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Doherty Design & Planning Limited

ENERGY STATEMENT

(To Accompany Detailed Planning Application)

Site

6 STREATLEY PLACE, LONDON, NW3 1HP

Proposal

ERECTION OF FOUR RESIDENTIAL UNITS

22nd DECEMBER 2016

Ref. E338-ES-00

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1.0 SUMMARY OF RECOMMENDATIONS

a) This development is for the erection of four residential units at 6 Streatley Place, London NW3 1HP.

b) It is proposed that in order to meet the requirements of policy this development will adopt a high standard of design with regard to energy efficiency principles.

c) This report highlights a reduction in excess of 35% in carbon dioxide emissions by the incorporation of a combination of fabric and energy efficiency measures, together with the provision of on-site renewable energy production equipment.

d) This development is at the planning stage and the detailed construction drawings have not been prepared, therefore initial stage SAP calculations and procedures provided in the Renewables Toolkit, which form the basis of the London Plan's "Energy Hierarchy", have been used to estimate that the baseline carbon dioxide emissions of this development.

e) This report has demonstrated, by using initial SAP Assessments, to calculate carbon dioxide emissions for the development and that it is possible to achieve a 26.5% reduction in carbon dioxide emissions by making fabric and energy efficiency measures, with a further 40.6% reduction in carbon dioxide emissions by incorporating photovoltaic systems, resulting in a total reduction of 56.3% in carbon dioxide emissions. It is envisaged during detailed construction design, these figures can be improved.

f) This Energy Statement demonstrates that the proposed development complies with the requirements of planning policy with regard to carbon dioxide reduction and incorporation of low and zero carbon technologies. It is for these reasons it is considered that this application should be viewed favorably by London Borough of Camden.

2.0 INTRODUCTION

a) Doherty Design and Planning Limited have been instructed to prepare an Energy Statement to support the submission of the planning application for the development at 6 Streatley Place, London, NW3 1HP. This report must be read in conjunction with the application forms, certificates, detailed plans and other supporting documents submitted to the Local Authority as part of the application.

b) The Application is for the erection of four dwelling in a single block on an infill site. The dwellings shall be a mixture of one and two bedroom dwellings, made up of flats.

c) The objectives of this Energy Statement are to make an appraisal of the carbon dioxide emissions of the proposed development, assess the potential fabric and building services efficiencies to reduce the carbon dioxide emission, review the various methods of generating and using renewable energy at source, and to suggest the most appropriate means by which the development can contribute towards the aspiration of policy relating to renewable energy provision.

d) The Assessment shall be carried out following the principles set out in the Mayor's "Energy Hierarchy" which is implemented through the London Plan. These principles can be summarised as follows:

- Be Lean –use less energy
- Be Clean – supply energy efficiently
- Be Green – use renewable energy

e) At this stage in the design of the development, the detailed Building Regulations construction information has not been prepared and therefore following detailed construction design, the energy calculations will be revisited to ensure the energy requirements and carbon dioxide emissions are up to date.

f) In order to demonstrate the carbon dioxide emissions, it is proposed to use the Standard Assessment Procedure (SAP) for the calculations to obtain initial baseline carbon dioxide emissions figures for the dwellings. Further calculations will be used to demonstrate the potential carbon dioxide emission savings from the initial calculations by enhancements to the building fabric, plant and controls – BE LEAN. The suitability of supplying energy, both heat and power, through the use of a combined heat and power system shall be assessed – BE CLEAN. Finally, the carbon dioxide emission saving by the use of renewable energy shall be assessed through the outputs from the SAP calculation – BE GREEN.

3.0 POLICY CONTEXT

a) The London Borough of Camden require all developments to ensure compliance with the applicable energy and sustainability standards stipulated in the London Plan, London Borough of Camden Local Plan and associated documented issued by the Mayor of London.

b) The London Plan, March 2016, Policy 5.2 expects development proposals to make the fullest contribution to minimising carbon dioxide emissions in accordance with the following energy hierarchy:

- Be Lean –use less energy
- Be Clean – supply energy efficiently
- Be Green – use renewable energy

c) The Policy also states that the Mayor will work with boroughs and developers to ensure that major developments meet the following targets for carbon dioxide emissions reduction in buildings. These targets are expressed as minimum improvements over the Target Emission Rate (TER) outlined in the national Building Regulations leading to zero carbon residential buildings from 2016 and zero carbon non-domestic buildings from 2019.

Residential buildings:

Year	Improvement on 2010 building Regulations 2010
2010-2013	25 per cent (Code for Sustainable Homes Level 4)
2013-2016	40 per cent
2016-2031	Zero Carbon

Non-domestic buildings:

Year	Improvement on 2010 building Regulations 2010
2010-2013	25 per cent
2013-2016	40 per cent
2016-2019	As per Building Regulations
2019-2031	Zero Carbon

d) The Energy Statement follows the principles set out in the Energy Hierarchy and is broken down to provide the following details:

i) Estimated site-wide regulated carbon dioxide emissions and reductions (broken down for the domestic and non-domestic elements of the development), expressed in tonnes per annum, after each stage of the energy hierarchy

ii) A clear commitment to regulated carbon dioxide emissions savings compared to a Part L 2013 of the Building Regulations compliant development through energy demand reduction measures alone

iii) Clear evidence that the risk of overheating has been mitigated through passive design

iv) Evidence of investigation into existing or planned district heating networks that the development could be connected to, including relevant correspondence with local heat network operators

v) Commitment to a site heat network served by a single energy centre linking all apartments and non-domestic building uses, if appropriate for the development

vi) Where applicable, investigations of the feasibility of installing CHP in the proposed development (if connection can't be made to an area wide network) before considering renewables

vii) An initial feasibility test for renewable energy technologies and, where appropriate, commitment to further reduce carbon dioxide emissions through the use of onsite renewable energy generation

g) As can be seen above, the London Plan policy 5.2 sets a zero carbon target for residential developments over the Building Regulations 2010.

h) However, as the Building Regulations were revised in 2013, the Greater London Authority issued their "Sustainable Design and Construction SPG" in April 2014, which clarifies the current target. This document states:

"To avoid complexity and extra costs for developers, the Mayor will adopt a flat carbon dioxide improvement target beyond Part L 2013 of 35% to both residential and non-residential development."

e) Under The London Plan Policy 5.5, the Mayor expects 25 per cent of the heat and power used in London to be generated through the use if localised decentralised energy system by 2025. The London Heat Map has been used to assess the district heat systems, both current and proposed, with the view to connecting the building to them.

f) Policy 5.7 seeks to increase the proportion of energy generated from renewable energy sources and expects that projects that developments will provide on-site renewable energy generation in order to meet the requirements of Policy 5.2.

g) The aim of the Energy Statement is to meet the carbon dioxide reduction targets on-site. Where it is clearly demonstrated that the specific targets cannot be fully achieved on-site, as per the requirements of The London Plan, any shortfall may be provided off-site or through a "cash in lieu" contribution to the relevant borough to be ring fenced to secure delivery of carbon dioxide savings elsewhere.

4.0 LOW CARBON AND RENEWABLE ENERGY SYSTEMS

4.1 Introduction

a) This section of the Energy Statement shall make an appraisal of the carbon dioxide emissions of the proposed development, the various methods of generating and using renewable energy at source, and to suggest the most appropriate means by which the development can contribute towards the aspiration of policy relating to renewable energy provision.

b) The London Renewables Toolkit (LRT) is the system developed by the Greater London Authority to assist Planners, Developers and Consultants with the assessment of the appropriateness of renewable energy resources and technologies. It offers advice on which renewable technologies are suitable including aesthetic issues, risks, reliability and gives an insight into the cost benefit analysis of installing renewable.

c) It also provides guidance on how to comply with the requirements of the London Plan and relevant borough development documents. Typical detailed calculations are provided to help determine the most appropriate renewable technology for each scheme.

d) Within Section 4 of the LRT – 'Including Renewables in the Development Proposals', a route map is provided to help consider the feasibility of renewable technologies and how to include them into the development.

e) The dwellings emissions have been estimated using the Standard Assessment Procedure. A second set of SAP calculations have been undertaken to demonstrate an improvement in the carbon dioxide emissions by incorporating better fabric constructions, better windows and doors, improved ventilation systems and enhanced air tightness.

4.2 Baseline Carbon Dioxide Emissions

a) In order to assess the carbon dioxide emissions of the development, the delivered energy demand needs to be estimated. At this stage in the design of the dwellings, the detailed construction drawings have not been prepared and therefore detailed carbon emission calculations cannot be undertaken to produce the carbon dioxide emissions.

b) However, the dwellings carbon dioxide emission estimates can be based on initial stage SAP calculations. In this case, SAP calculations have been prepared for all of the proposed dwellings.

c) Table 1 below summarises the results from the TER Worksheets that can be found in Appendix A.

Dwelling	Floor Area (m^2)	Heating (kg/yr)	Water Heating (kg/yr)	Pumps & Fans (kg/yr)	Electricity for Lighting (kg/yr)	Total Emissions (kg/yr)	Dwelling CO_2 Emission Rate
1	82.9	856.91	518.67	38.93	184.18	1598.69	19.28
2	74.1	721.01	497.88	38.93	168.88	1426.7	19.25
3	104.1	922.71	549.2	38.93	214.73	1725.57	16.58
4	63.6	612.17	464.28	38.93	148.93	1264.31	19.88

Flat	TER ($kg/m^2/yr$)	Area (m^2)	Emissions (kg/yr)
1	19.28	82.9	1,598
2	19.25	74.1	1,426
3	16.58	104.1	1,726
4	19.88	63.6	1,264
Total		**324.7**	**6,014**
Baseline Carbon Dioxide Emissions (kg/yr)			**6,014**

Table 1 – Baseline Carbon Dioxide Emissions

4.3 Improved Baseline Carbon Dioxide Emissions – BE LEAN

a) Following the principles set out in the Mayor's "Energy Hierarchy" which is implemented in the London Plan and the Local Policy, the design has been improved to use less energy - BE LEAN.

b) This has been achieved by improving the thermal performance of the various constructions, like the walls, roof, floors, windows, doors etc and incorporating mechanical ventilation heat recovery and improving the air tightness of the dwelling.

c) The floor U Values can be improved by incorporating insulation under the screed, or by using insulation blocks instead of concrete blocks between the beams. For the purposes of these calculations, the U Values of the current floor constructions have been calculated as 0.15 W/m^2K.

d) The wall U Values can be improved by improving the thermal performance of the insulation, either by increased thickness or lower thermal conductivity. For the purposes of these calculations, the U Values of the current wall constructions have been calculated as 0.13 W/m^2K.

e) The roof areas offer excellent opportunity to enhance the insulation levels and for the purposes of these calculations, the U Value of 0.089 W/m^2K has been used.

f) The party walls between the dwellings shall be fully filled with insulation and shall have sealed edges, which effective results on a U Value of 0.0 W/m^2K. There are also Robust Details to lower the noise transmissions through fully filled party walls.

g) The thermal performance of the windows can be improved by adding coatings to the panes or adding an inert gas to the cavities. For the purposes of these calculations, the U Values of the windows has been taken as 1.2 W/m^2K, which uses double glazed planitherm glass, argon gas and warm edge spacer bars.

h) A composite front door can be used instead of a timber door. Modern composite doors have good thermal, fire, acoustic and security properties. These types of door can have U Values as low as 0.55 W/m^2K.

i) The air leakage rate for the dwellings can be improved. The maximum allowed under the current Building Regulations Approved Document L1A:2013 is 10 $m^3/hr/m^2$ at 50 Pascal's. With carful detailing, this can be easily improved to 3 $m^3/hr/m^2$ at 50 Pascal's.

j) The use of Accredited Construction Details in the development means that the thermal bridging coefficient can be greatly improved, thus lowering the γ can be lowered.

k) With regard to the heating, a combi boiler shall be provided in each dwelling to provide the heating and hot water.

l) More efficient controls can be installed to control the heating, which can include weather compensation on the boiler control and the use of programmers, thermostats and thermostatic radiator valves all improve the efficiency of the heating system.

m) Instead of simply installing 75% of the light fittings as low energy efficient light fittings, as required by the current Building Regulations, 100% of the light fitting could be low energy fittings.

n) The use of natural lighting has been considered and although its use is not measured in the SAP calculations, it can help lower the energy use and therefore carbon dioxide emissions of the development. This has to be carefully assessed against any unwanted solar overheating. Whilst a degree of solar gain can be beneficial for the occupants and helps lower the carbon dioxide emissions, it must be controlled to minimise the risk of solar overheating. The calculations show only slight to medium risk of overheating.

o) Mechanical ventilation heat recovery systems work by removing the warm moist air from kitchens and bathrooms and passing it through a heat exchanger to recover waste heat. This waste heat can then be used to warm the fresh air that is brought into the living areas of the dwelling, therefore reducing the heating load.

p) The development shall be designed to ensure that the Dwelling Emission Rates are better than the Target Emission Rates and the Fabric Energy Efficiency is better than the Target Fabric Energy Efficiency. These are the requirements from Criterion 1 of the current Building Regulations Approved Document L (2013).

q) By incorporating items like those stated above, the SAP calculations have been updated to demonstrate the effect of these improvements and the results are listed in Table 2 below.

r) Full details of the SAP calculations can be found in the SAP Worksheets in Appendix B.

Dwelling	Floor Area (m^2)	Heating (kg/yr)	Water Heating (kg/yr)	Pumps & Fans (kg/yr)	Electricity for Lighting (kg/yr)	Total Emissions (kg/yr)	DER
1	82.9	393.04	454.31	122.39	184.18	1153.92	18.94
2	74.1	317.48	438.77	113.53	168.88	1038.66	18.93
3	104.1	426.85	478.2	143.73	214.73	1263.51	16.07
4	63.6	308.23	414.79	90.87	148.66	962.55	19.75

Flat	Dwelling CO_2 Emission Rate ($kg/m^2/yr$)	Area (m^2)	Emissions (kg/yr)
1	13.92	82.9	1,154
2	14.02	74.1	1,039
3	12.14	104.1	1,264
4	15.13	63.6	963
Total		**643.3**	**4,419**
Total Residential Emissions (kg/yr)			**4,419**
Percentage Improvement over current Building Regulations			**26.5 %**

Table 2 – Actual Carbon Dioxide Emissions

s) As demonstrated in Table 2 above, it can be seen that the improvements in the thermal performance and fixed building services, a reduction of 26.5%.

4.4 Supplying Energy Efficiently – BE CLEAN

a) Following the principles set out in the Energy Hierarchy, which is implemented in the London Plan and Local Policy, the next step is to reduce the carbon dioxide emissions by supplying energy efficiently - BE CLEAN.

4.5 District Heat Network

a) The London Heat Map is an online tool that can help identify opportunities for the use of decentralised energy networks and systems for use in projects.

b) Using the Heat Map, there appears to be no district heating systems available or even proposed in the area within the next five years, so it would not be feasible to install plant for future connection to such a network at this time.

c) Due to the small size of the development, a communal heating system would be relatively expensive to install and to operate and therefore is not be considered at this time. This is in line with the Greater London Authority's "Sustainable Design and Construction SPG" in published in April 2014.

d) In line with the Greater London Authority's "Sustainable Design and Construction SPG" in published in April 2014, it is considered that no potential heat networks available in the foreseeable future.

4.6 Combined Heat and Power

a) Combined Heat and Power typically generates electricity on site as a by-product of generating heat. It uses fuel efficient energy technology that, unlike traditional forms of power generation, uses the by-product of the heat generation required for the development. Normally during power generation, the heat is discharged or wasted to atmosphere. A typical CHP plant can increase the overall efficiency of the fuel use to more than 75%, compared to the traditional power supplies of 40%, which uses inefficient power stations and takes into account transmission and distribution losses.

b) The use of this development is primarily residential and it will be built to exceed the current Building Regulations. The aim of these regulations is to minimise the base heating load and electrical loads. The site base heating and electrical loads is key to the sizing and operation of any CHP system.

c) Due to the high levels of insulation and energy efficiency measures that will be incorporated into this development, there is no year round heat load for the CHP plant and therefore, a CHP system would be considered not viable on this development. As such, if a CHP system were to be incorporated, it would not operate efficiently and therefore NOT BE CLEAN.

4.7 Renewable Technologies Considered – BE GREEN

a) Taking into account the requirements of planning policy set out by London Borough of Camden and the London Plan, the developments annual carbon dioxide emission reduction target of 35%, based on the Building Regulations 2013, from energy efficiencies and renewable technology has been calculated as 19,139 kgCO_2/year.

b) The final step in the Mayor's "Energy Hierarchy" is to reduce the carbon dioxide emissions by the use of renewable technologies - BE GREEN.

c) In accordance with the toolkit the following renewable energy resources have been assessed for availability and appropriateness in relation to the site location, building occupancy and design.

- Combined Heat and Power
- Biomass Heating
- Biomass CHP
- Heat Pumps
- Solar Photovoltaics
- Domestic Solar Hot Water Systems
- Wind Power

d) A preliminary assessment has been carried out for each renewable energy technology and for those appearing viable a further detailed appraisal has been undertaken.

e) The preliminary study considered the site location and the type of building in the development and surroundings and produced a shortlist of renewable energy technologies that will be the subject of a further feasibility study.

f) Table 3 below provides a summary of the assessment.

4.8 Renewables Toolkit Assessment

Energy System	Description	Comment
Combined Heat and Power (CHP)	Combined Heat and Power systems use the waste heat from an engine to provide heating and hot water, while the engine drives an electricity generator. These systems uses gas or oil as the main fuel and therefore can not truly be considered as renewable technology however, it is recognised that they have a significant reduced impact on the environment compared to conventional fossil fueled systems.	As CHP systems produce roughly twice as much heat as they generate electricity, they are usually sized according to the base load heat demand of a building, to minimise heat that is wasted during part-load operations. Therefore, to be viable economically they require a large and constant demand for heat, which make their use in new energy efficient housing, with high insulation, not really suitable. The efficiency of small scale CHP is relatively low and is unlikely to result in CO_2 emission savings. Economic viability relies on 4000 hours running time, which is unlikely to be achieved in this scheme. As policy requires a reduction in carbon dioxide emissions via true renewable sources this would not assist in achieving the policy objectives.
Combined Heat and Power		**Feasible – NO**
Biomass Heating	Solid, liquid or gaseous fuels derived from plant material can provide boiler heat for space and water heating. Biomass can be burnt directly to provide heat in buildings. Wood from forests, urban tree pruning, farmed coppices or farm and factory waste, is the most common fuel and is used commercially in the form of wood chips or pellets, although traditional logs are also used. Other forms of Biomass can be used, e.g. bio-diesel.	Wood pellet or wood chip fired or dual bio-diesel/gas-fired boilers could be considered. As this development consists of a new building, it offers the opportunity to accommodate such a system. The flues would have to be discharged to atmosphere above roof level and concerns raised by Environmental Health regarding the pollutants and particles, which would have to be addressed. Care need to be taken with the design of the flue to ensure particle discharge is not a concern to residents. The fuel storage silo/tank would have to be located external to the building, which is not available on this site. A suitable local fuel supplier is required to supply the site.
Biomass Heating		**Feasible – NO**

Energy System	Description	Comment
Biomass CHP	CHP as above, but with biomass as the fuel.	Biomass CHP overcomes the issue of the reduction in carbon dioxide emissions via true renewable sources, however, the lack of a year round base load is still a problem and therefore Biomass CHP is not feasible for this development.
Biomass CHP		**Feasible - NO**
Ground/Air Source Heat Pumps (GSHP / ASHP) - heating	The ground collector can be installed, either as a loop of pipe, in the piles or using a borehole and a compressor offer efficient heating of a space in winter, as the temperature of the ground (below approx 2m) remains almost constant all year. For air source, the external condensing unit can be located adjacent to the dwelling in a discreet location.	Ground and air source heat pumps are most efficient when supplying heat continuously and in areas where a mains gas supply is not available. In dwellings, GSHP and ASHP are capable of supplying the majority of the total space heating and pre heat for the hot water demand. This site does not have external areas of sufficient size for the installation of ground loops for the collection of heat. Due to the size of the dwellings and their location, it is considered that the use of ASHP to offset the heat losses of these dwellings is not feasible.
Ground/Air Source Heat Pumps		**Feasible – NO**
Solar Photovoltaics (PV)	Building Integrated Photovoltaics (BIPV) or Roof mounted collectors provide noiseless, low maintenance, carbon free electricity.	There appears to be a reasonable amount of roof area that can be utilitised to install PV panels onto the scheme. These could be integrated into the roof finishes or mounted on frames on the roof and orientated south for optimal performance. Careful consideration must be given to the chosen roof finish to ensure compatibility.
Solar PhotoVoltaics		**Feasible – YES**
Solar Thermal Hot Water	Solar collectors for low temperature hot water systems require direct isolation, so the chosen location, orientation and tilt are critical.	This solution could be utilised to generate hot water using the energy from the sun. The area of roof could be used for the installation of solar thermal collectors. These could be mounted on frames and orientated south for optimal performance. These would have to be installed at a pitch of 30-40 degrees and ideally as close to the dwelling served as possible.
Solar Thermal Hot Water		**Feasible - YES**

Energy System	Description	Comment
Wind Power	Most small (1-25kW) wind turbines can be mounted on buildings, but larger machines require foundations at ground level and suitable site location	It could be viable to install some form of wind turbines on this site, however due to surrounding buildings and the visual impact it is not considered to be the most sensitive system of providing energy via renewable resources in this built up location. There are also concerns that the wind across the site would be turbulent because of the surrounding buildings.
Wind Power		**Feasible – NO**

Table 3 – Renewable Technology Feasibility Assessment

a) From the above it has been established that there are two potential ways of providing energy via renewable sources appropriate for inclusion in this scheme, these being the use of solar photovoltaics and domestic solar hot water or a combination thereof.

b) CHP and Micro CHP are considered not feasible as the economic viability relies on at least 4,000 hours runtime which is unlikely to be achieved in this development.

c) Biomass systems have been considered unfeasible for this site due to particle discharge in a built up area, fuel handling and storage on a site with limited open space, required plant areas and the on going maintenance of the system.

d) Heat pumps have been considered not feasible for this development as there is insufficient ground area for the installation of ground loops. Air source have been considered unfeasible due to the size of the dwellings and their close proximity of the neighboring dwellings.

e) Wind has been considered not viable for this site as there are a lot of the buildings and trees in the surrounding area which are likely to cause disruption to air flows.

4.9 Solar Photovoltaics

a) Photovoltaics (PV) is a technology that allows the production of electricity directly from sunlight. The term originates from “Photo” referring to light and “voltaic” referring to voltage. This type of technology has been developed for incorporation within building design to produce electricity for either direct consumption or re-sale to the National Grid.

b) PV panels come in modular panels which can be fitted on the top of roofs or incorporated in the finishes like slates or shingles to form integral part of the roof covering. PV cells can be incorporated into glass for atria walls and roofs or used in the cladding or rain screen on a building wall.

c) When planning to install PV panels, it is important to consider the inherent cost of installation in comparison to possible alternatives. The aesthetic impact of the PV panels also requires careful consideration.

d) Roof mounted PV panels should ideally face south-east to south-west at an elevation of about 30-40°. However, in the UK even if installed flat on a roof, they receive 90% of the energy of an optimum system.

e) PV installations are expressed in terms of the electrical output of the system, i.e. kilowatt peak (kWp). The Department of Trade and Industry estimate that an installation of 1kWp, could produce approximately 700-850 kWh/yr, which would require an area of between 8-20m^2, depending on the efficiencies and type of PV panel used.

f) It is also estimated that a gas heated, well insulated typical dwelling would use approximately 1,500kWh/year electricity for the lights and appliances, therefore the 1kWp system could save approximately 45% of a single dwellings electrical energy requirements.

g) Although often not unattractive, and possible to integrate into the building or roof cladding system PV systems are still considered likely to have visual implications, therefore careful sighting of the panels is required. As this installation will be contained on the roof of the proposed dwellings, it involves no additional land use.

h) With regard to noise and vibration, a PV system is completely silent in operation.

i) Care must be taken with the design and installation of PV systems as they need to meet standards for electrical safety.

j) Space has been identified on the proposed roof for photovoltaic system with a total output of 4.0 kWp.

Development incorporating Energy Efficiency Measures	Total Carbon Dioxide Emissions ($kgCO_2/yr$)	Percentage Reduction (%)
No Renewables	4,419	-
Reduction by including 4.0 kWp PV system	1,793	40.6%

Table 4 – Photovoltaic Carbon Dioxide Emissions

k) As can be seen from Table 4 above, the incorporation of 4.0 kWp photovoltaic systems on the roof of the development could reduce the carbon dioxide emissions by a further 40.6% and when combined with the fabric energy efficiency measures from in Table 2 above, a total reduction of 56.3% is achieved, which complies with the requirements of Planning Policy.

l) From the above calculations, based on 250 watt panels, orientated towards the south and mounted on the roof finishes at a 30 degree pitch, it is calculated that 63-No. panels are required on the proposed developments roof. An indicative layout is shown on the drawing 15012(PA)12. It is believed that these panels will not be visible from the street level due to the parapet wall around the roof.

m) It is estimated that this size of system could generate 13,386 kWh of electricity in a year.

n) Further detailed calculations for the carbon dioxide emissions and the final system size and layout shall be carried out during detailed design.

4.10 Domestic Solar Hot Water System

a) This system uses the energy from the sun to heat water, most commonly to provide the hot water demands of the development. The system uses heat collectors, generally mounted on the roof, in which a fluid is heated by the sun. This fluid is used to heat up water that is stored in either a separate cylinder or a twin coil hot water cylinder inside the dwelling. The system works very successfully in the UK, as it can operate in diffused light conditions.

b) As with PV panels, the collectors should be mounted facing in a southerly direction, from south-east through to south-west and at an elevation of 10 to 60°. The panels can be installed on the roof, either on the slope of the roof, on a frame, or they can be integrated into the roof finishes.

c) This system would be best suited on sites where the solar thermal collectors can be located close to the hot water storage vessel within the dwelling and therefore any losses can be minimised.

d) Approximately 2-4m^2 of solar thermal collectors could provide the hot water requirements of a typical dwelling. These could be used to feed twin coil hot water cylinders positioned within the dwellings, allowing the water to be heated by the sun when possible whilst retaining the back up of the main heating system when required.

e) This system would be relatively easy to install. However, the visual impact needs to be given consideration.

f) Although often not unattractive, and possible to integrate into the building or roof cladding system domestic solar thermal collectors are still considered likely to have visual implications, therefore careful sighting of the panels is required.

g) As this installation will be contained on the roof of the proposed development, it involves no additional land use.

h) With regard to noise and vibration, a domestic solar hot water system is completely silent in operation.

i) The current proposal for the heating and hot water utilitises combi boilers so therefore there is no hot water storage cylinders being installed in the flats.

j) Therefore, at this stage, the use of domestic solar hot water will not be considered further.

4.11 Annual Carbon Dioxide Emission Reduction

a) From the above, it can be seen that a Photovoltaic system, together with the fabric and energy efficiency measures, could be used to achieve the 35% reduction in carbon dioxide emissions as required by Planning Policy.

b) Based on the initial SAP calculations for the dwellings and SBEM calculations for the commercial area, it has been calculated that the baseline carbon dioxide emissions figure for the development is 6,014 $kgCO_2$/year.

c) In accordance with the Planning Policies set out by London Borough of Camden and the London Plan, this report has demonstrated a 26.5% improvement in carbon dioxide emissions by fabric and energy efficiencies. In addition, a further reduction of 40.6% in carbon dioxide emissions is possible by the use of renewable technologies, resulting in a total reduction of 56.3%.

d) A number of options have been considered and the potential carbon dioxide reductions calculated using the SAP calculations and a summary of the results is provided in Table 5 below.

	Total Carbon Dioxide Emissions ($kgCO_2$/yr)	Reduction in Carbon Dioxide Emissions (%)
Building Regulations Compliant Development	6,014	-
Development incorporating Energy Efficiency Measures	4,419	26.5%
Further Reduction in Carbon Dioxide Emissions by incorporating a Renewable Technology		
PV (4.0 kWp)	1,793	40.6%
Percentage Improvement incorporating the PV system		**56.3 %**

Table 5 – Summary of Reduction in Carbon Dioxide Emissions

e) It has been demonstrated that it is possible to achieve a 56.3% reduction in carbon dioxide emissions over and above the 2013 Building Regulations by improving the energy efficiency of the development and its building services efficiencies and by the incorporation of renewable technologies.

f) CHP and Biomass CHP have been analysed but are considered not feasible for this development as the heating and electrical load profiles would not provide a good clean efficient system for the development.

g) Biomass heating has been analysed but is considered not feasible for this development due to particle discharge in the built up area, space requirements and the cost and the reliability of a biomass fuel source.

h) Wind power is considered not feasible for this development due to the turbulence caused by the surrounding buildings and trees etc.

i) Solar hot water has been considered but as the type of boiler being install is not best suited for solar hot water, it is not being considered further at this stage.

j) The initial calculations show that in order to achieve in excess of the 35% reduction via fabric and energy efficiency measure and incorporating PV panels, a system with an output of 4.0 kWp with a southerly aspect would be required.

k) Detailed calculations of the total carbon dioxide emissions compared to the estimated carbon dioxide reduction for the development can be undertaken once the detailed design has progressed to construction drawing stage.

l) For the purpose of planning and based on the figures provided by initial SAP calculations, this report has demonstrated that it is feasible, with the improvement of the building fabric, the introduction of energy efficient controls and systems and the incorporation of photovoltaic systems, a reduction in excess of 35% of the developments carbon dioxide emissions could be achieved. This complies with the requirements of the planning policies set out by London Borough of Camden and in the London Plan.

4.12 Energy Hierarchy Carbon Dioxide Emissions Summary

a) The concept of applying the energy hierarchy in relation to Approved Document L of the Building Regulations 2013, the Energy Planning, Greater London Authority Guidance on Preparing Energy Assessments (March 2016) document provides further guidance on how the carbon dioxide emission figures can be presented.

b) The regulated carbon dioxide emissions reduction target for the development would be to achieve zero carbon as assessed under the Approved Document L 2013 of the Building Regulations.

c) These figures are based on the current design information and are subject to change when the detailed construction information is produced.

d) Table 6 provides Carbon Dioxide Emissions after each stage of the Energy Hierarchy for domestic buildings.

		Tonnes CO_2/yr
Baseline: Part L 2013 of the Building Regulations Compliant Development	a	6.0
After energy demand reduction	b	4.4
After heat network / CHP	c	4.4
After renewable energy	d	2.6

Table 6 – Carbon Dioxide Emissions after each stage of the Energy Hierarchy

e) Table 7 provides Regulated carbon dioxide savings from each stage of the Energy Hierarchy for domestic buildings

		Tonnes CO_2/yr		%
Savings from energy demand reduction	a-b	1.6	(a-b)/a*100	26.5%
Savings from heat network / CHP	b-c	0.0	(b-c)/a*100	0.0%
Savings from renewable energy	c-d	1.8	(c-d)/a*100	29.8%
Cumulative on site savings	**a-d=e**	**3.4**	**(a-d)/a*100**	**56.3%**
Annual Savings from off-set payment	a-e=f	2.6		
Cumulative savings for off-set payment	f*30=g	78.77		

Table 7 – Regulated carbon dioxide savings from each stage of the Energy Hierarchy

f) The calculations contained within this Energy Statement are based on the current design information and are subject to change when the detailed design is undertaken and the construction information is produced.

5.0 OVERHEATING

a) It is important to consider the internal comfort conditions for the occupants of the dwellings. At design stage, this can be met through the cooling hierarchy set out in the London Plan.

b) The cooling hierarchy in Policy 5.9 seeks to reduce any potential overheating and also the need to cool a building through active cooling measures. Air conditioning systems are a very resource intensive form of active cooling, increasing carbon dioxide emissions, and also emitting large amounts of heat into the surrounding area. By incorporating the cooling hierarchy into the design process buildings will be better equipped to manage their cooling needs and to adapt to the changing climate they will experience over their lifetime.

c) The development shall reduce the potential for overheating and reliance on air conditioning systems and demonstrate this in accordance with the following cooling hierarchy:

- i) minimise internal heat generation through energy efficient design
- ii) reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and walls
- iii) manage the heat within the building through exposed internal thermal mass and high ceilings
- iv) passive ventilation
- v) mechanical ventilation
- vi) active cooling systems (ensuring they are the lowest carbon options).

d) During the initial design, the initial SAP Assessments were carried out for each flat to help assess the energy demand and carbon emissions of the development. The SAP Assessments included an overheating assessment in line with the requirements of the Building Regulations.

e) Based on these SAP Assessments, some of the dwellings have a slight to medium risk of solar overheating, but none have a high risk of overheating. This is acceptable under the requirements of the Building Regulations.

f) The internal heat generation has been minimised through energy efficient design. The heat generating equipment shall be located in a central plant room which is naturally ventilated. No heat generating plant will be installed in any of the dwellings. All of the luminaires shall be low energy which will also remove an internal heat generating load.

g) The heat entering the building in summer is reduced through the optimisation of glazing area, the use of shading via balconies and other protruding edges, together with the inclusion of very high performance façade materials and improved air tightness. The use of a solar control glazing, which has a coating applied to lower the G Value of the glass, can be applied. This acts in the same way that the low e coating lowers the U Value which helps reduce heat losses through the windows.

h) The dwellings will have a mechanical ventilation system installed, which provides filtered fresh air to the dwellings. This is tempered by the crossover heat exchanger, which recovers waste heat from the extract air from the dwellings. These ventilation systems shall be individual systems installed in each dwelling so they are controlled locally by the occupants, therefore avoiding the distribution losses of a central system with large fans and ducts.

i) Low energy lamps shall be used in the luminaires to reduce heat gain. These lamps do not emit heat like traditional GLS lamps.

6.0 CONCLUSION

a) The London Borough of Camden and the London Plan 2016 Policy 5.2 requires new residential developments to minimise and exhibit the highest standards of sustainable design and construction. The reduction in carbon dioxide emissions target has been set as zero carbon. The development should achieve a minimum of 35% over the Target Emission Rate, as defined by the Building Regulations 2013.

b) This development is for the erection of four residential units on the site at 6 Streatley Place, London NW3 1HP.

c) It is proposed that in order to meet the requirements of policy this development will adopt a high standard of design with regard to energy efficiency principles and will achieve a reduction of at least 35% in the carbon dioxide emissions.

d) At planning stage it is not possible to produce final reports on the energy demand, carbon dioxide emissions or financial appraisals of the appropriate systems, based on the initial construction information.

e) However, for the development as a whole, this Energy Statement has demonstrated using initial SAP calculations that it is possible to achieve a 26.5% reduction in carbon dioxide emissions by making improvements in fabric and energy efficiency measures, with a further 40.6% reduction in carbon dioxide emissions by incorporating a photovoltaic system, resulting in a total carbon dioxide emissions reduction of more than 56.3%. It is envisaged during detailed construction design, these figures can be improved.

f) This Energy Statement demonstrates that the proposed development complies with the requirements of planning policy with regard to carbon dioxide reduction and incorporation of low and zero carbon technologies. It is for these reasons it is considered that this application should be viewed favorably by London Borough of Camden.

Appendix A – TER Worksheets

TER Worksheet
Design - Draft

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

Assessor name	Mr Jason Doherty	Assessor number	2634
Client		Last modified	23/12/2016
Address	1 6 Streatley Place, London, NW3 1HP		

1. Overall dwelling dimensions

		Area (m^2)			Average storey height (m)			Volume (m^3)	
Lowest occupied		82.90	(1a)	x	2.40	(2a)	=	198.96	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	82.90	(4)						
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =			198.96	(5)

2. Ventilation rate

			m^3 per hour	
Number of chimneys	0	x 40 =	0	(6a)
Number of open flues	0	x 20 =	0	(6b)
Number of intermittent fans	3	x 10 =	30	(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) =	30	÷ (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		5.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.40	(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) =	0.34	(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	0.43	0.43	0.42	0.37	0.37	0.32	0.32	0.32	0.34	0.37	0.38	0.40	(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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
d) natural ventilation or whole house positive input ventilation from loft	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(24d)
Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)	0.59	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.57	0.58	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m^2	Openings m^2	Net area A, m^2		U-value W/m^2K		A x U W/K	κ-value, $kJ/m^2.K$	A x κ, kJ/K	
Window			16.05	x	1.33	=	21.28			(27)
Door			1.95	x	1.00	=	1.95			(26)
Roof window			2.72	x	1.59	=	4.33			(27a)
Ground floor			82.90	x	0.13	=	10.78			(28a)
External wall			64.76	x	0.18	=	11.66			(29a)
Party wall			36.72	x	0.00	=	0.00			(32)
Roof			33.80	x	0.13	=	4.39			(30)
Total area of external elements ∑A, m^2			202.18							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	54.39	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m^2K		250.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		14.12	(36)
Total fabric heat loss	(33) + (36) =	68.51	(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)	39.02	38.78	38.55	37.44	37.23	36.27	36.27	36.09	36.64	37.23	37.65	38.09	(38)
Heat transfer coefficient, W/K (37)m + (38)m	107.53	107.29	107.05	105.95	105.74	104.78	104.78	104.60	105.15	105.74	106.16	106.60	
Heat loss parameter (HLP), W/m^2K (39)m ÷ (4)	1.30	1.29	1.29	1.28	1.28	1.26	1.26	1.26	1.27	1.28	1.28	1.29	
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)

Average = ∑(39)1...12/12 = 105.95 (39)

Average = ∑(40)1...12/12 = 1.28 (40)

4. Water heating energy requirement

Assumed occupancy, N	2.52	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	93.95	(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)	103.34	99.58	95.82	92.07	88.31	84.55	84.55	88.31	92.07	95.82	99.58	103.34	
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	153.25	134.03	138.31	120.58	115.70	99.84	92.52	106.17	107.43	125.20	136.67	148.41	
Distribution loss 0.15 x (45)m	22.99	20.10	20.75	18.09	17.36	14.98	13.88	15.92	16.12	18.78	20.50	22.26	(46)
Water storage loss calculated for each month (55) x (41)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)
Primary circuit loss for each month from Table 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)
Combi loss for each month from Table 3a, 3b or 3c	50.96	45.83	48.83	45.40	45.00	41.70	43.09	45.00	45.40	48.83	49.11	50.96	(61)

∑(44)1...12 = 1127.34 (44)

∑(45)1...12 = 1478.12 (45)

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

204.21	179.87	187.14	165.98	160.70	141.54	135.60	151.17	152.84	174.03	185.78	199.37	(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

204.21	179.87	187.14	165.98	160.70	141.54	135.60	151.17	152.84	174.03	185.78	199.37

∑(64)1...12 = 2038.24 (64)

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

63.70	56.02	58.20	51.44	49.72	43.62	41.53	46.55	47.07	53.84	57.72	62.09	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	125.78	125.78	125.78	125.78	125.78	125.78	125.78	125.78	125.78	125.78	125.78	125.78	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	20.09	17.85	14.51	10.99	8.21	6.93	7.49	9.74	13.07	16.60	19.37	20.65	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	225.39	227.73	221.84	209.29	193.45	178.57	168.62	166.28	172.18	184.72	200.56	215.45	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.58	35.58	35.58	35.58	35.58	35.58	35.58	35.58	35.58	35.58	35.58	35.58	(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)	-100.62	-100.62	-100.62	-100.62	-100.62	-100.62	-100.62	-100.62	-100.62	-100.62	-100.62	-100.62	(71)
Water heating gains (Table 5)	85.61	83.37	78.22	71.45	66.83	60.59	55.82	62.57	65.38	72.36	80.17	83.45	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	394.83	392.68	378.31	355.46	332.23	309.82	295.67	302.32	314.36	337.42	363.84	383.29	(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	
SouthEast	0.77	x	7.54	x	36.79	x 0.9 x	0.63	x	0.70	=	84.78	(77)
SouthWest	0.77	x	1.52	x	36.79	x 0.9 x	0.63	x	0.70	=	17.09	(79)
NorthWest	0.77	x	1.56	x	11.28	x 0.9 x	0.63	x	0.70	=	5.38	(81)
NorthEast	0.77	x	5.43	x	11.28	x 0.9 x	0.63	x	0.70	=	18.72	(75)
Horizontal	1.00	x	2.72	x	26.00	x 0.9 x	0.63	x	0.70	=	28.07	

Solar gains in watts ∑(74)m...(82)m

154.05	280.89	429.47	601.30	731.94	751.09	714.05	613.68	488.95	323.00	187.98	129.54	(83)

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

548.88	673.58	807.78	956.76	1064.17	1060.91	1009.72	916.01	803.32	660.42	551.82	512.83	(84)

7. Mean internal temperature (heating season)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	1.00	0.99	0.98	0.92	0.79	0.60	0.45	0.51	0.78	0.96	0.99	1.00	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

19.62	19.83	20.16	20.55	20.84	20.97	20.99	20.99	20.89	20.48	19.97	19.59	(87)

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

19.84	19.85	19.85	19.86	19.86	19.87	19.87	19.87	19.87	19.86	19.86	19.85	(88)

Utilisation factor for gains for rest of dwelling n2,m

1.00	0.99	0.97	0.89	0.73	0.51	0.34	0.39	0.69	0.94	0.99	1.00	(89)

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

18.03	18.33	18.80	19.36	19.72	19.85	19.87	19.87	19.78	19.28	18.55	17.98	(90)

Living area fraction — Living area ÷ (4) = 0.54 (91)

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

18.89	19.14	19.53	20.00	20.32	20.45	20.48	20.47	20.38	19.93	19.32	18.85	(92)

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

18.89	19.14	19.53	20.00	20.32	20.45	20.48	20.47	20.38	19.93	19.32	18.85	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.99	0.99	0.96	0.90	0.75	0.56	0.40	0.46	0.73	0.94	0.99	1.00	(94)
Useful gains, ηmGm, W (94)m x (84)m	545.93	664.62	778.64	856.78	801.93	592.12	402.54	419.45	589.84	622.41	545.63	510.77	(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]	1568.70	1527.90	1395.17	1176.49	911.81	613.13	406.03	425.91	660.44	986.62	1297.05	1561.32	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	760.94	580.13	458.70	230.20	81.75	0.00	0.00	0.00	0.00	270.98	541.03	781.61	

∑(98)1...5, 10...12 = 3705.33 (98)

Space heating requirement kWh/m^2/year — (98) ÷ (4) 44.70 (99)

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

Space heating

Fraction of space heat from secondary/supplementary system (table 11)		0.00	(201)
Fraction of space heat from main system(s)	1 - (201) =	1.00	(202)
Fraction of space heat from main system 2		0.00	(202)
Fraction of total space heat from main system 1	(202) x [1- (203)] =	1.00	(204)
Fraction of total space heat from main system 2	(202) x (203) =	0.00	(205)
Efficiency of main system 1 (%)		93.40	(206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating fuel (main system 1), kWh/month	814.71	621.12	491.11	246.46	87.53	0.00	0.00	0.00	0.00	290.13	579.26	836.84

∑(211)1...5, 10...12 = 3967.16 (211)

Water heating

Efficiency of water heater

88.06	87.79	87.22	85.87	83.44	80.30	80.30	80.30	80.30	86.16	87.58	88.15	(217)

Water heating fuel, kWh/month

231.91	204.89	214.56	193.29	192.59	176.26	168.87	188.25	190.33	201.99	212.11	226.18

∑(219a)1...12 = 2401.23 (219)

Annual totals

Space heating fuel - main system 1 — 3967.16

TER Worksheet
Design - Draft

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

Assessor name	Mr Jason Doherty	Assessor number	2634
Client		Last modified	23/12/2016
Address	2 6 Streatley Place, London, NW3 1HP		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		74.10	(1a)	x	2.40	(2a)	=	177.84	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	74.10	(4)						
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =			177.84	(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	3	x 10 =	30	(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) =	30	÷ (5) =	0.17	(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)		0.42	(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) =	0.36	(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	0.45	0.44	0.44	0.39	0.38	0.34	0.34	0.33	0.36	0.38	0.40	0.42	(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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
d) natural ventilation or whole house positive input ventilation from loft	0.60	0.60	0.60	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(24d)
Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)	0.60	0.60	0.60	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			14.02	x	1.33	=	18.59			(27)
Door			1.95	x	1.00	=	1.95			(26)
Roof window			2.56	x	1.59	=	4.07			(27a)
Ground floor			74.10	x	0.13	=	9.63			(28a)
External wall			55.32	x	0.18	=	9.96			(29a)
Party wall			36.72	x	0.00	=	0.00			(32)
Roof			29.20	x	0.13	=	3.80			(30)
Total area of external elements ∑A, m²			177.15							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	48.00	(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		12.95	(36)
Total fabric heat loss	(33) + (36) =	60.95	(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)	35.39	35.15	34.92	33.84	33.64	32.70	32.70	32.52	33.06	33.64	34.05	34.47	(38)
Heat transfer coefficient, W/K (37)m + (38)m	96.34	96.10	95.87	94.79	94.59	93.65	93.65	93.47	94.01	94.59	95.00	95.43	

Average = ∑(39)1...12/12 = 94.79 (39)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.30	1.30	1.29	1.28	1.28	1.26	1.26	1.26	1.27	1.28	1.28	1.29	

Average = ∑(40)1...12/12 = 1.28 (40)

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

4. Water heating energy requirement

Assumed occupancy, N	2.34	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	89.81	(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)	98.79	95.20	91.60	88.01	84.42	80.83	80.83	84.42	88.01	91.60	95.20	98.79	

∑(44)1...12 = 1077.70 (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)	146.50	128.13	132.22	115.27	110.61	95.45	88.44	101.49	102.70	119.69	130.65	141.88	

∑(45)1...12 = 1413.04 (45)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Distribution loss 0.15 x (45)m	21.98	19.22	19.83	17.29	16.59	14.32	13.27	15.22	15.41	17.95	19.60	21.28	(46)
Water storage loss calculated for each month (55) x (41)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)
Primary circuit loss for each month from Table 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)
Combi loss for each month from Table 3a, 3b or 3c	50.34	43.82	46.68	43.40	43.02	39.86	41.19	43.02	43.40	46.68	46.95	50.34	(61)

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

196.84	171.95	178.90	158.68	153.63	135.31	129.63	144.51	146.11	166.37	177.60	192.22	(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

196.84	171.95	178.90	158.68	153.63	135.31	129.63	144.51	146.11	166.37	177.60	192.22

∑(64)1...12 = 1951.74 (64)

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

61.30	53.56	55.63	49.18	47.53	41.70	39.70	44.50	45.00	51.47	55.18	59.76	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	117.07	117.07	117.07	117.07	117.07	117.07	117.07	117.07	117.07	117.07	117.07	117.07	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	18.42	16.36	13.31	10.08	7.53	6.36	6.87	8.93	11.99	15.22	17.76	18.94	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	206.67	208.82	203.41	191.91	177.38	163.73	154.61	152.47	157.87	169.38	183.90	197.55	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.71	34.71	34.71	34.71	34.71	34.71	34.71	34.71	34.71	34.71	34.71	34.71	(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)	-93.66	-93.66	-93.66	-93.66	-93.66	-93.66	-93.66	-93.66	-93.66	-93.66	-93.66	-93.66	(71)
Water heating gains (Table 5)	82.39	79.70	74.78	68.30	63.89	57.92	53.37	59.81	62.50	69.18	76.64	80.32	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	368.61	366.00	352.62	331.41	309.92	289.13	275.97	282.33	293.48	314.90	339.42	357.93	(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	
SouthEast	0.77	x	6.55	x	36.79	x 0.9 x	0.63	x	0.70	=	73.65	(77)
NorthEast	0.77	x	1.44	x	11.28	x 0.9 x	0.63	x	0.70	=	4.97	(75)
NorthWest	0.77	x	0.90	x	11.28	x 0.9 x	0.63	x	0.70	=	3.10	(81)
SouthWest	0.77	x	5.13	x	36.79	x 0.9 x	0.63	x	0.70	=	57.69	(79)
Horizontal	1.00	x	2.56	x	26.00	x 0.9 x	0.63	x	0.70	=	26.42	

Solar gains in watts ∑(74)m...(82)m

165.82	295.01	433.23	580.28	685.22	694.60	663.79	584.09	484.35	334.39	201.00	140.32	(83)

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

534.43	661.01	785.85	911.69	995.15	983.73	939.76	866.42	777.83	649.28	540.42	498.26	(84)

7. Mean internal temperature (heating season)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	1.00	0.99	0.97	0.90	0.77	0.58	0.43	0.49	0.74	0.94	0.99	1.00	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

19.67	19.90	20.22	20.60	20.86	20.97	20.99	20.99	20.91	20.54	20.03	19.63	(87)

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

19.84	19.84	19.85	19.86	19.86	19.87	19.87	19.87	19.87	19.86	19.85	19.85	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.99	0.98	0.96	0.87	0.70	0.49	0.32	0.37	0.65	0.92	0.99	1.00	(89)

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

18.10	18.42	18.89	19.41	19.73	19.85	19.87	19.87	19.80	19.35	18.62	18.04	(90)

Living area fraction — Living area ÷ (4) = 0.54 (91)

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

18.94	19.21	19.60	20.05	20.34	20.45	20.47	20.47	20.40	19.99	19.38	18.90	(92)

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

18.94	19.21	19.60	20.05	20.34	20.45	20.47	20.47	20.40	19.99	19.38	18.90	(93)

8. Space heating requirement

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

Utilisation factor for gains, ηm

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.99	0.98	0.95	0.88	0.73	0.54	0.38	0.43	0.70	0.92	0.98	0.99	(94)

Useful gains, ηmGm, W (94)m x (84)m

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
530.44	648.75	748.80	799.51	729.36	531.54	360.00	375.84	541.43	599.85	531.96	495.48	(95)

Monthly average external temperature from Table U1

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1410.57	1375.64	1256.39	1056.91	816.90	548.00	362.64	380.45	592.00	888.39	1166.44	1402.48	(97)

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
654.81	488.47	377.65	185.33	65.13	0.00	0.00	0.00	0.00	214.67	456.83	674.80

∑(98)1...5, 10...12 = 3117.70 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) 42.07 (99)

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

Space heating

Fraction of space heat from secondary/supplementary system (table 11)		0.00	(201)
Fraction of space heat from main system(s)	1 - (201) =	1.00	(202)
Fraction of space heat from main system 2		0.00	(202)
Fraction of total space heat from main system 1	(202) x [1- (203)] =	1.00	(204)
Fraction of total space heat from main system 2	(202) x (203) =	0.00	(205)
Efficiency of main system 1 (%)		93.40	(206)

Space heating fuel (main system 1), kWh/month

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
701.08	522.99	404.33	198.43	69.73	0.00	0.00	0.00	0.00	229.84	489.11	722.49

∑(211)1...5, 10...12 = 3338.01 (211)

Water heating

Efficiency of water heater

87.85	87.53	86.89	85.44	83.06	80.30	80.30	80.30	80.30	85.69	87.33	87.95	(217)

Water heating fuel, kWh/month

224.08	196.44	205.90	185.71	184.95	168.50	161.44	179.96	181.95	194.15	203.38	218.56

∑(219a)1...12 = 2305.01 (219)

Annual totals

Space heating fuel - main system 1 — 3338.01

Water heating fuel			2305.01	
Electricity for pumps, fans and electric keep-hot (Table 4f)				
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			75.00	(231)
Electricity for lighting (Appendix L)			325.39	(232)
Total delivered energy for all uses		(211)...(221) + (231) + (232)...(237b) =	6043.41	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	3338.01	x	3.48	x 0.01 =	116.16	(240)
Water heating	2305.01	x	3.48	x 0.01 =	80.21	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	325.39	x	13.19	x 0.01 =	42.92	(250)
Additional standing charges					120.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	369.19	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.30	(257)
SAP value	81.84	
SAP rating (section 13)	82	(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	3338.01	x	0.22	=	721.01	(261)
Water heating	2305.01	x	0.22	=	497.88	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1218.89	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	325.39	x	0.52	=	168.88	(268)
Total CO_2, kg/year				(265)...(271) =	1426.69	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	19.25	(273)
EI value					83.95	
EI rating (section 14)					84	(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	3338.01	x	1.22	=	4072.37	(261)
Water heating	2305.01	x	1.22	=	2812.12	(264)
Space and water heating			(261) + (262) + (263) + (264) =		6884.49	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	325.39	x	3.07	=	998.94	(268)
Primary energy kWh/year					8113.68	(272)
Dwelling primary energy rate kWh/m2/year					109.50	(273)

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

Assessor name	Mr Jason Doherty	Assessor number	2634
Client		Last modified	23/12/2016
Address	3 6 Streatley Place, London, NW3 1HP		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		104.10	(1a)	x	2.40	(2a)	=	249.84	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	104.10	(4)						
Dwelling volume							(3a) + (3b) + (3c) + (3d)...(3n) =	249.84	(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) =	0.16	(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)		0.41	(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) =	0.35	(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	0.44	0.44	0.43	0.38	0.37	0.33	0.33	0.32	0.35	0.37	0.39	0.41	(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)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
d) natural ventilation or whole house positive input ventilation from loft	0.60	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.58	0.58	(24d)
Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)	0.60	0.59	0.59	0.57	0.57	0.55	0.55	0.55	0.56	0.57	0.58	0.58	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			22.00	x	1.33	=	29.17			(27)
Door			1.95	x	1.00	=	1.95			(26)
Roof window			2.06	x	1.59	=	3.28			(27a)
Exposed floor			12.80	x	0.13	=	1.66			(28b
External wall			83.50	x	0.18	=	15.03			(29a)
Party wall			23.52	x	0.00	=	0.00			(32)
Roof			51.66	x	0.13	=	6.72			(30)
Total area of external elements ∑A, m²			173.97							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	57.81	(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		16.38	(36)
Total fabric heat loss	(33) + (36) =	74.18	(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)	49.37	49.05	48.74	47.28	47.01	45.74	45.74	45.51	46.23	47.01	47.56	48.14	(38)
Heat transfer coefficient, W/K (37)m + (38)m	123.55	123.23	122.92	121.47	121.19	119.93	119.93	119.69	120.41	121.19	121.75	122.32	
Average = ∑(39)1...12/12 =												121.47	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.19	1.18	1.18	1.17	1.16	1.15	1.15	1.15	1.16	1.16	1.17	1.18	
Average = ∑(40)1...12/12 =												1.17	(40)
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.77	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	100.09	(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)	110.10	106.10	102.09	98.09	94.09	90.08	90.08	94.09	98.09	102.09	106.10	110.10	
∑(44)1...12 =												1201.10	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	163.28	142.80	147.36	128.47	123.27	106.37	98.57	113.11	114.46	133.39	145.61	158.12	
∑(45)1...12 =												1574.83	(45)
Distribution loss 0.15 x (45)m	24.49	21.42	22.10	19.27	18.49	15.96	14.79	16.97	17.17	20.01	21.84	23.72	(46)
Water storage loss calculated for each month (55) x (41)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)
Primary circuit loss for each month from Table 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)
Combi loss for each month from Table 3a, 3b or 3c	50.96	46.03	50.96	48.37	47.95	44.42	45.90	47.95	48.37	50.96	49.32	50.96	(61)

Total heat required for water heating calculated for each month 0.85 x (45)m + (46)m + (57)m + (59)m + (61)m	214.23	188.83	198.32	176.84	171.22	150.80	144.48	161.06	162.84	184.35	194.93	209.08	(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	214.23	188.83	198.32	176.84	171.22	150.80	144.48	161.06	162.84	184.35	194.93	209.08	
											∑(64)1…12 =	2156.97	(64)
Heat gains from water heating (kWh/month) 0.25 × [0.85 × (45)m + (61)m] + 0.8 × [(46)m + (57)m + (59)m]	67.03	58.99	61.74	54.81	52.97	46.48	44.25	49.60	50.15	57.09	60.74	65.32	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	138.72	138.72	138.72	138.72	138.72	138.72	138.72	138.72	138.72	138.72	138.72	138.72	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	23.43	20.81	16.92	12.81	9.58	8.09	8.74	11.36	15.24	19.35	22.59	24.08	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	262.79	265.52	258.65	244.02	225.55	208.19	196.60	193.87	200.74	215.37	233.84	251.20	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.87	36.87	36.87	36.87	36.87	36.87	36.87	36.87	36.87	36.87	36.87	36.87	(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)	-110.98	-110.98	-110.98	-110.98	-110.98	-110.98	-110.98	-110.98	-110.98	-110.98	-110.98	-110.98	(71)
Water heating gains (Table 5)	90.09	87.78	82.98	76.12	71.20	64.55	59.48	66.66	69.66	76.74	84.37	87.79	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	443.93	441.72	426.16	400.57	373.94	348.44	332.43	339.50	353.26	379.08	408.41	430.68	(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	
NorthWest	0.77	x	2.98	x	11.28	x 0.9 x	0.63	x	0.70	=	10.28	(81)
SouthEast	0.77	x	14.59	x	36.79	x 0.9 x	0.63	x	0.70	=	164.06	(77)
SouthWest	0.77	x	1.12	x	36.79	x 0.9 x	0.63	x	0.70	=	12.59	(79)
NorthEast	0.77	x	3.31	x	11.28	x 0.9 x	0.63	x	0.70	=	11.41	(75)
Horizontal	1.00	x	2.06	x	26.00	x 0.9 x	0.63	x	0.70	=	21.26	

Solar gains in watts ∑(74)m…(82)m	219.60	389.21	569.75	763.41	903.97	917.99	876.55	769.17	636.75	440.48	265.86	186.06	(83)
Total gains - internal and solar (73)m + (83)m	663.53	830.93	995.91	1163.98	1277.91	1266.43	1208.98	1108.68	990.00	819.56	674.27	616.74	(84)

7. Mean internal temperature (heating season)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	1.00	0.99	0.97	0.91	0.78	0.59	0.43	0.49	0.75	0.96	0.99	1.00	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

19.74	19.96	20.27	20.63	20.88	20.98	21.00	20.99	20.92	20.57	20.08	19.71	(87)

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

19.93	19.93	19.94	19.95	19.95	19.96	19.96	19.96	19.95	19.95	19.94	19.94	(88)

Utilisation factor for gains for rest of dwelling n2,m

1.00	0.99	0.97	0.89	0.72	0.50	0.33	0.38	0.67	0.94	0.99	1.00	(89)

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

18.26	18.58	19.03	19.54	19.84	19.94	19.96	19.96	19.90	19.47	18.77	18.22	(90)

Living area fraction — Living area ÷ (4) = 0.41 (91)

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

18.87	19.15	19.54	19.99	20.27	20.37	20.38	20.38	20.32	19.92	19.31	18.83	(92)

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

18.87	19.15	19.54	19.99	20.27	20.37	20.38	20.38	20.32	19.92	19.31	18.83	(93)

8. Space heating requirement

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

Utilisation factor for gains, ηm

1.00	0.99	0.96	0.89	0.74	0.53	0.37	0.43	0.70	0.93	0.99	1.00	(94)

Useful gains, ηmGm, W (94)m x (84)m

660.37	819.68	957.33	1032.27	940.72	676.23	451.63	472.69	693.30	766.12	666.88	614.64	(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]

1800.22	1755.54	1602.70	1346.70	1038.08	691.72	453.70	476.62	748.82	1129.41	1485.91	1789.34	(97)

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

848.04	628.90	480.15	226.39	72.43	0.00	0.00	0.00	0.00	270.29	589.70	873.97

∑(98)1...5, 10...12 = 3989.88 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) 38.33 (99)

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

Space heating

Fraction of space heat from secondary/supplementary system (table 11)		0.00	(201)
Fraction of space heat from main system(s)	1 - (201) =	1.00	(202)
Fraction of space heat from main system 2		0.00	(202)
Fraction of total space heat from main system 1	(202) x [1- (203)] =	1.00	(204)
Fraction of total space heat from main system 2	(202) x (203) =	0.00	(205)
Efficiency of main system 1 (%)		93.40	(206)

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

Space heating fuel (main system 1), kWh/month

907.97	673.34	514.08	242.39	77.55	0.00	0.00	0.00	0.00	289.39	631.37	935.73

∑(211)1...5, 10...12 = 4271.82 (211)

Water heating

Efficiency of water heater

88.16	87.85	87.19	85.67	83.06	80.30	80.30	80.30	80.30	86.01	87.66	88.26	(217)

Water heating fuel, kWh/month

243.00	214.95	227.44	206.42	206.14	187.79	179.92	200.57	202.78	214.33	222.36	236.90

∑(219a)1...12 = 2542.61 (219)

Annual totals

Space heating fuel - main system 1 — 4271.82

Water heating fuel			2542.61	
Electricity for pumps, fans and electric keep-hot (Table 4f)				
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			75.00	(231)
Electricity for lighting (Appendix L)			413.75	(232)
Total delivered energy for all uses		(211)...(221) + (231) + (232)...(237b) =	7303.17	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	4271.82	x	3.48	x 0.01 =	148.66	(240)
Water heating	2542.61	x	3.48	x 0.01 =	88.48	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	413.75	x	13.19	x 0.01 =	54.57	(250)
Additional standing charges					120.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	421.61	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.19	(257)
SAP value	83.43	
SAP rating (section 13)	83	(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	4271.82	x	0.22	=	922.71	(261)
Water heating	2542.61	x	0.22	=	549.20	(264)
Space and water heating				(261) + (262) + (263) + (264) =	1471.92	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	413.75	x	0.52	=	214.73	(268)
Total CO_2, kg/year				(265)...(271) =	1725.58	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	16.58	(273)
EI value					84.49	
EI rating (section 14)					84	(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	4271.82	x	1.22	=	5211.62	(261)
Water heating	2542.61	x	1.22	=	3101.98	(264)
Space and water heating				(261) + (262) + (263) + (264) =	8313.60	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	413.75	x	3.07	=	1270.20	(268)
Primary energy kWh/year					9814.05	(272)
Dwelling primary energy rate kWh/m2/year					94.28	(273)

Water heating fuel			2401.23	
Electricity for pumps, fans and electric keep-hot (Table 4f)				
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			75.00	(231)
Electricity for lighting (Appendix L)			354.87	(232)
Total delivered energy for all uses		(211)...(221) + (231) + (232)...(237b) =	6798.26	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	3967.16	x	3.48	x 0.01 =	138.06	(240)
Water heating	2401.23	x	3.48	x 0.01 =	83.56	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	354.87	x	13.19	x 0.01 =	46.81	(250)
Additional standing charges					120.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	398.32	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.31	(257)
SAP value	81.75	
SAP rating (section 13)	82	(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	3967.16	x	0.22	=	856.91	(261)
Water heating	2401.23	x	0.22	=	518.67	(264)
Space and water heating				(261) + (262) + (263) + (264) =	1375.57	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	354.87	x	0.52	=	184.18	(268)
Total CO_2, kg/year				(265)...(271) =	1598.68	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	19.28	(273)
EI value					83.25	
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	3967.16	x	1.22	=	4839.94	(261)
Water heating	2401.23	x	1.22	=	2929.51	(264)
Space and water heating				(261) + (262) + (263) + (264) =	7769.44	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	354.87	x	3.07	=	1089.44	(268)
Primary energy kWh/year					9089.14	(272)
Dwelling primary energy rate kWh/m2/year					109.64	(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	Mr Jason Doherty	Assessor number	2634
Client		Last modified	23/12/2016
Address	4 6 Streatley Place, London, NW3 1HP		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		2.20	(1a)	x	2.40	(2a)	=	5.28	(3a)
+1		61.40	(1b)	x	2.40	(2b)	=	147.36	(3b)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	63.60	(4)						
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =			152.64	(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		2	x 10 =	20	(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) =	20	÷ (5) =	0.13	(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)		0.38	(18)
Number of sides on which the dwelling is sheltered		1	(19)
Shelter factor	1 - [0.075 x (19)] =	0.93	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.35	(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	0.45	0.44	0.43	0.39	0.38	0.33	0.33	0.33	0.35	0.38	0.40	0.41	(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

0.60	0.60	0.59	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(24d)

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

0.60	0.60	0.59	0.58	0.57	0.56	0.56	0.55	0.56	0.57	0.58	0.59	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			12.76	x	1.33	=	16.92			(27)
Door			1.95	x	1.00	=	1.95			(26)
Roof window			1.20	x	1.59	=	1.91			(27a)
External wall			58.78	x	0.18	=	10.58			(29a)
Party wall			23.52	x	0.00	=	0.00			(32)
Roof			58.86	x	0.13	=	7.65			(30)
Total area of external elements ∑A, m²			133.55							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	39.01	(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		11.02	(36)
Total fabric heat loss	(33) + (36) =	50.03	(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)	30.27	30.07	29.88	28.97	28.80	28.01	28.01	27.86	28.31	28.80	29.15	29.51	(38)
Heat transfer coefficient, W/K (37)m + (38)m	80.30	80.10	79.91	79.00	78.83	78.04	78.04	77.89	78.34	78.83	79.18	79.54	
Average = ∑(39)1...12/12 =												79.00	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.26	1.26	1.26	1.24	1.24	1.23	1.23	1.22	1.23	1.24	1.24	1.25	
Average = ∑(40)1...12/12 =												1.24	(40)
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.08	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	83.63	(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)	92.00	88.65	85.31	81.96	78.61	75.27	75.27	78.61	81.96	85.31	88.65	92.00	
∑(44)1...12 =												1003.59	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	136.43	119.32	123.13	107.35	103.00	88.88	82.36	94.51	95.64	111.46	121.67	132.12	
∑(45)1...12 =												1315.87	(45)
Distribution loss 0.15 x (45)m	20.46	17.90	18.47	16.10	15.45	13.33	12.35	14.18	14.35	16.72	18.25	19.82	(46)
Water storage loss calculated for each month (55) x (41)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)
Primary circuit loss for each month from Table 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)
Combi loss for each month from Table 3a, 3b or 3c	46.88	40.80	43.47	40.42	40.06	37.12	38.36	40.06	40.42	43.47	43.72	46.88	(61)

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

183.31	160.12	166.60	147.76	143.06	126.00	120.72	134.57	136.06	154.93	165.39	179.00	(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

183.31	160.12	166.60	147.76	143.06	126.00	120.72	134.57	136.06	154.93	165.39	179.00

∑(64)1...12 = 1817.53 (64)

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

57.08	49.87	51.81	45.80	44.26	38.83	36.97	41.44	41.91	47.93	51.38	55.65	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	104.07	104.07	104.07	104.07	104.07	104.07	104.07	104.07	104.07	104.07	104.07	104.07	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	16.22	14.40	11.71	8.87	6.63	5.60	6.05	7.86	10.55	13.40	15.64	16.67	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	181.93	183.81	179.06	168.93	156.15	144.13	136.10	134.21	138.97	149.10	161.88	173.90	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	33.41	33.41	33.41	33.41	33.41	33.41	33.41	33.41	33.41	33.41	33.41	33.41	(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)	-83.26	-83.26	-83.26	-83.26	-83.26	-83.26	-83.26	-83.26	-83.26	-83.26	-83.26	-83.26	(71)
Water heating gains (Table 5)	76.72	74.22	69.63	63.61	59.49	53.93	49.70	55.70	58.20	64.42	71.37	74.80	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	332.09	329.66	317.63	298.63	279.49	260.88	249.07	255.00	264.95	284.14	306.11	322.59	(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	
NorthWest	0.77	x	1.73	x	11.28	x 0.9 x	0.63	x	0.70	=	5.97	(81)
SouthEast	0.77	x	8.46	x	36.79	x 0.9 x	0.63	x	0.70	=	95.13	(77)
SouthWest	0.77	x	0.65	x	36.79	x 0.9 x	0.63	x	0.70	=	7.31	(79)
NorthEast	0.77	x	1.92	x	11.28	x 0.9 x	0.63	x	0.70	=	6.62	(75)
Horizontal	1.00	x	1.20	x	26.00	x 0.9 x	0.63	x	0.70	=	12.38	

Solar gains in watts ∑(74)m...(82)m

127.41	225.83	330.63	443.06	524.68	532.83	508.78	446.43	369.53	255.59	154.25	107.95	(83)

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

459.50	555.49	648.25	741.69	804.17	793.71	757.85	701.42	634.47	539.73	460.36	430.54	(84)

7. Mean internal temperature (heating season)

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains for living area n1,m (see Table 9a)	1.00	0.99	0.97	0.91	0.79	0.60	0.45	0.50	0.75	0.95	0.99	1.00	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

19.72	19.93	20.23	20.59	20.85	20.97	20.99	20.99	20.91	20.55	20.06	19.68	(87)

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

19.87	19.87	19.88	19.89	19.89	19.90	19.90	19.90	19.89	19.89	19.88	19.88	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.99	0.99	0.96	0.88	0.72	0.51	0.34	0.39	0.67	0.92	0.99	1.00	(89)

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

18.19	18.49	18.93	19.43	19.75	19.88	19.90	19.90	19.83	19.39	18.70	18.14	(90)

Living area fraction — Living area ÷ (4) = 0.64 (91)

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

19.16	19.40	19.76	20.17	20.45	20.57	20.59	20.59	20.52	20.13	19.57	19.12	(92)

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

19.16	19.40	19.76	20.17	20.45	20.57	20.59	20.59	20.52	20.13	19.57	19.12	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.99	0.98	0.96	0.89	0.76	0.57	0.41	0.46	0.72	0.93	0.99	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	456.20	546.14	621.40	661.22	608.79	450.10	308.99	321.87	455.95	502.37	453.55	428.20	(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]	1193.47	1161.79	1059.33	890.41	689.94	465.97	311.64	326.43	502.63	751.21	986.99	1186.80	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	548.53	413.71	325.82	165.02	60.38	0.00	0.00	0.00	0.00	185.14	384.08	564.40	

∑(98)1...5, 10...12 = 2647.07 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) 41.62 (99)

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

Space heating

Fraction of space heat from secondary/supplementary system (table 11)		0.00	(201)
Fraction of space heat from main system(s)	1 - (201) =	1.00	(202)
Fraction of space heat from main system 2		0.00	(202)
Fraction of total space heat from main system 1	(202) x [1- (203)] =	1.00	(204)
Fraction of total space heat from main system 2	(202) x (203) =	0.00	(205)
Efficiency of main system 1 (%)		93.40	(206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating fuel (main system 1), kWh/month	587.29	442.95	348.84	176.68	64.64	0.00	0.00	0.00	0.00	198.22	411.22	604.29

∑(211)1...5, 10...12 = 2834.13 (211)

Water heating

Efficiency of water heater	87.64	87.33	86.71	85.33	83.05	80.30	80.30	80.30	80.30	85.50	87.10	87.74	(217)
Water heating fuel, kWh/month	209.16	183.34	192.13	173.17	172.25	156.91	150.33	167.59	169.44	181.20	189.87	204.01	

∑(219a)1...12 = 2149.42 (219)

Annual totals

Space heating fuel - main system 1 — 2834.13

Water heating fuel			2149.42	
Electricity for pumps, fans and electric keep-hot (Table 4f)				
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			75.00	(231)
Electricity for lighting (Appendix L)			286.42	(232)
Total delivered energy for all uses		(211)...(221) + (231) + (232)...(237b) =	5344.97	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2834.13	x	3.48	x 0.01 =	98.63	(240)
Water heating	2149.42	x	3.48	x 0.01 =	74.80	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	286.42	x	13.19	x 0.01 =	37.78	(250)
Additional standing charges					120.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	341.10	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.32	(257)
SAP value	81.60	
SAP rating (section 13)	82	(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	2834.13	x	0.22	=	612.17	(261)
Water heating	2149.42	x	0.22	=	464.28	(264)
Space and water heating				(261) + (262) + (263) + (264) =	1076.45	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	286.42	x	0.52	=	148.65	(268)
Total CO_2, kg/year				(265)...(271) =	1264.02	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	19.87	(273)
EI value					84.40	
EI rating (section 14)					84	(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	2834.13	x	1.22	=	3457.63	(261)
Water heating	2149.42	x	1.22	=	2622.30	(264)
Space and water heating				(261) + (262) + (263) + (264) =	6079.93	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	286.42	x	3.07	=	879.31	(268)
Primary energy kWh/year					7189.49	(272)
Dwelling primary energy rate kWh/m2/year					113.04	(273)

Appendix B – DER Worksheets

DER Worksheet
Design - Draft

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

Assessor name	Mr Jason Doherty	Assessor number	2634
Client		Last modified	23/12/2016
Address	1 6 Streatley Place, London, NW3 1HP		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		82.90	(1a)	x	2.40	(2a)	=	198.96	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	82.90	(4)						
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =			198.96	(5)

2. Ventilation rate

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

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

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15	(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) =	0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table 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	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(24a)	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)
Effective air change rate - enter (24a) or (24b) or (24c) or (24d) in (25)	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			17.77	x	1.15	=	20.35			(27)
Door			1.95	x	0.55	=	1.07			(26)
Roof window			3.00	x	0.96	=	2.88			(27a)
Ground floor			82.90	x	0.15	=	12.44			(28a)
External wall			64.76	x	0.13	=	8.42			(29a)
Party wall			36.72	x	0.00	=	0.00			(32)
Roof			33.80	x	0.09	=	3.01			(30)
Total area of external elements ∑A, m²			204.18							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	48.17	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K		200.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		16.35	(36)
Total fabric heat loss	(33) + (36) =	64.51	(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)	17.27	17.06	16.85	15.81	15.60	14.55	14.55	14.34	14.97	15.60	16.02	16.43	(38)
Heat transfer coefficient, W/K (37)m + (38)m	81.79	81.58	81.37	80.32	80.11	79.07	79.07	78.86	79.48	80.11	80.53	80.95	
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	0.99	0.98	0.98	0.97	0.97	0.95	0.95	0.95	0.96	0.97	0.97	0.98	
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)

Average = ∑(39)1...12/12 = 80.27 (39)

Average = ∑(40)1...12/12 = 0.97 (40)

4. Water heating energy requirement

Assumed occupancy, N	2.52	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	93.95	(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)	103.34	99.58	95.82	92.07	88.31	84.55	84.55	88.31	92.07	95.82	99.58	103.34	
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	153.25	134.03	138.31	120.58	115.70	99.84	92.52	106.17	107.43	125.20	136.67	148.41	
Distribution loss 0.15 x (45)m	22.99	20.10	20.75	18.09	17.36	14.98	13.88	15.92	16.12	18.78	20.50	22.26	(46)
Water storage loss calculated for each month (55) x (41)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)
Primary circuit loss for each month from Table 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)
Combi loss for each month from Table 3a, 3b or 3c	31.95	28.84	31.89	30.81	31.80	30.73	31.73	31.77	30.77	31.85	30.88	31.94	(61)

∑(44)1...12 = 1127.34 (44)

∑(45)1...12 = 1478.12 (45)

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

185.20	162.88	170.20	151.39	147.50	130.57	124.24	137.94	138.21	157.05	167.55	180.35	(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

185.20	162.88	170.20	151.39	147.50	130.57	124.24	137.94	138.21	157.05	167.55	180.35

∑(64)1...12 = 1853.08 (64)

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

58.94	51.78	53.96	47.80	46.42	40.88	38.69	43.24	43.41	49.59	53.16	57.33	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	125.78	125.78	125.78	125.78	125.78	125.78	125.78	125.78	125.78	125.78	125.78	125.78	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	20.09	17.85	14.51	10.99	8.21	6.93	7.49	9.74	13.07	16.60	19.37	20.65	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	225.39	227.73	221.84	209.29	193.45	178.57	168.62	166.28	172.18	184.72	200.56	215.45	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	35.58	35.58	35.58	35.58	35.58	35.58	35.58	35.58	35.58	35.58	35.58	35.58	(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)	-100.62	-100.62	-100.62	-100.62	-100.62	-100.62	-100.62	-100.62	-100.62	-100.62	-100.62	-100.62	(71)
Water heating gains (Table 5)	79.22	77.05	72.53	66.38	62.39	56.78	52.01	58.12	60.30	66.66	73.84	77.06	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	388.45	386.36	372.62	350.40	327.79	306.01	291.86	297.88	309.28	331.71	357.51	376.89	(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	
SouthEast	0.77	x	8.35	x	36.79	x 0.9 x	0.63	x	0.70	=	93.89	(77)
SouthWest	0.77	x	1.68	x	36.79	x 0.9 x	0.63	x	0.70	=	18.89	(79)
NorthWest	0.77	x	1.73	x	11.28	x 0.9 x	0.63	x	0.70	=	5.97	(81)
NorthEast	0.77	x	6.01	x	11.28	x 0.9 x	0.63	x	0.70	=	20.72	(75)
Horizontal	1.00	x	3.00	x	26.00	x 0.9 x	0.63	x	0.70	=	30.96	

Solar gains in watts ∑(74)m...(82)m

170.43	310.74	475.04	665.04	809.49	830.66	789.70	678.72	540.82	357.30	207.96	143.32	(83)

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

558.88	697.10	847.66	1015.44	1137.29	1136.67	1081.56	976.60	850.10	689.02	565.47	520.21	(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)	0.99	0.98	0.93	0.81	0.62	0.44	0.32	0.37	0.62	0.90	0.98	0.99	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

19.87	20.12	20.46	20.79	20.95	20.99	21.00	21.00	20.96	20.70	20.21	19.82	(87)

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

20.09	20.10	20.10	20.11	20.11	20.12	20.12	20.12	20.12	20.11	20.11	20.10	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.99	0.97	0.92	0.77	0.57	0.38	0.26	0.30	0.55	0.87	0.98	0.99	(89)

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

19.06	19.31	19.64	19.95	20.08	20.12	20.12	20.12	20.10	19.88	19.41	19.02	(90)

Living area fraction — Living area ÷ (4) = 0.54 (91)

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

19.50	19.75	20.08	20.40	20.55	20.59	20.60	20.60	20.57	20.32	19.84	19.46	(92)

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

19.50	19.75	20.08	20.40	20.55	20.59	20.60	20.60	20.57	20.32	19.84	19.46	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm													
	0.99	0.97	0.92	0.79	0.60	0.41	0.29	0.34	0.58	0.88	0.97	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m													
	551.93	674.89	776.59	799.16	679.89	469.80	315.37	329.77	495.46	602.97	550.59	515.41	(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]													
	1243.02	1211.13	1104.97	924.04	708.94	473.66	315.92	330.86	514.03	778.92	1026.26	1234.91	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m													
	514.17	360.36	244.32	89.92	21.61	0.00	0.00	0.00	0.00	130.90	342.49	535.31	

∑(98)1...5, 10...12 = 2239.07 (98)

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

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

Space heating

Fraction of space heat from secondary/supplementary system (table 11)		0.00	(201)
Fraction of space heat from main system(s)	1 - (201) =	1.00	(202)
Fraction of space heat from main system 2		0.00	(202)
Fraction of total space heat from main system 1	(202) x [1- (203)] =	1.00	(204)
Fraction of total space heat from main system 2	(202) x (203) =	0.00	(205)
Efficiency of main system 1 (%)		93.20	(206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating fuel (main system 1), kWh/month												
	551.68	386.65	262.14	96.48	23.19	0.00	0.00	0.00	0.00	140.46	367.47	574.37

∑(211)1...5, 10...12 = 2402.44 (211)

Water heating

Efficiency of water heater

89.33	89.18	88.86	88.17	87.40	87.00	87.00	87.00	87.00	88.43	89.12	89.37	(217)

Water heating fuel, kWh/month

207.32	182.64	191.54	171.71	168.77	150.08	142.81	158.55	158.86	177.61	188.00	201.80

∑(219a)1...12 = 2099.69 (219)

Annual totals

Space heating fuel - main system 1 — 2402.44

Water heating fuel		2099.69	
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	160.81		(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		235.81	(231)
Electricity for lighting (Appendix L)		354.87	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	5092.81	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2402.44	x	3.48	x 0.01 =	83.60	(240)
Water heating	2099.69	x	3.48	x 0.01 =	73.07	(247)
Pumps and fans	235.81	x	13.19	x 0.01 =	31.10	(249)
Electricity for lighting	354.87	x	13.19	x 0.01 =	46.81	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		354.58	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.16	(257)
SAP value	83.76	
SAP rating (section 13)	84	(258)
SAP band	B	

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

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	2402.44	x	0.22	=	518.93	(261)
Water heating	2099.69	x	0.22	=	453.53	(264)
Space and water heating			(261) + (262) + (263) + (264) =		972.46	(265)
Pumps and fans	235.81	x	0.52	=	122.39	(267)
Electricity for lighting	354.87	x	0.52	=	184.18	(268)
Total CO_2, kg/year				(265)...(271) =	1279.02	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	15.43	(273)
EI value					86.60	
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	2402.44	x	1.22	=	2930.98	(261)
Water heating	2099.69	x	1.22	=	2561.62	(264)
Space and water heating			(261) + (262) + (263) + (264) =		5492.60	(265)
Pumps and fans	235.81	x	3.07	=	723.93	(267)
Electricity for lighting	354.87	x	3.07	=	1089.44	(268)
Primary energy kWh/year					7305.98	(272)
Dwelling primary energy rate kWh/m2/year					88.13	(273)

DER Worksheet
Design - Draft

NHER

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

Assessor name	Mr Jason Doherty	Assessor number	2634
Client		Last modified	23/12/2016
Address	2 6 Streatley Place, London, NW3 1HP		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		74.10	(1a)	x	2.40	(2a)	=	177.84	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	74.10	(4)						
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =			177.84	(5)

2. Ventilation rate

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

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

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15	(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) =	0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table 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	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

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

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

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

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	
0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			16.41	x	1.15	=	18.79			(27)
Door			1.95	x	0.55	=	1.07			(26)
Roof window			3.00	x	0.96	=	2.88			(27a)
Ground floor			74.10	x	0.15	=	11.12			(28a)
External wall			55.32	x	0.13	=	7.19			(29a)
Party wall			36.72	x	0.00	=	0.00			(32)
Roof			29.20	x	0.09	=	2.60			(30)
Total area of external elements ∑A, m²			179.98							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	43.65	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K		200.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		15.14	(36)
Total fabric heat loss	(33) + (36) =	58.79	(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)	15.44	15.25	15.06	14.13	13.94	13.01	13.01	12.82	13.38	13.94	14.32	14.69	(38)
Heat transfer coefficient, W/K (37)m + (38)m	74.23	74.05	73.86	72.92	72.74	71.80	71.80	71.61	72.18	72.74	73.11	73.49	
Average = ∑(39)1...12/12 =												72.88	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.00	1.00	1.00	0.98	0.98	0.97	0.97	0.97	0.97	0.98	0.99	0.99	
Average = ∑(40)1...12/12 =												0.98	(40)
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.34	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	89.81	(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)	98.79	95.20	91.60	88.01	84.42	80.83	80.83	84.42	88.01	91.60	95.20	98.79	
∑(44)1...12 =												1077.70	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	146.50	128.13	132.22	115.27	110.61	95.45	88.44	101.49	102.70	119.69	130.65	141.88	
∑(45)1...12 =												1413.04	(45)
Distribution loss 0.15 x (45)m	21.98	19.22	19.83	17.29	16.59	14.32	13.27	15.22	15.41	17.95	19.60	21.28	(46)
Water storage loss calculated for each month (55) x (41)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)
Primary circuit loss for each month from Table 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)
Combi loss for each month from Table 3a, 3b or 3c	31.92	28.81	31.85	30.78	31.77	30.71	31.71	31.75	30.75	31.82	30.85	31.91	(61)

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

178.43	156.94	164.07	146.05	142.38	126.15	120.15	133.24	133.45	151.51	161.50	173.79	(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

178.43	156.94	164.07	146.05	142.38	126.15	120.15	133.24	133.45	151.51	161.50	173.79

∑(64)1...12 = 1787.66 (64)

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

56.69	49.81	51.93	46.02	44.72	39.41	37.33	41.68	41.84	47.75	51.15	55.15	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	117.07	117.07	117.07	117.07	117.07	117.07	117.07	117.07	117.07	117.07	117.07	117.07	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	18.42	16.36	13.31	10.08	7.53	6.36	6.87	8.93	11.99	15.22	17.76	18.94	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	206.67	208.82	203.41	191.91	177.38	163.73	154.61	152.47	157.87	169.38	183.90	197.55	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	34.71	34.71	34.71	34.71	34.71	34.71	34.71	34.71	34.71	34.71	34.71	34.71	(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)	-93.66	-93.66	-93.66	-93.66	-93.66	-93.66	-93.66	-93.66	-93.66	-93.66	-93.66	-93.66	(71)
Water heating gains (Table 5)	76.20	74.12	69.79	63.92	60.11	54.74	50.18	56.03	58.10	64.18	71.05	74.13	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	362.42	360.42	347.64	327.02	306.14	285.95	272.79	278.55	289.09	309.90	333.83	351.74	(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	
SouthEast	0.77	x	7.67	x	36.79	x 0.9 x	0.63	x	0.70	=	86.25	(77)
NorthEast	0.77	x	1.68	x	11.28	x 0.9 x	0.63	x	0.70	=	5.79	(75)
NorthWest	0.77	x	1.05	x	11.28	x 0.9 x	0.63	x	0.70	=	3.62	(81)
SouthWest	0.77	x	6.01	x	36.79	x 0.9 x	0.63	x	0.70	=	67.58	(79)
Horizontal	1.00	x	3.00	x	26.00	x 0.9 x	0.63	x	0.70	=	30.96	

Solar gains in watts ∑(74)m...(82)m

194.20	345.48	507.34	679.52	802.38	813.35	777.28	683.97	567.19	391.60	235.39	164.34	(83)

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

556.62	705.90	854.98	1006.54	1108.53	1099.30	1050.07	962.52	856.28	701.50	569.22	516.08	(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)	0.99	0.96	0.90	0.77	0.59	0.41	0.30	0.34	0.56	0.86	0.97	0.99	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

19.93	20.20	20.54	20.83	20.96	20.99	21.00	21.00	20.97	20.76	20.28	19.87	(87)

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

20.08	20.08	20.09	20.10	20.10	20.11	20.11	20.11	20.11	20.10	20.09	20.09	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.98	0.96	0.88	0.73	0.54	0.36	0.24	0.28	0.50	0.82	0.96	0.99	(89)

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

19.11	19.38	19.70	19.97	20.07	20.11	20.11	20.11	20.09	19.92	19.47	19.06	(90)

Living area fraction — Living area ÷ (4) = 0.54 (91)

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

19.55	19.82	20.15	20.43	20.55	20.58	20.59	20.59	20.57	20.37	19.90	19.50	(92)

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

19.55	19.82	20.15	20.43	20.55	20.58	20.59	20.59	20.57	20.37	19.90	19.50	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.98	0.95	0.89	0.74	0.56	0.39	0.27	0.31	0.53	0.83	0.96	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	546.35	672.37	757.09	749.83	622.56	426.76	285.88	299.14	454.84	583.67	546.98	509.00	(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]	1132.00	1105.06	1008.10	840.92	643.62	429.59	286.27	299.88	466.70	710.55	935.96	1124.23	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	435.72	290.77	186.75	65.58	15.67	0.00	0.00	0.00	0.00	94.39	280.07	457.73	

∑(98)1...5, 10...12 = 1826.68 (98)

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

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

Space heating

Fraction of space heat from secondary/supplementary system (table 11)		0.00	(201)
Fraction of space heat from main system(s)	1 - (201) =	1.00	(202)
Fraction of space heat from main system 2		0.00	(202)
Fraction of total space heat from main system 1	(202) x [1- (203)] =	1.00	(204)
Fraction of total space heat from main system 2	(202) x (203) =	0.00	(205)
Efficiency of main system 1 (%)		93.20	(206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Space heating fuel (main system 1), kWh/month	467.51	311.98	200.38	70.36	16.81	0.00	0.00	0.00	0.00	101.28	300.51	491.13

∑(211)1...5, 10...12 = 1959.96 (211)

Water heating

Efficiency of water heater	89.25	89.05	88.67	87.97	87.31	87.00	87.00	87.00	87.00	88.20	89.00	89.30	(217)
Water heating fuel, kWh/month	199.93	176.24	185.03	166.03	163.08	145.00	138.10	153.15	153.39	171.78	181.45	194.62	

∑(219a)1...12 = 2027.80 (219)

Annual totals

Space heating fuel - main system 1 — 1959.96

Water heating fuel			2027.80	
Electricity for pumps, fans and electric keep-hot (Table 4f)				
mechanical ventilation fans - balanced, extract or positive input from outside	143.74			(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			218.74	(231)
Electricity for lighting (Appendix L)			325.39	(232)
Total delivered energy for all uses		(211)...(221) + (231) + (232)...(237b) =	4531.89	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	1959.96	x	3.48	x 0.01 =	68.21	(240)
Water heating	2027.80	x	3.48	x 0.01 =	70.57	(247)
Pumps and fans	218.74	x	13.19	x 0.01 =	28.85	(249)
Electricity for lighting	325.39	x	13.19	x 0.01 =	42.92	(250)
Additional standing charges					120.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	330.54	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.17	(257)
SAP value	83.74	
SAP rating (section 13)	84	(258)
SAP band	B	

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

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	1959.96	x	0.22	=	423.35	(261)
Water heating	2027.80	x	0.22	=	438.00	(264)
Space and water heating				(261) + (262) + (263) + (264) =	861.36	(265)
Pumps and fans	218.74	x	0.52	=	113.53	(267)
Electricity for lighting	325.39	x	0.52	=	168.88	(268)
Total CO_2, kg/year				(265)...(271) =	1143.76	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	15.44	(273)
EI value					87.13	
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	1959.96	x	1.22	=	2391.15	(261)
Water heating	2027.80	x	1.22	=	2473.91	(264)
Space and water heating				(261) + (262) + (263) + (264) =	4865.06	(265)
Pumps and fans	218.74	x	3.07	=	671.53	(267)
Electricity for lighting	325.39	x	3.07	=	998.94	(268)
Primary energy kWh/year					6535.54	(272)
Dwelling primary energy rate kWh/m2/year					88.20	(273)

DER Worksheet
Design - Draft

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

Assessor name	Mr Jason Doherty	Assessor number	2634
Client		Last modified	23/12/2016
Address	3 6 Streatley Place, London, NW3 1HP		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		104.10	(1a)	x	2.40	(2a)	=	249.84	(3a)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	104.10	(4)						
Dwelling volume							(3a) + (3b) + (3c) + (3d)...(3n) =	249.84	(5)

2. Ventilation rate

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

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15	(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) =	0.13	(21)

Infiltration rate modified for monthly wind speed:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Monthly average wind speed from Table 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	0.16	0.16	0.16	0.14	0.14	0.12	0.12	0.12	0.13	0.14	0.14	0.15	(22b)

Calculate effective air change rate for the applicable case:

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
(24a)	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(24a)

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	
(25)	0.26	0.26	0.26	0.24	0.24	0.22	0.22	0.22	0.23	0.24	0.24	0.25	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			27.11	x	1.15	=	31.04			(27)
Door			1.95	x	0.55	=	1.07			(26)
Roof window			2.54	x	0.96	=	2.44			(27a)
Exposed floor			12.80	x	0.15	=	1.92			(28b
External wall			83.50	x	0.13	=	10.86			(29a)
Party wall			23.52	x	0.00	=	0.00			(32)
Roof			51.66	x	0.09	=	4.60			(30)
Total area of external elements ∑A, m²			179.56							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	51.93	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K		200.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		24.42	(36)
Total fabric heat loss	(33) + (36) =	76.35	(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)	21.69	21.43	21.16	19.85	19.59	18.27	18.27	18.01	18.80	19.59	20.11	20.64	(38)
Heat transfer coefficient, W/K (37)m + (38)m	98.04	97.77	97.51	96.20	95.93	94.62	94.62	94.36	95.15	95.93	96.46	96.99	
Average = ∑(39)1...12/12 =												96.13	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	0.94	0.94	0.94	0.92	0.92	0.91	0.91	0.91	0.91	0.92	0.93	0.93	
Average = ∑(40)1...12/12 =												0.92	(40)
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.77	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	100.09	(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)	110.10	106.10	102.09	98.09	94.09	90.08	90.08	94.09	98.09	102.09	106.10	110.10	
∑(44)1...12 =												1201.10	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	163.28	142.80	147.36	128.47	123.27	106.37	98.57	113.11	114.46	133.39	145.61	158.12	
∑(45)1...12 =												1574.83	(45)
Distribution loss 0.15 x (45)m	24.49	21.42	22.10	19.27	18.49	15.96	14.79	16.97	17.17	20.01	21.84	23.72	(46)
Water storage loss calculated for each month (55) x (41)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)
Primary circuit loss for each month from Table 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)
Combi loss for each month from Table 3a, 3b or 3c	31.98	28.87	31.93	30.85	31.84	30.76	31.76	31.81	30.81	31.89	30.91	31.97	(61)

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

195.26	171.67	179.29	159.32	155.11	137.14	130.33	144.92	145.27	165.29	176.52	190.09	(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

195.26	171.67	179.29	159.32	155.11	137.14	130.33	144.92	145.27	165.29	176.52	190.09

∑(64)1...12 = 1950.21 (64)

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

62.28	54.70	56.98	50.43	48.95	43.06	40.71	45.56	45.76	52.33	56.14	60.57	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	138.72	138.72	138.72	138.72	138.72	138.72	138.72	138.72	138.72	138.72	138.72	138.72	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	23.43	20.81	16.92	12.81	9.58	8.09	8.74	11.36	15.24	19.35	22.59	24.08	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	262.79	265.52	258.65	244.02	225.55	208.19	196.60	193.87	200.74	215.37	233.84	251.20	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	36.87	36.87	36.87	36.87	36.87	36.87	36.87	36.87	36.87	36.87	36.87	36.87	(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)	-110.98	-110.98	-110.98	-110.98	-110.98	-110.98	-110.98	-110.98	-110.98	-110.98	-110.98	-110.98	(71)
Water heating gains (Table 5)	83.72	81.40	76.59	70.04	65.79	59.81	54.72	61.24	63.56	70.33	77.98	81.41	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	437.55	435.34	419.77	394.49	368.53	343.70	327.67	334.08	347.16	372.67	402.02	424.30	(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	
NorthWest	0.77	x	3.68	x	11.28	x 0.9 x	0.63	x	0.70	=	12.69	(81)
SouthEast	0.77	x	17.97	x	36.79	x 0.9 x	0.63	x	0.70	=	202.07	(77)
SouthWest	0.77	x	1.38	x	36.79	x 0.9 x	0.63	x	0.70	=	15.52	(79)
NorthEast	0.77	x	4.08	x	11.28	x 0.9 x	0.63	x	0.70	=	14.07	(75)
Horizontal	1.00	x	2.54	x	26.00	x 0.9 x	0.63	x	0.70	=	26.21	

Solar gains in watts ∑(74)m...(82)m

270.55	479.53	702.02	940.71	1113.98	1131.27	1080.20	947.84	784.60	542.72	327.55	229.23	(83)

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

708.10	914.87	1121.79	1335.20	1482.51	1474.97	1407.88	1281.92	1131.76	915.39	729.57	653.53	(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)	0.99	0.97	0.91	0.77	0.58	0.41	0.30	0.34	0.56	0.87	0.98	0.99	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

19.95	20.23	20.56	20.85	20.97	21.00	21.00	21.00	20.98	20.77	20.29	19.90	(87)

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

20.13	20.13	20.14	20.15	20.15	20.16	20.16	20.16	20.16	20.15	20.14	20.14	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.99	0.96	0.89	0.74	0.53	0.36	0.24	0.28	0.50	0.83	0.97	0.99	(89)

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

19.18	19.45	19.77	20.03	20.13	20.16	20.16	20.16	20.14	19.98	19.53	19.13	(90)

Living area fraction — Living area ÷ (4) = 0.41 (91)

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

19.49	19.77	20.09	20.37	20.47	20.50	20.50	20.50	20.49	20.30	19.84	19.45	(92)

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

19.49	19.77	20.09	20.37	20.47	20.50	20.50	20.50	20.49	20.30	19.84	19.45	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.99	0.96	0.89	0.75	0.55	0.38	0.26	0.30	0.53	0.84	0.97	0.99	(94)
Useful gains, ηmGm, W (94)m x (84)m	698.51	878.18	1002.03	995.22	819.64	555.88	369.10	386.72	595.26	769.61	706.68	647.20	(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]	1489.51	1453.93	1325.59	1103.27	841.59	558.40	369.41	387.33	607.71	930.82	1228.97	1478.59	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	588.51	386.90	240.72	77.79	16.33	0.00	0.00	0.00	0.00	119.94	376.05	618.55	

∑(98)1...5, 10...12 = 2424.79 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 23.29 (99)

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

Space heating

Fraction of space heat from secondary/supplementary system (table 11)		0.00	(201)
Fraction of space heat from main system(s)	1 - (201) =	1.00	(202)
Fraction of space heat from main system 2		0.00	(202)
Fraction of total space heat from main system 1	(202) x [1- (203)] =	1.00	(204)
Fraction of total space heat from main system 2	(202) x (203) =	0.00	(205)
Efficiency of main system 1 (%)		93.20	(206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	631.45	415.13	258.29	83.47	17.52	0.00	0.00	0.00	0.00	128.69	403.49	663.68	

∑(211)1...5, 10...12 = 2601.71 (211)

Water heating

Efficiency of water heater	89.38	89.19	88.81	88.02	87.29	87.00	87.00	87.00	87.00	88.32	89.15	89.43	(217)
Water heating fuel, kWh/month	218.45	192.48	201.89	181.00	177.68	157.63	149.80	166.58	166.98	187.15	198.00	212.56	

∑(219a)1...12 = 2210.21 (219)

Annual totals

Space heating fuel - main system 1 — 2601.71

Water heating fuel		2210.21	
Electricity for pumps, fans and electric keep-hot (Table 4f)			
mechanical ventilation fans - balanced, extract or positive input from outside	201.93		(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		276.93	(231)
Electricity for lighting (Appendix L)		413.75	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	5502.60	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2601.71	x	3.48	x 0.01 =	90.54	(240)
Water heating	2210.21	x	3.48	x 0.01 =	76.92	(247)
Pumps and fans	276.93	x	13.19	x 0.01 =	36.53	(249)
Electricity for lighting	413.75	x	13.19	x 0.01 =	54.57	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		378.56	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.07	(257)
SAP value	85.12	
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	2601.71	x	0.22	=	561.97	(261)
Water heating	2210.21	x	0.22	=	477.41	(264)
Space and water heating			(261) + (262) + (263) + (264) =		1039.37	(265)
Pumps and fans	276.93	x	0.52	=	143.73	(267)
Electricity for lighting	413.75	x	0.52	=	214.73	(268)
Total CO_2, kg/year			(265)...(271) =		1397.84	(272)
Dwelling CO_2 emission rate			(272) ÷ (4) =		13.43	(273)
EI value					87.44	
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	2601.71	x	1.22	=	3174.08	(261)
Water heating	2210.21	x	1.22	=	2696.46	(264)
Space and water heating			(261) + (262) + (263) + (264) =		5870.54	(265)
Pumps and fans	276.93	x	3.07	=	850.18	(267)
Electricity for lighting	413.75	x	3.07	=	1270.20	(268)
Primary energy kWh/year					7990.92	(272)
Dwelling primary energy rate kWh/m2/year					76.76	(273)

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

Assessor name	Mr Jason Doherty	Assessor number	2634
Client		Last modified	23/12/2016
Address	4 6 Streatley Place, London, NW3 1HP		

1. Overall dwelling dimensions

		Area (m²)			Average storey height (m)			Volume (m³)	
Lowest occupied		2.20	(1a)	x	2.40	(2a)	=	5.28	(3a)
+1		61.40	(1b)	x	2.40	(2b)	=	147.36	(3b)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	63.60	(4)						
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =			152.64	(5)

2. Ventilation rate

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

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		3.00	(17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.15	(18)
Number of sides on which the dwelling is sheltered		1	(19)
Shelter factor	1 - [0.075 x (19)] =	0.93	(20)
Infiltration rate incorporating shelter factor	(18) x (20) =	0.14	(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	0.18	0.17	0.17	0.15	0.15	0.13	0.13	0.13	0.14	0.15	0.16	0.16	(22b)

Calculate effective air change rate for the applicable case:

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

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

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
	0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(24a)

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

0.28	0.27	0.27	0.25	0.25	0.23	0.23	0.23	0.24	0.25	0.26	0.26	(25)

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			27.11	x	1.15	=	31.04			(27)
Door			1.95	x	0.55	=	1.07			(26)
Roof window			2.54	x	0.96	=	2.44			(27a)
External wall			58.78	x	0.13	=	7.64			(29a)
Party wall			23.52	x	0.00	=	0.00			(32)
Roof			58.86	x	0.09	=	5.24			(30)
Total area of external elements ∑A, m²			149.24							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	47.44	(33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A	(34)
Thermal mass parameter (TMP) in kJ/m²K		200.00	(35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		16.48	(36)
Total fabric heat loss	(33) + (36) =	63.92	(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)	13.97	13.80	13.62	12.75	12.58	11.70	11.70	11.53	12.05	12.58	12.92	13.27	(38)
Heat transfer coefficient, W/K (37)m + (38)m	77.89	77.72	77.54	76.67	76.49	75.62	75.62	75.44	75.97	76.49	76.84	77.19	
Average = ∑(39)1...12/12 =												76.62	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)	1.22	1.22	1.22	1.21	1.20	1.19	1.19	1.19	1.19	1.20	1.21	1.21	
Average = ∑(40)1...12/12 =												1.20	(40)
Number of days in month (Table 1a)	31.00	28.00	31.00	30.00	31.00	30.00	31.00	31.00	30.00	31.00	30.00	31.00	(40)

4. Water heating energy requirement

Assumed occupancy, N	2.08	(42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	83.63	(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)	92.00	88.65	85.31	81.96	78.61	75.27	75.27	78.61	81.96	85.31	88.65	92.00	
∑(44)1...12 =												1003.59	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)	136.43	119.32	123.13	107.35	103.00	88.88	82.36	94.51	95.64	111.46	121.67	132.12	
∑(45)1...12 =												1315.87	(45)
Distribution loss 0.15 x (45)m	20.46	17.90	18.47	16.10	15.45	13.33	12.35	14.18	14.35	16.72	18.25	19.82	(46)
Water storage loss calculated for each month (55) x (41)m	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(56)
If the vessel contains dedicated solar storage or dedicated WWHRS (56)m x [(47) - Vs] ÷ (47), else (56)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(57)
Primary circuit loss for each month from Table 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(59)
Combi loss for each month from Table 3a, 3b or 3c	31.87	28.76	31.81	30.74	31.73	30.68	31.68	31.71	30.71	31.78	30.80	31.86	(61)

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

168.29	148.08	154.93	138.08	134.73	119.56	114.04	126.23	126.35	143.24	152.47	163.98	(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

168.29	148.08	154.93	138.08	134.73	119.56	114.04	126.23	126.35	143.24	152.47	163.98

∑(64)1...12 = 1689.98 (64)

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

53.33	46.86	48.89	43.38	42.18	37.22	35.30	39.35	39.48	45.00	48.15	51.89	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	104.07	104.07	104.07	104.07	104.07	104.07	104.07	104.07	104.07	104.07	104.07	104.07	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	16.22	14.41	11.72	8.87	6.63	5.60	6.05	7.86	10.55	13.40	15.64	16.67	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	181.93	183.81	179.06	168.93	156.15	144.13	136.10	134.21	138.97	149.10	161.88	173.90	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	33.41	33.41	33.41	33.41	33.41	33.41	33.41	33.41	33.41	33.41	33.41	33.41	(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)	-83.26	-83.26	-83.26	-83.26	-83.26	-83.26	-83.26	-83.26	-83.26	-83.26	-83.26	-83.26	(71)
Water heating gains (Table 5)	71.68	69.74	65.71	60.25	56.70	51.70	47.45	52.89	54.83	60.49	66.88	69.75	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	327.04	325.18	313.71	295.27	276.69	258.64	246.82	252.19	261.57	280.21	301.62	317.54	(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	
NorthWest	0.77	x	3.68	x	11.28	x 0.9 x	0.63	x	0.70	=	12.69	(81)
SouthEast	0.77	x	17.97	x	36.79	x 0.9 x	0.63	x	0.70	=	202.07	(77)
SouthWest	0.77	x	1.38	x	36.79	x 0.9 x	0.63	x	0.70	=	15.52	(79)
NorthEast	0.77	x	4.08	x	11.28	x 0.9 x	0.63	x	0.70	=	14.07	(75)
Horizontal	1.00	x	2.54	x	26.00	x 0.9 x	0.63	x	0.70	=	26.21	

Solar gains in watts ∑(74)m...(82)m

270.55	479.53	702.02	940.71	1113.98	1131.27	1080.20	947.84	784.60	542.72	327.55	229.23	(83)

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

597.60	804.71	1015.73	1235.98	1390.67	1389.92	1327.03	1200.03	1046.18	822.93	629.17	546.77	(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)												
0.98	0.93	0.84	0.67	0.49	0.35	0.25	0.29	0.49	0.79	0.95	0.98	(86)

Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)

19.76	20.13	20.53	20.84	20.96	20.99	21.00	21.00	20.97	20.75	20.18	19.69	(87)

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

19.90	19.90	19.90	19.92	19.92	19.93	19.93	19.93	19.92	19.92	19.91	19.91	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.97	0.92	0.81	0.63	0.44	0.29	0.19	0.22	0.42	0.74	0.93	0.98	(89)

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

18.80	19.16	19.53	19.80	19.89	19.93	19.93	19.93	19.91	19.74	19.23	18.74	(90)

Living area fraction — Living area ÷ (4) = 0.64 (91)

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

19.41	19.78	20.17	20.46	20.57	20.60	20.61	20.61	20.59	20.38	19.83	19.34	(92)

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

19.41	19.78	20.17	20.46	20.57	20.60	20.61	20.61	20.59	20.38	19.83	19.34	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm													
	0.97	0.92	0.82	0.65	0.47	0.32	0.23	0.26	0.46	0.76	0.93	0.97	(94)
Useful gains, ηmGm, W (94)m x (84)m													
	577.71	737.06	830.99	806.82	659.45	450.91	302.56	316.51	480.54	627.96	587.42	533.07	(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]													
	1177.07	1156.47	1059.72	886.21	678.55	453.98	303.09	317.48	492.68	748.06	978.55	1168.61	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m													
	445.92	281.85	170.18	57.16	14.21	0.00	0.00	0.00	0.00	89.36	281.62	472.85	

∑(98)1...5, 10...12 = 1813.14 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 28.51 (99)

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

Space heating

Fraction of space heat from secondary/supplementary system (table 11)		0.10	(201)
Fraction of space heat from main system(s)	1 - (201) =	0.90	(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)] =	0.90	(204)
Fraction of total space heat from main system 2	(202) x (203) =	0.00	(205)
Efficiency of main system 1 (%)		93.20	(206)
Efficiency of secondary/supplementary system (%)		65.00	(208)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month													
	430.61	272.17	164.33	55.20	13.72	0.00	0.00	0.00	0.00	86.29	271.95	456.61	

∑(211)1...5, 10...12 = 1750.89 (211)

Space heating fuel (secondary), kWh/month

68.60	43.36	26.18	8.79	2.19	0.00	0.00	0.00	0.00	13.75	43.33	72.75

∑(215)1...5, 10...12 = 278.94 (215)

Water heating

Efficiency of water heater

89.23	88.99	88.56	87.85	87.27	87.00	87.00	87.00	87.00	88.12	88.97	89.29	(217)

Water heating fuel, kWh/month

188.61	166.40	174.94	157.19	154.39	137.42	131.08	145.09	145.23	162.54	171.37	183.65

∑(219a)1...12 = 1917.90 (219)

Annual totals

Space heating fuel - main system 1			1750.89	
Space heating fuel - secondary			278.94	
Water heating fuel			1917.90	
Electricity for pumps, fans and electric keep-hot (Table 4f)				
mechanical ventilation fans - balanced, extract or positive input from outside	100.09			(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			175.09	(231)
Electricity for lighting (Appendix L)			286.43	(232)
Total delivered energy for all uses		(211)...(221) + (231) + (232)...(237b) =	4409.26	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	1750.89	x	3.48	x 0.01 =	60.93	(240)
Space heating - secondary	278.94	x	4.23	x 0.01 =	11.80	(242)
Water heating	1917.90	x	3.48	x 0.01 =	66.74	(247)
Pumps and fans	175.09	x	13.19	x 0.01 =	23.09	(249)
Electricity for lighting	286.43	x	13.19	x 0.01 =	37.78	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		320.35	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.24	(257)
SAP value	82.72	
SAP rating (section 13)	83	(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	1750.89	x	0.22	=	378.19	(261)
Space heating - secondary	278.94	x	0.02	=	5.30	(263)
Water heating	1917.90	x	0.22	=	414.27	(264)
Space and water heating			(261) + (262) + (263) + (264) =		797.76	(265)
Pumps and fans	175.09	x	0.52	=	90.87	(267)
Electricity for lighting	286.43	x	0.52	=	148.66	(268)
Total CO_2, kg/year				(265)...(271) =	1037.29	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	16.31	(273)
EI value					87.20	
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	1750.89	x	1.22	=	2136.08	(261)
Space heating - secondary	278.94	x	1.04	=	290.10	(263)
Water heating	1917.90	x	1.22	=	2339.84	(264)
Space and water heating			(261) + (262) + (263) + (264) =		4766.03	(265)
Pumps and fans	175.09	x	3.07	=	537.54	(267)
Electricity for lighting	286.43	x	3.07	=	879.34	(268)
Primary energy kWh/year					6182.91	(272)
Dwelling primary energy rate kWh/m2/year					97.22	(273)