82	0.96	1.00	1.00	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.39	19.54	19.81	20.18	20.54	20.82	20.94	20.92	20.67	20.20	19.72	19.36	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(°C)	19.89	19.89	19.89	19.90	19.90	19.90	19.90	19.90	19.90	19.90	19.89	19.89	(88)
Utilisation factor for gains for rest of dwelling n2,m	1.00	1.00	1.00	0.99	0.95	0.82	0.61	0.69	0.93	0.99	1.00	1.00	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)	18.40	18.56	18.83	19.20	19.55	19.80	19.89	19.87	19.68	19.22	18.75	18.38	(90)

Living area fraction — Living area ÷ (4) = | 0.16 | (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	18.56	18.72	18.99	19.36	19.71	19.97	20.06	20.05	19.85	19.38	18.91	18.54	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate	18.56	18.72	18.99	19.36	19.71	19.97	20.06	20.05	19.85	19.38	18.91	18.54	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	1.00	1.00	1.00	0.99	0.94	0.82	0.63	0.71	0.93	0.99	1.00	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	965.88	1234.27	1497.62	1750.15	1849.81	1602.66	1176.30	1196.15	1394.02	1213.07	983.82	892.04	(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]	5218.59	5048.22	4555.01	3785.88	2896.62	1929.46	1242.84	1307.91	2068.98	3175.26	4280.57	5214.72	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	3164.02	2562.97	2274.70	1465.72	778.83	0.00	0.00	0.00	0.00	1459.87	2373.66	3216.07	

∑(98)1...5, 10...12 = | 17295.85 | (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) | 58.78 | (99)

8c. Space cooling requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm	0.00	0.00	0.00	0.00	0.00	3376.27	2657.92	2726.42	0.00	0.00	0.00	0.00	(100)
Utilisation factor for loss ηm	0.00	0.00	0.00	0.00	0.00	0.67	0.77	0.72	0.00	0.00	0.00	0.00	(101)
Useful loss ηmLm (watts) (100)m x (101)m	0.00	0.00	0.00	0.00	0.00	2272.45	2045.35	1951.10	0.00	0.00	0.00	0.00	(102)
Gains	0.00	0.00	0.00	0.00	0.00	2441.09	2333.60	2143.15	0.00	0.00	0.00	0.00	(103)
Space cooling requirement, whole dwelling, continuous (kWh) 0.024 x [(103)m - (102)m] x (41)m	0.00	0.00	0.00	0.00	0.00	121.42	214.46	142.88	0.00	0.00	0.00	0.00	

∑(104)6...8 = | 478.76 | (104)

Cooled fraction cooled area ÷ (4) = 1.00 (105)

Intermittency factor (Table 10)

0.00	0.00	0.00	0.00	0.00	0.25	0.25	0.25	0.00	0.00	0.00	0.00

∑(106)6...8 = 0.75 (106)

Space cooling requirement (104)m x (105) x (106)m

0.00	0.00	0.00	0.00	0.00	30.35	53.61	35.72	0.00	0.00	0.00	0.00

∑(107)6...8 = 119.69 (107)

Space cooling requirement kWh/m²/year (107) ÷ (4) = 0.41 (108)

8f. Fabric energy efficiency

Target Fabric Energy Efficiency (TFEE) [(99) + (108)] * 1.15 = 68.06 (109)

Appendix 3- Be Green

L1A 2013 - Regulations Compliance Report

Design - Draft

This design draft submission provides evidence towards compliance with Part L of the Building Regulations, in accordance with Appendix C of AD L1A. It has been carried out using Approved SAP software. It has been prepared from plans and specifications and may not reflect the 'as built' property. This report covers only items included within the SAP and is not a complete report of regulations compliance.

Assessor name	Ms Rachell wootliff	Assessor number	8847
Client		Last modified	25/02/2017
Address	1, London		

Check	Evidence	Produced by	OK?
Criterion 1: predicted carbon dioxide emission from proposed dwelling does not exceed the target			
TER (kg CO_2/m^2.a)	Fuel = N/A Fuel factor = 1.00 TER = 16.02	Authorised SAP Assessor	
DER for dwelling as designed (kg CO_2/m^2.a)	DER = 12.49	Authorised SAP Assessor	
Are emissions from dwelling as designed less than or equal to the target?	DER 12.49 < TER 16.02	Authorised SAP Assessor	Passed
Is the fabric energy efficiency of the dwellling as designed less than or equal to the target?	DFEE 53.33 < TFEE 68.06	Authorised SAP Assessor	Passed
Criterion 2: the performance of the building fabric and the heating, hot water and fixed lighting systems should be no worse than the design limits			
Fabric U-values			
Are all U-values better than the design limits in Table 2?	**Element** / **Weighted average** / **Highest** Wall: 0.15 (max 0.30) / 0.15 (max 0.70) Party wall: (no party wall) Floor: 0.10 (max 0.25) / 0.10 (max 0.70) Roof: 0.11 (max 0.20) / 0.11 (max 0.35) Openings: 1.41 (max 2.00) / 1.50 (max 3.30)	Authorised SAP Assessor	Passed
Thermal bridging			
How has the loss from thermal bridges been calculated?	Thermal bridging calculated from linear thermal transmittances for each junction	Authorised SAP Assessor	
Heating and hot water systems			
Does the efficiency of the heating systems meet the minimum value set out in the Domestic Heating Compliance Guide?	Main heating system: Mains gas, Regular boiler from database Ravenheat CSI System A Efficiency = 90.10% - SEDBUK 2009 Minimum = 88.00% Secondary heating system: None	Authorised SAP Assessor	Passed
Does the insulation of the hot water cylinder meet the standards set out in the Domestic Heating Compliance Guide?	Cylinder volume = 300.00 litres Declared cylinder loss = 0.17kWh/day Maximum permitted cylinder loss = 3.18kWh/day Primary hot water pipes are not insulated	Authorised SAP Assessor	Passed
Do controls meet the minimum controls provision set out in the Domestic Heating Compliance Guide?	Space heating control: Time and temperature zone control - plumbing circuit Hot water control: Boiler interlock (main system 1) Cylinder thermostat Separate water control	Authorised SAP Assessor	Passed

Check	Evidence	Produced by	OK?
Fixed internal lighting			
Does fixed internal lighting comply with paragraphs 42 to 44?	Schedule of installed fixed internal lighting Standard lights = 0 Low energy lights = 20 Percentage of low energy lights = 100% Minimum = 75 %	Authorised SAP Assessor	Passed
Criterion 3: the dwelling has appropriate passive control measures to limit solar gains			
Does the dwelling have a strong tendency to high summertime temperatures?	Overheating risk (June) = Not significant (19.25°) Overheating risk (July) = Slight (21°) Overheating risk (August) = Slight (20.69°) Region = Thames Thermal mass parameter = 250.00 Ventilation rate in hot weather = 2.50 ach Blinds/curtains = None	Authorised SAP Assessor	Passed
Criterion 4: the performance of the dwelling, as designed, is consistent with the DER			
Design air permeability ($m^3/(h.m^2)$ at 50Pa)	Design air permeability = 4.00 Max air permeability = 10.00	Authorised SAP Assessor	Passed
Mechanical ventilation system Specific fan power (SFP)	Mechanical extract ventilation: SFP = 0.18 W/(litre/sec) Max SFP = 0.7 W/(litre/sec)	Authorised SAP Assessor	Passed
Have the key features of the design been included (or bettered) in practice?	The following floors have a U-value less than $0.13W/m^2K$: • Floor 1 (0.10) The following roofs have a U-value less than $0.13W/m^2K$: • Roof 1 (0.11) • Roof 2 (0.11) • Roof 3 (0.11) Thermal bridging y value (0.033) is less than 0.04 Space cooling is specified Use of the following low carbon or renewable technologies: • Photovoltaic array	Authorised SAP Assessor	

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	Ms Rachell wootliff	Assessor number	8847
Client		Last modified	25/02/2017
Address	1, London		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		120.21	(1a)	x	3.00	(2a)	=	360.63	(3a)
+1		94.70	(1b)	x	3.50	(2b)	=	331.45	(3b)
+2		79.35	(1c)	x	2.70	(2c)	=	214.25	(3c)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	294.26	(4)						
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =			906.33	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys	1	x 40 =	40	(6a)
Number of open flues	1	x 20 =	20	(6b)
Number of intermittent fans	0	x 10 =	0	(7a)
Number of passive vents	0	x 10 =	0	(7b)
Number of flueless gas fires	1	x 40 =	40	(7c)

				Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs	(6a) + (6b) + (7a) + (7b) + (7c) =	100	÷ (5) =	0.11	(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		4.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.31	(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) =	0.26	(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	0.34	0.33	0.32	0.29	0.28	0.25	0.25	0.24	0.26	0.28	0.30	0.31	(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	N/A	(23c)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.59	0.58	0.57	0.54	0.53	0.50	0.50	0.50	0.51	0.53	0.55	0.56	(24c)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.59	0.58	0.57	0.54	0.53	0.50	0.50	0.50	0.51	0.53	0.55	0.56	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Door			3.60	x	1.50	=	5.40			(26)
Window			43.36	x	1.33	=	57.48			(27)
Basement floor			120.12	x	0.10	=	12.01			(28)
External wall			482.29	x	0.15	=	72.34			(29a)
Roof			120.21	x	0.11	=	13.22			(30)
Total area of external elements ∑A, m²			769.58							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	160.46	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K		250.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		9.22	(36)
Total fabric heat loss	(33) + (36) =	169.68	(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)	175.36	173.39	171.42	161.56	159.58	149.72	149.72	149.54	153.67	159.58	163.53	167.47	(38)
Heat transfer coefficient, W/K (37)m + (38)m	345.04	343.07	341.10	331.24	329.26	319.40	319.40	319.22	323.35	329.26	333.21	337.15	
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.17	1.17	1.16	1.13	1.12	1.09	1.09	1.08	1.10	1.12	1.13	1.15	
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)

Heat transfer coefficient: Average = ∑(39)1...12/12 = 330.89 (39)

Heat loss parameter: Average = ∑(40)1...12/12 = 1.12 (40)

4. Water heating energy requirement

Assumed occupancy, N	3.12	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	108.41	(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)	119.25	114.91	110.57	106.24	101.90	97.57	97.57	101.90	106.24	110.57	114.91	119.25	
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	176.84	154.66	159.60	139.14	133.51	115.21	106.76	122.51	123.97	144.48	157.71	171.26	
Distribution loss 0.15 x (45)m	26.53	23.20	23.94	20.87	20.03	17.28	16.01	18.38	18.60	21.67	23.66	25.69	(46)

Hot water usage: ∑(44)1...12 = 1300.87 (44)

Energy content: ∑(45)1...12 = 1705.65 (45)

Storage volume (litres) including any solar or WWHRS storage within same vessel	300.00	(47)
Water storage loss:		
a) If manufacturer's declared loss factor is known (kWh/day)	0.17	(48)
Temperature factor from Table 2b	0.72	(49)
Energy lost from water storage (kWh/day) (48) x (49)	0.12	(50)
Enter (50) or (54) in (55)	0.12	(55)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
3.80	3.43	3.80	3.68	3.80	3.68	3.80	3.80	3.68	3.80	3.68	3.80	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	3.80	3.43	3.80	3.68	3.80	3.68	3.80	3.80	3.68	3.80	3.68	3.80	(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	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)
Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m	180.64	158.10	163.40	142.82	137.31	118.89	110.56	126.31	127.65	148.28	161.38	175.06	(62)
Solar DHW input calculated using Appendix G or Appendix H	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(63)
Output from water heater for each month (kWh/month) (62)m + (63)m	180.64	158.10	163.40	142.82	137.31	118.89	110.56	126.31	127.65	148.28	161.38	175.06	
											∑(64)1...12 =	1750.38	(64)
Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]	61.84	54.17	56.11	49.21	47.43	41.25	38.54	43.77	44.16	51.08	55.38	59.98	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	187.47	187.47	187.47	187.47	187.47	187.47	187.47	187.47	187.47	187.47	187.47	187.47	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	104.45	92.77	75.44	57.12	42.70	36.05	38.95	50.63	67.95	86.28	100.70	107.35	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	677.01	684.04	666.34	628.65	581.07	536.36	506.49	499.46	517.17	554.85	602.43	647.14	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	56.87	56.87	56.87	56.87	56.87	56.87	56.87	56.87	56.87	56.87	56.87	56.87	(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)	-124.98	-124.98	-124.98	-124.98	-124.98	-124.98	-124.98	-124.98	-124.98	-124.98	-124.98	-124.98	(71)
Water heating gains (Table 5)	83.12	80.61	75.41	68.34	63.75	57.29	51.80	58.83	61.34	68.65	76.92	80.62	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	986.94	979.78	939.55	876.47	809.88	752.05	719.59	731.28	768.81	832.15	902.40	957.48	(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	
NorthEast	0.77	x	5.43	x	11.28	x 0.9 x	0.60	x	0.80	=	20.38	(75)
SouthEast	0.77	x	7.18	x	36.79	x 0.9 x	0.60	x	0.80	=	87.88	(77)
NorthWest	0.77	x	2.40	x	11.28	x 0.9 x	0.60	x	0.80	=	9.01	(81)
SouthWest	0.77	x	15.53	x	36.79	x 0.9 x	0.60	x	0.80	=	190.07	(79)
West	0.77	x	3.60	x	19.64	x 0.9 x	0.60	x	0.80	=	23.52	(80)
East	0.77	x	5.57	x	19.64	x 0.9 x	0.60	x	0.80	=	36.39	(76)
North	0.77	x	3.65	x	10.63	x 0.9 x	0.60	x	0.80	=	12.91	(74)

Solar gains in watts ∑(74)m...(82)m	380.16	675.14	990.50	1328.47	1572.64	1596.43	1524.65	1338.48	1107.63	764.80	460.52	321.90	(83)

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

1367.10	1654.92	1930.05	2204.94	2382.52	2348.48	2244.24	2069.76	1876.44	1596.94	1362.93	1279.37	(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	0.98	0.92	0.78	0.61	0.67	0.90	0.99	1.00	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.90	20.02	20.22	20.50	20.74	20.90	20.94	20.93	20.82	20.50	20.16	19.90	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	19.94	19.95	19.95	19.98	19.99	20.01	20.01	20.01	20.00	19.99	19.97	19.96	(88)
Utilisation factor for gains for rest of dwelling n2,m	1.00	1.00	0.99	0.97	0.89	0.69	0.48	0.55	0.85	0.98	1.00	1.00	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)	18.45	18.64	18.94	19.36	19.69	19.90	19.93	19.93	19.81	19.37	18.87	18.47	(90)

Living area fraction — Living area ÷ (4) = 0.16 (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	18.69	18.87	19.15	19.55	19.86	20.06	20.10	20.09	19.98	19.56	19.08	18.70	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate	18.54	18.72	19.00	19.40	19.71	19.91	19.95	19.94	19.83	19.41	18.93	18.55	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	1.00	1.00	0.99	0.96	0.88	0.68	0.47	0.54	0.83	0.98	1.00	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	1365.34	1649.15	1909.69	2121.26	2088.64	1599.14	1057.89	1109.42	1563.98	1562.60	1358.91	1278.22	(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]	4913.89	4740.22	4263.27	3477.84	2638.79	1697.01	1069.29	1131.19	1851.91	2900.18	3941.48	4839.24	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	2640.12	2077.20	1751.07	976.74	409.32	0.00	0.00	0.00	0.00	995.16	1859.45	2649.40	

∑(98)1...5, 10...12 = 13358.45 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) 45.40 (99)

8c. Space cooling requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm	0.00	0.00	0.00	0.00	0.00	3002.38	2363.58	2426.10	0.00	0.00	0.00	0.00	(100)
Utilisation factor for loss ηm	0.00	0.00	0.00	0.00	0.00	0.78	0.86	0.82	0.00	0.00	0.00	0.00	(101)
Useful loss ηmLm (watts) (100)m x (101)m	0.00	0.00	0.00	0.00	0.00	2333.51	2039.27	1979.14	0.00	0.00	0.00	0.00	(102)
Gains	0.00	0.00	0.00	0.00	0.00	2615.01	2498.65	2292.74	0.00	0.00	0.00	0.00	(103)
Space cooling requirement, whole dwelling, continuous (kWh) 0.024 x [(103)m - (102)m] x (41)m	0.00	0.00	0.00	0.00	0.00	202.68	341.78	233.32	0.00	0.00	0.00	0.00	

∑(104)6...8 = 777.77 (104)

Cooled fraction — cooled area ÷ (4) = 0.85 (105)

Intermittency factor (Table 10)

0.00	0.00	0.00	0.00	0.00	0.25	0.25	0.25	0.00	0.00	0.00	0.00

∑(106)6...8 = 0.75 (106)

Space cooling requirement (104)m x (105) x (106)m

0.00	0.00	0.00	0.00	0.00	43.05	72.59	49.56	0.00	0.00	0.00	0.00

∑(107)6...8 = 165.20 (107)

Space cooling requirement kWh/m²/year — (107) ÷ (4) = 0.56 (108)

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 (%)		91.10	(206)
Cooling system energy efficiency ratio (Table 10c)		3.38	(209)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating fuel (main system 1), kWh/month	2898.05	2280.13	1922.14	1072.17	449.31	0.00	0.00	0.00	0.00	1092.38	2041.11	2908.23

∑(211)1...5, 10...12 = 14663.50 (211)

Water heating

Efficiency of water heater

90.33	90.25	90.08	89.58	88.15	80.40	80.40	80.40	80.40	89.55	90.14	90.35	(217)

Water heating fuel, kWh/month

199.98	175.18	181.40	159.43	155.76	147.87	137.51	157.10	158.77	165.57	179.03	193.75

∑(219a)1...12 = 2011.34 (219)

Space cooling fuel, kWh/month

0.00	0.00	0.00	0.00	0.00	12.76	21.51	14.68	0.00	0.00	0.00	0.00

∑(221)6...8 = 48.95 (221)

Annual totals

Space heating fuel - main system 1			14663.50	
Water heating fuel			2011.34	
Space cooling fuel			48.95	
Electricity for pumps, fans and electric keep-hot (Table 4f)				
mechanical ventilation fans - balanced, extract or positive input from outside	258.74			(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			333.74	(231)
Electricity for lighting (Appendix L)			737.83	(232)
Energy saving/generation technologies				
electricity generated by PV (Appendix M)			-1646.70	(233)
Total delivered energy for all uses		(211)...(221) + (231) + (232)...(237b) =	16148.66	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	14663.50	x	3.48	x 0.01 =	510.29	(240)

Water heating	2011.34	x	3.48	x 0.01 =	69.99	(247)
Space cooling	48.95	x	13.19	x 0.01 =	6.46	(248)
Pumps and fans	333.74	x	13.19	x 0.01 =	44.02	(249)
Electricity for lighting	737.83	x	13.19	x 0.01 =	97.32	(250)
Additional standing charges					120.00	(251)
Energy saving/generation technologies						
pv savings	-1646.70	x	13.19	x 0.01 =	-217.20	(252)
Total energy cost				(240)...(242) + (245)...(254) =	630.88	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	0.78	(257)
SAP value	89.10	
SAP rating (section 13)	89	(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	14663.50	x	0.22	=	3167.32	(261)
Water heating	2011.34	x	0.22	=	434.45	(264)
Space and water heating				(261) + (262) + (263) + (264) =	3601.77	(265)
Space cooling	48.95	x	0.52	=	25.40	(266)
Pumps and fans	333.74	x	0.52	=	173.21	(267)
Electricity for lighting	737.83	x	0.52	=	382.93	(268)
Energy saving/generation technologies						
pv savings	-1646.70	x	0.52	=	-854.64	(269)
Total CO_2, kg/year				(265)...(271) =	3328.68	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	11.31	(273)
EI value					86.85	
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	14663.50	x	1.22	=	17889.48	(261)
Water heating	2011.34	x	1.22	=	2453.84	(264)
Space and water heating				(261) + (262) + (263) + (264) =	20343.31	(265)
Space cooling	48.95	x	3.07	=	150.27	(266)
Pumps and fans	333.74	x	3.07	=	1024.57	(267)
Electricity for lighting	737.83	x	3.07	=	2265.14	(268)
Energy saving/generation technologies						
Electricity generated - PVs	-1646.70	x	3.07	=	-5055.37	(269)
Primary energy kWh/year					18727.92	(272)
Dwelling primary energy rate kWh/m2/year					63.64	(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	Ms Rachell wootliff	Assessor number	8847
Client		Last modified	25/02/2017
Address	1, London		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		120.21	(1a)	x	3.00	(2a)	=	360.63	(3a)
+1		94.70	(1b)	x	3.50	(2b)	=	331.45	(3b)
+2		79.35	(1c)	x	2.70	(2c)	=	214.25	(3c)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	294.26	(4)						
Dwelling volume							(3a) + (3b) + (3c) + (3d)...(3n) =	906.33	(5)

2. Ventilation rate

			m³ per hour	
Number of chimneys	1	x 40 =	40	(6a)
Number of open flues	1	x 20 =	20	(6b)
Number of intermittent fans	4	x 10 =	40	(7a)
Number of passive vents	0	x 10 =	0	(7b)
Number of flueless gas fires	1	x 40 =	40	(7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs (6a) + (6b) + (7a) + (7b) + (7c) =	140	÷ (5) =	0.15	(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		4.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.35	(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) =	0.30	(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	0.38	0.38	0.37	0.33	0.32	0.29	0.29	0.28	0.30	0.32	0.34	0.35	(22b)

Calculate effective air change rate for the applicable case:

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

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.55	0.55	0.56	0.56	(24d)

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

0.57	0.57	0.57	0.55	0.55	0.54	0.54	0.54	0.55	0.55	0.56	0.56	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Door			3.60	x	1.50	=	5.40			(26)
Window			43.36	x	1.33	=	57.48			(27)
Basement floor			120.12	x	0.10	=	12.01			(28)
External wall			482.29	x	0.15	=	72.34			(29a)
Roof			120.21	x	0.11	=	13.22			(30)
Total area of external elements ∑A, m²			769.58							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	160.46	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K		250.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		9.22	(36)
Total fabric heat loss	(33) + (36) =	169.68	(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)	171.61	170.76	169.92	165.97	165.23	161.80	161.80	161.16	163.12	165.23	166.73	168.29	(38)
Heat transfer coefficient, W/K (37)m + (38)m	341.29	340.44	339.60	335.65	334.91	331.48	331.48	330.84	332.80	334.91	336.41	337.97	

Average = ∑(39)1...12/12 = 335.65 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.16	1.16	1.15	1.14	1.14	1.13	1.13	1.12	1.13	1.14	1.14	1.15

Average = ∑(40)1...12/12 = 1.14 (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	3.12	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	108.41	(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)	119.25	114.91	110.57	106.24	101.90	97.57	97.57	101.90	106.24	110.57	114.91	119.25

∑(44)1...12 = 1300.87 (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)	176.84	154.66	159.60	139.14	133.51	115.21	106.76	122.51	123.97	144.48	157.71	171.26

∑(45)1...12 = 1705.65 (45)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Distribution loss 0.15 x (45)m	26.53	23.20	23.94	20.87	20.03	17.28	16.01	18.38	18.60	21.67	23.66	25.69	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	300.00	(47)
Water storage loss:		
a) If manufacturer's declared loss factor is known (kWh/day)	0.17	(48)
Temperature factor from Table 2b	0.72	(49)
Energy lost from water storage (kWh/day) (48) x (49)	0.12	(50)
Enter (50) or (54) in (55)	0.12	(55)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Water storage loss calculated for each month (55) x (41)m	3.80	3.43	3.80	3.68	3.80	3.68	3.80	3.80	3.68	3.80	3.68	3.80	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

3.80	3.43	3.80	3.68	3.80	3.68	3.80	3.80	3.68	3.80	3.68	3.80	(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

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

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

180.64	158.10	163.40	142.82	137.31	118.89	110.56	126.31	127.65	148.28	161.38	175.06	(62)

Solar DHW input calculated using Appendix G or Appendix H

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

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

176.84	154.66	159.60	139.14	133.51	115.21	106.76	122.51	123.97	144.48	157.71	171.26

∑(64)1...12 = 1705.65 (64)

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

37.58	32.87	33.92	29.57	28.37	24.48	22.69	26.03	26.34	30.70	33.51	36.39	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	156.22	156.22	156.22	156.22	156.22	156.22	156.22	156.22	156.22	156.22	156.22	156.22	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	41.78	37.11	30.18	22.85	17.08	14.42	15.58	20.25	27.18	34.51	40.28	42.94	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	453.60	458.31	446.45	421.19	389.32	359.36	339.35	334.64	346.50	371.75	403.63	433.59	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.62	38.62	38.62	38.62	38.62	38.62	38.62	38.62	38.62	38.62	38.62	38.62	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-124.98	-124.98	-124.98	-124.98	-124.98	-124.98	-124.98	-124.98	-124.98	-124.98	-124.98	-124.98	(71)
Water heating gains (Table 5)	50.51	48.91	45.58	41.07	38.13	34.00	30.49	34.99	36.59	41.27	46.55	48.91	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	615.75	614.19	592.08	554.97	514.40	477.65	455.28	459.75	480.14	517.40	560.32	595.31	(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	
NorthEast	0.77	x	5.43	x	11.28	x 0.9 x	0.60	x	0.80	=	20.38	(75)
SouthEast	0.77	x	7.18	x	36.79	x 0.9 x	0.60	x	0.80	=	87.88	(77)
NorthWest	0.77	x	2.40	x	11.28	x 0.9 x	0.60	x	0.80	=	9.01	(81)
SouthWest	0.77	x	15.53	x	36.79	x 0.9 x	0.60	x	0.80	=	190.07	(79)
West	0.77	x	3.60	x	19.64	x 0.9 x	0.60	x	0.80	=	23.52	(80)
East	0.77	x	5.57	x	19.64	x 0.9 x	0.60	x	0.80	=	36.39	(76)
North	0.77	x	3.65	x	10.63	x 0.9 x	0.60	x	0.80	=	12.91	(74)

Solar gains in watts ∑(74)m...(82)m

380.16	675.14	990.50	1328.47	1572.64	1596.43	1524.65	1338.48	1107.63	764.80	460.52	321.90	(83)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	995.91	1289.33	1582.57	1883.45	2087.03	2074.08	1979.93	1798.23	1587.76	1282.19	1020.84	917.20	(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	1.00	0.99	0.95	0.85	0.69	0.76	0.95	1.00	1.00	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.50	19.66	19.93	20.30	20.64	20.88	20.97	20.95	20.75	20.29	19.83	19.48	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	19.95	19.95	19.96	19.97	19.97	19.98	19.98	19.98	19.98	19.97	19.97	19.96	(88)
Utilisation factor for gains for rest of dwelling n2,m	1.00	1.00	1.00	0.98	0.93	0.77	0.55	0.63	0.91	0.99	1.00	1.00	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)	18.57	18.73	19.00	19.37	19.70	19.92	19.97	19.96	19.81	19.37	18.91	18.55	(90)

Living area fraction — Living area ÷ (4) = 0.16 (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	18.72	18.88	19.16	19.52	19.86	20.08	20.13	20.13	19.97	19.52	19.06	18.71	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate	18.72	18.88	19.16	19.52	19.86	20.08	20.13	20.13	19.97	19.52	19.06	18.71	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	1.00	1.00	1.00	0.98	0.93	0.78	0.57	0.65	0.91	0.99	1.00	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	995.64	1287.96	1575.87	1847.52	1930.66	1609.49	1137.52	1170.50	1443.23	1272.09	1020.09	917.04	(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]	4921.82	4760.94	4297.77	3566.12	2732.05	1815.28	1171.68	1232.86	1952.02	2989.08	4023.56	4902.52	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	2921.08	2333.84	2025.10	1237.39	596.24	0.00	0.00	0.00	0.00	1277.44	2162.49	2965.20	

∑(98)1...5, 10...12 = 15518.78 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) 52.74 (99)

8c. Space cooling requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm	0.00	0.00	0.00	0.00	0.00	3115.88	2452.92	2514.38	0.00	0.00	0.00	0.00	(100)
Utilisation factor for loss ηm	0.00	0.00	0.00	0.00	0.00	0.75	0.84	0.79	0.00	0.00	0.00	0.00	(101)
Useful loss ηmLm (watts) (100)m x (101)m	0.00	0.00	0.00	0.00	0.00	2339.89	2061.54	1988.27	0.00	0.00	0.00	0.00	(102)
Gains	0.00	0.00	0.00	0.00	0.00	2591.72	2477.34	2268.89	0.00	0.00	0.00	0.00	(103)
Space cooling requirement, whole dwelling, continuous (kWh) 0.024 x [(103)m - (102)m] x (41)m	0.00	0.00	0.00	0.00	0.00	181.32	309.35	208.78	0.00	0.00	0.00	0.00	

∑(104)6...8 = 699.46 (104)

Cooled fraction cooled area ÷ (4) = 1.00 (105)

Intermittency factor (Table 10)

0.00	0.00	0.00	0.00	0.00	0.25	0.25	0.25	0.00	0.00	0.00	0.00

∑(106)6...8 = 0.75 (106)

Space cooling requirement (104)m x (105) x (106)m

0.00	0.00	0.00	0.00	0.00	45.33	77.34	52.20	0.00	0.00	0.00	0.00

∑(107)6...8 = 174.86 (107)

Space cooling requirement kWh/m²/year (107) ÷ (4) = 0.59 (108)

8f. Fabric energy efficiency

Dwelling Fabric Energy Efficiency (DFEE) (99) + (108) = 53.33 (109)

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	Ms Rachell wootliff	Assessor number	8847
Client		Last modified	25/02/2017
Address	1, London		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		120.21	(1a)	x	3.00	(2a)	=	360.63	(3a)
+1		94.70	(1b)	x	3.50	(2b)	=	331.45	(3b)
+2		79.35	(1c)	x	2.70	(2c)	=	214.25	(3c)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	294.26	(4)						
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =			906.33	(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	4	x 10 =	40	(7a)
Number of passive vents	0	x 10 =	0	(7b)
Number of flueless gas fires	0	x 40 =	0	(7c)
			Air changes per hour	
Infiltration due to chimneys, flues, fans, PSVs (6a) + (6b) + (7a) + (7b) + (7c) =	40	÷ (5) =	0.04	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		5.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.29	(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) =	0.25	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table 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	0.32	0.31	0.31	0.28	0.27	0.24	0.24	0.23	0.25	0.27	0.28	0.29	(22b)

Calculate effective air change rate for the applicable case:

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.55	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.54	0.54	0.54	(24d)

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

0.55	0.55	0.55	0.54	0.54	0.53	0.53	0.53	0.53	0.54	0.54	0.54	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Door			3.60	x	1.00	=	3.60			(26)
Window			43.36	x	1.33	=	57.48			(27)
Basement floor			120.12	x	0.13	=	15.62			(28)
External wall			482.29	x	0.18	=	86.81			(29a)
Roof			120.21	x	0.13	=	15.63			(30)
Total area of external elements ∑A, m²			769.58							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	179.14	(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		22.06	(36)
Total fabric heat loss	(33) + (36) =	201.20	(37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)	164.74	164.15	163.57	160.85	160.35	157.98	157.98	157.54	158.89	160.35	161.37	162.45	(38)
Heat transfer coefficient, W/K (37)m + (38)m	365.94	365.35	364.77	362.05	361.54	359.18	359.18	358.74	360.09	361.54	362.57	363.65	
Average = ∑(39)1...12/12 =												362.05	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.24	1.24	1.24	1.23	1.23	1.22	1.22	1.22	1.22	1.23	1.23	1.24	
Average = ∑(40)1...12/12 =												1.23	(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	3.12	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	108.41	(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)	119.25	114.91	110.57	106.24	101.90	97.57	97.57	101.90	106.24	110.57	114.91	119.25	
∑(44)1...12 =												1300.87	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	176.84	154.66	159.60	139.14	133.51	115.21	106.76	122.51	123.97	144.48	157.71	171.26	
∑(45)1...12 =												1705.65	(45)
Distribution loss 0.15 x (45)m	26.53	23.20	23.94	20.87	20.03	17.28	16.01	18.38	18.60	21.67	23.66	25.69	(46)

Storage volume (litres) including any solar or WWHRS storage within same vessel	150.00	(47)
Water storage loss:		
a) If manufacturer's declared loss factor is known (kWh/day)	1.39	(48)
Temperature factor from Table 2b	0.54	(49)
Energy lost from water storage (kWh/day) (48) x (49)	0.75	(50)
Enter (50) or (54) in (55)	0.75	(55)

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

23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(56)

If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)

23.33	21.07	23.33	22.58	23.33	22.58	23.33	23.33	22.58	23.33	22.58	23.33	(57)

Primary circuit loss for each month from Table 3

23.26	21.01	23.26	22.51	23.26	22.51	23.26	23.26	22.51	23.26	22.51	23.26	(59)

Combi loss for each month from Table 3a, 3b or 3c

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(61)

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

223.43	196.75	206.20	184.24	180.11	160.30	153.35	169.10	169.06	191.07	202.80	217.85	(62)

Solar DHW input calculated using Appendix G or Appendix H

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

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

176.84	154.66	159.60	139.14	133.51	115.21	106.76	122.51	123.97	144.48	157.71	171.26	

∑(64)1...12 = 1705.65 (64)

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

37.58	32.87	33.92	29.57	28.37	24.48	22.69	26.03	26.34	30.70	33.51	36.39	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	156.22	156.22	156.22	156.22	156.22	156.22	156.22	156.22	156.22	156.22	156.22	156.22	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	42.91	38.11	30.99	23.46	17.54	14.81	16.00	20.80	27.92	35.44	41.37	44.10	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	453.60	458.31	446.45	421.19	389.32	359.36	339.35	334.64	346.50	371.75	403.63	433.59	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	38.62	38.62	38.62	38.62	38.62	38.62	38.62	38.62	38.62	38.62	38.62	38.62	(69)
Pump and fan gains (Table 5a)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(70)
Losses e.g. evaporation (Table 5)	-124.98	-124.98	-124.98	-124.98	-124.98	-124.98	-124.98	-124.98	-124.98	-124.98	-124.98	-124.98	(71)
Water heating gains (Table 5)	50.51	48.91	45.58	41.07	38.13	34.00	30.49	34.99	36.59	41.27	46.55	48.91	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	616.88	615.19	592.89	555.59	514.86	478.04	455.71	460.29	480.87	518.33	561.41	596.47	(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	
NorthEast	0.77	x	5.43	x	11.28	x 0.9 x	0.63	x	0.70	=	18.72	(75)
SouthEast	0.77	x	7.18	x	36.79	x 0.9 x	0.63	x	0.70	=	80.74	(77)
NorthWest	0.77	x	2.40	x	11.28	x 0.9 x	0.63	x	0.70	=	8.28	(81)
SouthWest	0.77	x	15.53	x	36.79	x 0.9 x	0.63	x	0.70	=	174.63	(79)
West	0.77	x	3.60	x	19.64	x 0.9 x	0.63	x	0.70	=	21.61	(80)
East	0.77	x	5.57	x	19.64	x 0.9 x	0.63	x	0.70	=	33.43	(76)
North	0.77	x	3.65	x	10.63	x 0.9 x	0.63	x	0.70	=	11.86	(74)

Solar gains in watts ∑(74)m...(82)m

349.27	620.28	910.02	1220.53	1444.86	1466.72	1400.77	1229.73	1017.63	702.66	423.11	295.74	(83)

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

966.15	1235.47	1502.91	1776.13	1959.72	1944.76	1856.48	1690.02	1498.50	1220.99	984.51	892.21	(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	1.00	0.99	0.97	0.89	0.75	0.82	0.96	1.00	1.00	1.00	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	19.39	19.54	19.81	20.18	20.54	20.82	20.94	20.92	20.67	20.20	19.72	19.36	(87)
Temperature during heating periods in the rest of dwelling from Table 9, Th2(˚C)	19.89	19.89	19.89	19.90	19.90	19.90	19.90	19.90	19.90	19.90	19.89	19.89	(88)
Utilisation factor for gains for rest of dwelling n2,m	1.00	1.00	1.00	0.99	0.95	0.82	0.61	0.69	0.93	0.99	1.00	1.00	(89)
Mean internal temperature in the rest of dwelling T2 (follow steps 3 to 7 in Table 9c)	18.40	18.56	18.83	19.20	19.55	19.80	19.89	19.87	19.68	19.22	18.75	18.38	(90)

Living area fraction — Living area ÷ (4) = 0.16 (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	18.56	18.72	18.99	19.36	19.71	19.97	20.06	20.05	19.85	19.38	18.91	18.54	(92)
Apply adjustment to the mean internal temperature from Table 4e where appropriate	18.56	18.72	18.99	19.36	19.71	19.97	20.06	20.05	19.85	19.38	18.91	18.54	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	1.00	1.00	1.00	0.99	0.94	0.82	0.63	0.71	0.93	0.99	1.00	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	965.88	1234.27	1497.62	1750.15	1849.81	1602.66	1176.30	1196.15	1394.02	1213.07	983.82	892.04	(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]	5218.59	5048.22	4555.01	3785.88	2896.62	1929.46	1242.84	1307.91	2068.98	3175.26	4280.57	5214.72	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	3164.02	2562.97	2274.70	1465.72	778.83	0.00	0.00	0.00	0.00	1459.87	2373.66	3216.07	

∑(98)1...5, 10...12 = 17295.85 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) 58.78 (99)

8c. Space cooling requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss rate Lm	0.00	0.00	0.00	0.00	0.00	3376.27	2657.92	2726.42	0.00	0.00	0.00	0.00	(100)
Utilisation factor for loss ηm	0.00	0.00	0.00	0.00	0.00	0.67	0.77	0.72	0.00	0.00	0.00	0.00	(101)
Useful loss ηmLm (watts) (100)m x (101)m	0.00	0.00	0.00	0.00	0.00	2272.45	2045.35	1951.10	0.00	0.00	0.00	0.00	(102)
Gains	0.00	0.00	0.00	0.00	0.00	2441.09	2333.60	2143.15	0.00	0.00	0.00	0.00	(103)
Space cooling requirement, whole dwelling, continuous (kWh) 0.024 x [(103)m - (102)m] x (41)m	0.00	0.00	0.00	0.00	0.00	121.42	214.46	142.88	0.00	0.00	0.00	0.00	

∑(104)6...8 = 478.76 (104)

Cooled fraction — cooled area ÷ (4) = 1.00 (105)

Intermittency factor (Table 10)

0.00	0.00	0.00	0.00	0.00	0.25	0.25	0.25	0.00	0.00	0.00	0.00

∑(106)6...8 = 0.75 (106)

Space cooling requirement (104)m x (105) x (106)m

0.00	0.00	0.00	0.00	0.00	30.35	53.61	35.72	0.00	0.00	0.00	0.00

∑(107)6...8 = 119.69 (107)

Space cooling requirement kWh/m²/year — (107) ÷ (4) = 0.41 (108)

8f. Fabric energy efficiency

Target Fabric Energy Efficiency (TFEE) — [(99) + (108)] * 1.15 = 68.06 (109)