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BOULEVARD HOUSE, LONDON

Energy Statement

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Energy Statement

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Revision	Amendment Details	Revision Prepared By	Revision Approved By

EXECUTIVE SUMMARY

Create Consulting Engineers Ltd has been appointed to provide an Energy Statement to support the forthcoming planning application for the proposed Boulevard House development at Fortis Green in the London Borough of Haringey. This report has been developed to detail the energy strategy for the development and demonstrates how it relates to the following guidance documents:

- Haringey's Local Plan: Strategic Policies, March 2013:
  - Policy SP4: Working Towards a Low Carbon Haringey.
- Haringey Sustainable Design and Construction SPD, March 2013:
  - Supporting Statements, Section 2.

This Energy Assessment has been prepared following the principles of the London Plan Energy Hierarchy: 'Be Lean', 'Be Clean' and 'Be Green'.

'Be Lean': Energy efficiency measures will be applied to the development. The strategy aims to reduce energy demands by first incorporating suitable passive design measures, followed by proposed enhancements to provide a highly efficient building fabric and efficient heating system. The proposed energy conservation measures will reduce the dwellings' Fabric Energy Efficiency (DFEE) below the Target Fabric Energy Efficiency (TFEE) as well as Dwellings Emission Rate (DER) below Target Emission Rate (TER) figures dictated by the Building Regulations. These measures will result in a reduction in the regulated CO_2 emissions in comparison to the 2013 Building Regulations Part L compliant case by **0.93%** for the scheme.

'Be Clean': The opportunity for the proposed development to link into an existing or planned decentralised energy network has been considered. The development is not located within immediate proximity of a proposed district heat network and its compact size makes the integration of centralised heating system extremely difficult, therefore this heating strategy has not been explored further.

'Be Green': A feasibility study has been undertaken to establish the most suitable renewable technology for integration at the proposed development. Due to the constraints of the site, photovoltaic systems have been deemed the most viable and practical option for the scheme. A PV array of 1.8kWp for the site is initially proposed which, combined with the 'Be Lean' measures, would result in a **25.1%** CO_2 emissions reduction compared to a Part L 2013 compliant development for the regulated residential loads.

The table below summarises the energy and CO_2 emission reductions for the stages of the energy hierarchy for the proposed Boulevard House development.

London Plan Energy Hierarchy	Regulated CO_2 emissions (kg/year)	CO_2 emissions reduction over 'Base Case' (kg/year)	Percentage reduction over 'Base Case' (Part L)	Unregulated CO_2 emissions (kg/year)
Baseline: Part L 2013 of the Building Regulations Compliant Development (TER)	2,345.7	n/a	n/a	2,365
Be Lean - After energy demand reduction	2,324	21.7	0.93%	2,365
Be Green – with PV	1,767	588.7	**25.1%**	2,365

Copy of Table 5.2: London Plan - Energy Hierarchy - CO_2 emissions and CO_2 emissions reductions

The London Borough of Haringey CO_2 emissions reduction requirement (25% improvement over Part L 2013) has been achieved for the site through incorporation of energy efficiency measures and photovoltaic panels.

The proposed LZC technology for the scheme (PV modules) achieves 23.9% CO_2 emissions reduction for the scheme over the 'Be Lean' scenario, which exceeds the requirements of the London Plan – Policy 5.7: 'Renewable Energy' and Haringey's Local Plan Policy SP4: Working Towards a Low Carbon Haringey.

1.0 INTRODUCTION

1.1 Create Consulting Engineers Ltd has been commissioned by LOM Architecture and Design Ltd to provide an Energy Statement in support of the planning application for the proposed development at rear of Boulevard House at Fortis Green in the London Borough of Haringey ("the Site").

Site Location and Description

1.2 The Site is located in London Borough of Haringey. Please refer to Figure 1.1 for site location.

1.3 The Site is located at the rear of existing 3 storey residential building and is currently occupied by two double garages and a small storage building. The Site is located within the northern part of the Fortis Green Conservation Area.

1.4 The Site is located to the north of Fortis Green (road A504) and is surrounded by buildings of various uses: workshops, public house, restaurant, shops and dwellings.



Figure 1.1: Site Location

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Proposed Development

1.5 The development proposal is to demolish the existing garages and construct two 1 bedroom mews houses, as shown on the architectural drawings prepared by LOM Architecture and Design ltd.

1.6 This report details information gathered from consultation with the design team.

Objectives

1.7 The objectives of this report are to:

- Demonstrate how the proposed development will meet the policy requirements of the London Borough of Haringey and of the London Plan, including its associated Energy Hierarchy (Policy 5.2: 'Minimising carbon dioxide emissions') and Cooling Hierarchy (Policy 5.9: 'Overheating and Cooling').

- Identify the most suitable passive and energy efficient design approach for the scheme, the feasibility of Low and Zero Carbon (LZC) technologies and operational Best Practice.

- Identify the drivers relating to an energy efficient design over and above minimum compliance with current Building Regulations and other appropriate regional and national policies.

Report Structure

1.8 The introductory section is followed by a review of national and local current and future policies on energy, good practice review and project requirements. A detailed assessment of the estimated energy consumption and associated carbon dioxide emissions is provided, with passive design measures along with energy efficient equipment. This relates to the 'Be Lean' element of the proposed Energy Hierarchy. Low and Zero Carbon technologies are reviewed in detail for feasibility within the scheme, relating to the 'Be Clean' and 'Be Green' elements of the Energy Hierarchy. A summary of the Energy Strategy for the scheme is provided at the end of this document.

2.0 CURRENT AND FUTURE PLANNING POLICIES / GOOD PRACTICE REVIEW AND PROJECT REQUIREMENTS

National Planning Policy Framework (March 2012)

2.1 The National Planning Policy Framework (NPPF) was released by the Department for Communities and Local Government in March 2012 to set out the Government's planning policies for England and how these are to be applied. The NPPF must be taken into account as a material consideration in planning decisions.

2.2 The policies contained in the framework constitute the Government's view of what sustainable development in England means for the planning system; covering the three dimensions of economic, social and environmental. At the core of the NPPF is a presumption in favour of sustainable development. The main relevant sections for this report are:

- *'Paragraph 17: Support the transition to a low carbon future in a changing climate, taking full account of flood risk and coastal change, and encourage the reuse of existing resources, including conversion of existing buildings, and encourage the use of renewable resources (for example, by the development of renewable energy)';*

- *'Paragraph 93: Planning plays a key role in helping shape places to secure radical reductions in greenhouse gas emissions, minimising vulnerability and providing resilience to the impacts of climate change, and supporting the delivery of renewable and low carbon energy and associated infrastructure. This is central to the economic, social and environmental dimensions of sustainable development.'*

- *'Paragraph 95: To support the move to a low carbon future, local planning authorities should:*
  - *Plan for new development in locations and ways which reduce greenhouse gas emissions;*
  - *Actively support energy efficiency improvements to existing buildings; and*
  - *When setting any local requirement for a building's sustainability, do so in a way consistent with the Government's zero carbon buildings policy and adopt nationally described standards.'*

- *'Paragraph 96: In determining planning applications, local planning authorities should expect new development to:*

- *Comply with adopted Local Plan policies on local requirements for decentralised energy supply unless it can be demonstrated by the applicant, having regard to the type of development involved and its design, that this is not feasible or viable; and*
  - *Take account of landform, layout, building orientation'*

- *'Paragraph 97: To help increase the use and supply of renewable and low-carbon energy, local planning authorities should recognise the responsibility on all communities to contribute to energy generation from renewable or low-carbon sources. They should:*
  - *Have a positive strategy to promote energy from renewable and low-carbon sources, including deep geothermal energy;*
  - *Design their policies to maximise renewable and low-carbon energy development while ensuring that adverse impacts are addressed satisfactorily;*
  - *Consider identifying suitable areas for renewable and low-carbon energy sources, and supporting infrastructure, where this would help secure the development of such sources;*
  - *Support community-led initiatives for renewable and low carbon energy, including developments outside such areas being taken forward through neighbourhood planning;*
  - *Identify opportunities where development can draw its energy supply from decentralised, renewable or low carbon energy supply systems and for co-locating potential heat customers and suppliers'.*

- *'Paragraph 98: When determining planning applications, local planning authorities should:*
  - *Not require applicants for energy development to demonstrate the overall need for renewable or low carbon energy and also recognise that even small-scale projects provide a valuable contribution to cutting greenhouse gas emissions; and*
  - *Approve the application if its impacts are (or can be made) acceptable. Once suitable areas for renewable and low carbon energy have been identified in plans, local planning authorities should also expect subsequent applications for commercial scale projects outside these areas to demonstrate that the proposed location meets the criteria used in identifying suitable areas.'*

The London Plan (2011) with 2015 amendments

2.3 This Spatial Development Strategy for Greater London includes objectives to reduce the capital's impact on, and exposure to, the effect of climate change. Policies that are appropriate to the Boulevard House development:

<u>Policy 5.2: 'Minimising Carbon Dioxide Emissions'</u>

2.4 Development proposals should make the fullest contribution to minimising carbon dioxide emissions in accordance with the following energy hierarchy:

- *'Be Lean'*: reduction of the energy demand and associated emissions using a passive design approach and high specification plant;

- *'Be Clean'*: further reducing energy demand and associated emissions by incorporating viable Low Carbon technologies;
- *'Be Green'*: meeting a proportion of the residual demand via renewable energy technologies, where feasible.

Policy 5.6: 'Decentralised Energy in Development proposals'

2.5 Development proposals should evaluate the feasibility of Combined Heat and Power (CHP) systems, and where a new CHP system is appropriate also examine opportunities to extend the system beyond the site boundary to adjacent sites.

2.6 Major development proposals should select energy systems in accordance with the following hierarchy:

1. Connection to existing heating or cooling networks;
2. Site wide CHP network;
3. Communal heating and cooling.

2.7 Potential opportunities to meet the first priority in this hierarchy are outlined in the London Heat Map tool. Where future network opportunities are identified, proposals should be designed to connect to these networks.

Policy 5.7: 'Renewable Energy'

2.8 Within the framework of the energy hierarchy (see Policy 5.2), major development proposals should provide a reduction in expected carbon dioxide emissions through the use of on-site renewable energy generation, where feasible. Major developments should seek to reduce carbon dioxide emissions by at least 20% through the use of on-site renewable energy generation, where feasible.

Policy 5.9: 'Overheating and Cooling'

2.9 Major development proposals should reduce potential overheating and reliance on air conditioning systems and demonstrate this in accordance with the following cooling hierarchy.

1. Minimise internal heat generation through energy efficient design;
2. Reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation and green roofs and walls;
3. Manage the heat within the building through exposed internal thermal mass and high ceilings;
4. Passive ventilation;
5. Mechanical ventilation;
6. Active cooling systems (ensuring they are the lowest carbon options).

Haringey's Local Plan: Strategic Policies 2013-2026 (March 2013)

Policy SP4: Working Towards a Low Carbon Haringey

2.10 *"In line with London Plan policy, the Council will promote and require all new developments to take measures to reduce energy use and carbon emissions during design, construction and occupation, by incorporating the following measures:*

a. From 2011 onward, all new residential development will achieve a minimum 25% reduction in total (regulated) CO_2 emissions in line with Code for Sustainable Homes Level 4 energy standards."

2.11 The Policy SP4 requires all developments to consider connection to decentralised energy facilities in either local area or wider borough area. All new developments are also required, where viable, to achieve a reduction in predicted carbon dioxide emissions of 20% from on site renewable energy generation.

Haringey Sustainable Design and Construction SPD (March 2013)

2.12 This document sets out the requirement for all developments to provide an Energy Statement and Sustainability Statement that will demonstrate how their proposal follows sustainable design and construction principles. It also explains further what information should be included in an Energy Statement for major developments allowing applications for minor development to demonstrate their sustainability credentials in a less prescribed way.

Building Regulations Approved Document Part L1A: 2013

2.13 Part L of the current Building Regulations considers the reduction of carbon emissions in new and existing buildings. As the proposals consist of the creation of new dwellings, they fall under Part L1A of the Building Regulations (Conservation of fuel and power in new dwellings).

2.14 The overall structure of compliance with the 2013 Building Regulations includes five criteria to comply with for all new residential dwellings:

- **Criterion 1** – The Dwelling Emission Rate (DER) should be better than the Target Emission Rate (TER) and the Dwelling Fabric Energy Efficiency (DFEE) should be better than the Target Fabric Energy Efficiency (TFEE);
- **Criterion 2** - Limit on design flexibility;
- **Criterion 3** - Limiting effects of heat gain in summer;
- **Criterion 4** - Commissioning and air-tightness;
- **Criterion 5** - Efficient operation of buildings.

2.15 The new Building Regulations came into force on 6th April 2014. The changes, which involve a strengthening of the Building Regulation requirements, represent the next step towards the Government's ambitions for all new build dwellings to be zero carbon by 2016, and will contribute to the achievement of national emission reduction targets. For new homes, the changes introduced within the new version of Part L1A:2013 will deliver a 6% improvement on the previous 2010 standards across the build mix for residential scheme.

2.16 The detailed energy strategy for the scheme will be developed to ensure the scheme meets the relevant requirements of the Building Regulations.

3.0 ENERGY EFFICIENCY STRATEGY – 'BE LEAN'

Introduction

3.1 The proposed energy strategy has, as its first priority, minimised energy consumption through the performance of the building envelope and services. The following section details the energy efficiency features of the development. The cooling hierarchy set out within the London Plan has been followed.

3.2 This analysis included:

- Building Regulations Approved Document ADL1A (2013) initial compliance assessment, identifying the potential for the design to comply with and exceed Building Regulations requirements.
- An energy demand assessment of the proposed scheme contained within this document provides carbon dioxide emissions estimates from the analysis of passive energy efficiency enhancements and Low and Zero Carbon potential. This will utilise Building Regulations 2013 carbon dioxide factors.

3.3 In further detail, the energy efficiency strategy of the scheme has been achieved by incorporating the following design and technology features:

Energy Efficiency Features Proposed

Physical Form and Orientation of the Building

3.4 While the orientation of the development is relatively fixed due to the size of the site and existing buildings closely surrounding the site, the facade has been optimised in order to provide a balance of thermal control, both from within and outside of the building.

3.5 Passive solar design involves adapting the internal layout and glazing to best respond to the local climate and annual sun path, with the aim of reducing energy demands and improving occupant comfort through the use of heat and light from the sun. The main facade of the development is orientated south and accommodates large floor height windows permitting maximum daylight penetration into the new mews houses.

3.6 Good levels of natural daylight will be achieved for the majority of the scheme. This will reduce reliance on artificial lighting and thus limit energy consumption.

3.7 Overheating will be avoided due to moderate overshading created by existing 3 storey Boulevard House located to the south of the proposed development.

3.8 Shading control systems in the form of occupier controlled interior blinds/curtains will offer efficient solar control as they provide both solar shading and glare control, which in turn improves occupier comfort and reduces the risk of overheating within the dwellings.

Building Envelope Specification and Thermal Performance

3.9 Building fabric thermal transmittance is measured by the U-value of each building element in Watts/m^2/K. The U-value describes how well a building element conducts heat. It measures the rate of heat transfer through a building element over a given area, under standardised conditions: the lower the U-value, the better the insulating ability. Table 3.1 below details the U-values for Boulevard House development in relation to Building Regulations minimum standards.

Building Element/Characteristic	Proposed Residential Development	Building Regulations Part L1A: 2013 Requirements
Exterior Wall - U value (W/m^2K)	**0.20**	0.30
Ground floor	**0.12**	0.25
Flat Roof - U value (W/m^2K)	**0.15**	0.20
Windows - U value (W/m^2K)	**1.3**	2.0
Doors - U value (W/m^2K)	**1.3**	2.0
Design Air Permeability(m^3/hr/m^2 @50Pa)	**4**	10
Thermal Bridges	**ACD/Default**	n/a

Table 3.1: Proposed building fabric performance

Thermal Mass

3.10 Utilising the thermal mass of a building can help to regulate internal temperatures and temper heating and cooling loads by absorbing and radiating heat, thus reducing annual energy consumption. To exploit the thermal mass of the building, either direct or indirect contact is required between the structure and the occupied space, via exposed surfaces or high energy exchange systems. Due to the proposed residential use, there is limited opportunity to exploit thermal mass directly; this is because the internal finishes such as carpets and dry-lining will reduce the effectiveness of the building's structure as an energy store.

3.11 The proposed development, constructed mainly from timber, will have a low thermal mass.

Air Tightness and Ventilation Strategy

3.12 Air permeability is a measure of infiltration. It indicates how often the entire air quantity in a building is exchanged with outside air within 1 hour without any ventilation in place. Any air exchange with outside air is carrying heat energy away from the building, resulting in a

higher heating load. Lower air permeability levels are desirable for conserving heat energy and in the case of mechanical ventilation systems for reducing fan power consumption. Infiltration is different from ventilation. Infiltration is essentially unwanted air exchanges through imperfections in the building fabric while ventilation is the air exchanges intended by the designer.

3.13 As detailed in Table 3.1 the air permeability of the proposed development has been assumed to be 4 m^3/m^2@50PA/hr for both dwellings.

3.14 Ventilation system proposed for the development is via natural means (purge ventilation, trickle vents) and low energy mechanical extract ventilation provided to all kitchen and wet rooms (bathrooms and toilets).

The Choice and Design of Building Systems and Plant

3.15 The building systems and plant have been designed to optimise the efficiency of the systems by matching installed capacity to anticipated building demand. Items of equipment, which make up the building's mechanical building services installation, will be specified to achieve high annual energy efficiency in operation and will be regularly serviced to maintain their performance.

3.16 The proposed method of supplying heating and hot water to the dwellings will be via individual condensing gas boilers. Each house will be served by a combination boiler providing both space heating and hot water. Space heating will be provided via radiators. The efficiency of the proposed system will be in region of 89.9% (e.g. Greenstar Compact range) and heating system will be controlled by time and temperature zone control system and weather or load compensator.

Lighting and Appliances

3.17 High efficiency low energy lighting and controls will be specified throughout. All residential spaces will utilise 100% low energy lighting.

Carbon Dioxide and Energy Reductions - Part L compliance

Standard Assessment Procedure

3.18 The Standard Assessment Procedure (SAP 2012) which formed the basis for demonstrating dwelling compliance with Part L1 of the Building Regulations 2013 for new build has been used for the Boulevard House development proposal to estimate the savings achieved through the energy efficiency features proposed and to predict the annual building regulated energy consumption and CO_2 emissions of the dwellings (using NHER Plan Assessor version 6.2 – Part L1A certified compliance software). The energy consumption and CO_2 emissions of the

unregulated elements (cooking and appliances) have been estimated based on the methodology developed in Appendix L of SAP 2012.

3.19 Both houses been modelled based on the latest set of architectural drawings from LOM architecture and design Ltd.

Results of the CO_2 / Energy Consumption Estimation – Part L compliance

3.20 The total energy consumption has been estimated based on the results from the energy modelling for the proposed dwellings. Please refer to Table 3.2 below:

Residential Energy Consumption 'Be Lean'	Total energy consumption (kWh/year)	Total CO_2 emissions ($kgCO_2$/year)
Space and water heating	9,166	1,980
Lighting	513	266
Pumps and Fans	150	78
Electrical appliances	3,722	1,932
Cooking	1,178	433
Total	14,729	4,689

Table 3.2: CO_2 emissions and energy consumption for the 'Be Lean' case

3.21 The optimised building fabric specified for the scheme has ensured the scheme achieves a Dwelling Fabric Energy Efficiency (DFEE) rate lower than the Part L1A:2013 Target Fabric Energy Efficiency rate (TFEE) at **3.15%** improvement over Part L1A (TFEE/DFEE criterion) – Please refer to Table 3.3 below.

Fabric Energy Efficiency for Assessed Dwellings	House 1	House 2
Target Fabric Energy Efficiency (TFEE) ($kWh/m^2/yr$)	57.1	57.1
Dwelling Fabric Energy Efficiency (DFEE) ($kWh/m^2/yr$)	55.3	55.3
Improvement over PartL1A:2013 DFEE<TFEE criterion	**3.15%**	**3.15%**

Table 3.3: Energy modelling results - Improvement over Part L – TFEE/DFEE criteria – energy efficiency features only

3.22 It is worth noting that due to the current calculation methodology used for Part L compliance and the GLA Energy Assessment methodology, the CO_2 savings achieved through the provision of energy efficient appliances (unregulated loads) are not included in the conservative CO_2 savings presented in this report. The unregulated CO_2 emissions have been

considered similar for all the different stages of the London Plan energy hierarchy. It is however expected that this scheme will lead to unregulated CO_2 emissions significantly lower than those of a standard Part L 2013 compliant scheme.

3.23 The energy efficiency strategy for the scheme has been developed following a hierarchical approach. The strategy aims to reduce energy demands by first incorporating suitable passive design measures, followed by proposed enhancements to provide an efficient building fabric and highly efficient heating system. Energy efficiency features have led to an overall projected improvement over Part L 2013 of **0.93%** for regulated loads (Please refer to Appendix A for SAP calculations spreadsheets).

Carbon Dioxide Emissions after each stage of the Energy Hierarchy Total Scheme	Carbon Dioxide Emissions (kilograms CO_2 per annum)	
	Regulated	Unregulated
Baseline: Part L 2013 of the Building Regulations Compliant Development	2,345.7	2,365
Be Lean - After energy demand reduction	2,324.0	2,365
Improvement over Part LA: 2013	**21.7**	**Tonnes CO_2 per annum**
	0.93	**%**

Table 3.4: CO_2 emissions reduction for the 'Be Lean' scheme

3.24 To achieve the Haringey's Local Plan Policy SP4 target of 25% CO_2 emissions reduction over Building Regulations Part L the proposed development will incorporate renewable or low carbon technology. A feasibility study of different renewable systems to determine their suitability for the scheme is presented in Section 5 of this report.

4.0 'BE CLEAN': SUPPLY ENERGY EFFICIENTLY

4.1 Connection to a decentralised energy network and the use of combined heat and power is a recognised method of generating energy more efficiently. The London Plan Policy 5.5: 'Decentralised Energy Networks' and Haringey's Local Plan Policy SP4: 'Working Towards a Low Carbon Haringey' requires development proposals to explore the opportunities to link into an existing or planned decentralised energy network using the London Heat Map tool. Where an existing decentralised energy network is not present, an assessment of the feasibility of establishing a decentralised energy system for the proposed development should be undertaken; including an assessment of the feasibility of a Combined Heat and Power (CHP) communal heating system.

4.2 The feasibility of connecting to an existing network and specification of a Combined Heat and Power system has been assessed within the following section.

Decentralised Energy Networks

4.3 The London Heat Map tool is an interactive tool that allows users to identify opportunities for decentralised energy projects in London. It builds on the 2005 London Community Heating Development Study. All information has been updated and the map is now in a user friendly format using an interactive GIS system. This tool details the existing and proposed major heat loads and supplies within London as well as existing and proposed heat distribution networks.

4.4 The London Heat Map tool indicates the location of a future decentralised energy network approximately 3 kilometres from the Boulevard House site (Please refer to Figure 4.1). The site is not located within a viable distance of the heat networks and therefore the connection to a decentralised energy network is considered unfeasible at the present time.

4.5 Based on the proposed individual heating strategy for the dwellings, a connection to an external district heating system, should a district scheme become reality, is considered technically and economically unfeasible. The development is classified as minor and is very compact in form without allocated space for a central plant.

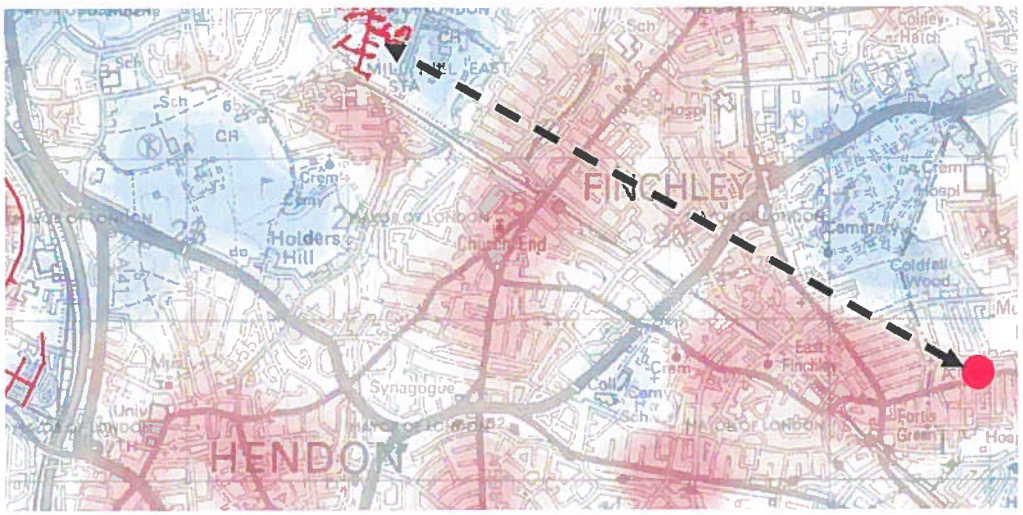


Figure 4.1: Location of the proposed site in relation to existing and proposed energy networks

5.0 'BE GREEN': USE RENEWABLE ENERGY

5.1 The final step in the energy hierarchy requires the clean generation of energy by renewable energy technologies be examined. The London Plan Policy 5.7:' Renewable Energy' and London Borough of Haringey Local Plan Policy SP4: 'Working Towards a Low Carbon Haringey' require the incorporation of on site renewable energy generation to provide a percentage reduction in the carbon emissions from the proposed development. The London Plan requires all developments to achieve a 'reduction in carbon dioxide emissions of 20% from on-site renewable energy generation unless it can be demonstrated that such provision is not feasible'.

5.2 Renewable or Low Carbon energy sources will also have to be incorporated into the mews houses design to achieve the Local Plan Policy SP4 target of 25% CO_2 emissions reduction over the requirements of the Building Regulations Part L.

5.3 A feasibility study has been undertaken to establish the most economically viable renewable technology which provides the highest overall reduction in carbon dioxide emissions for the proposed development to meet the policy requirements. The following renewable technologies have been reviewed:

- Heat pumps;
- CHP;
- Bio-fuels;
- Wind turbines;
- Solar water heating;
- Photovoltaic panels.

Renewable Technology Feasibility Study

Heat Pumps: Suitability – **NOT VIABLE**

5.4 Heat Pumps, utilising low grade, ground source or recovered heat can potentially provide high efficiency, low carbon heating.

5.5 Ground Source Heat Pumps (GSHP) utilising the ground as a thermal resource, can provide heating and cooling, and have been reviewed in the context of this development, with the following outcomes:

- There is no space around the buildings for a horizontal system.
- It is not considered economically or practically feasible to integrate pile/loop under the development.
- Significant ground investigation required;
- Available capacity of the site electrical infrastructure;
- Refrigerant's Global Warming Potential (GWP).

5.6 Consequently GSHP are not considered viable for this scheme.

5.7 An Air Source Heat Pump (ASHP) could be used for the heat supply of the development. However, this system will lead to very limited savings due to use of carbon intensive electricity and the low COP of this system.

5.8 Air Source Heat Pumps require space for external units and internally for a hot water cylinder. Due to limited space around the development and relatively small size of the dwellings ASHP are not considered viable for the scheme.

Gas Combined Heat and Power: Suitability – **NOT VIABLE**

5.9 A conventionally fuelled CHP system would utilise a prime mover such as a diesel engine or gas turbine to drive an electrical generator. The heat generated by the prime mover during this process would be utilised to in a community heating network.

5.10 Gas CHP systems are energy efficient and considered as low carbon technologies. For CHP to be viable, it must run almost continuously and thus requires a permanent heat demand (hence its suitability for swimming pools, hospitals etc).

5.11 Moreover, the use of a large combined heat and power system for the hot water provision of the residential units would require the use of a very large thermal storage unit to ensure it runs for a continuous number of hours during the year.

5.12 It is therefore not recommended that gas fired-CHP be considered for this site.

Bio-fuels, Suitability – **NOT VIABLE**

5.13 Bio-fuels have the potential to contribute to the reduction of CO_2 emissions of various developments by using this fuel within a boiler or CHP plant. Biofuels are considered to have low or zero CO_2 intensities as theoretically the CO_2 released when these fuels are combusted is no greater than the CO_2 that has been absorbed from the atmosphere when the plants grew.

5.14 However, there are a number of issues which must be considered with this type of fuel in urban locations:

- Potential air quality impacts with combusting bio-fuels in urban areas, in particular elevated NOx emissions and particulates and must be addressed.
- Transporting this type of fuel increases lorry movements into and out of London, affecting congestion and transport emissions. The relatively rapid degradation of biodiesel would require appropriately sized on-site storage tanks with regular fuel deliveries.

- Importantly, the actual bio-diesel CO_2 intensity cannot be guaranteed due to variations in fuel stock supplier, demand, the energy input processing the fuel and CO_2 emissions due to growing, harvesting and processing the base fuel.
- Biofuel availability is currently uncertain due to unknown future supply and demand. Whilst an increase in demand for larger developments may stimulate the supply chain, availability could change with variation in demand. Transport is likely to have the most significant impact on the biofuel industry over emerging building demand.
- Socio-economic issues from growing and harvesting feedstock, with potential impacts on food production, particularly for biodiesel that is imported. Solid biofuels have a lesser impact in this area.
- On-site fuel storage requirements requiring additional space, along with regular access to the on-site fuel storage area.
- Increased plant maintenance is generally required, adding to costs and plant down-time.

5.15 Consequently biofuels for combustion within a boiler are not appropriate for the scheme.

Wind Turbines: Suitability – **NOT VIABLE**

5.16 Although a wind turbine could be sized to meet the requirements of this development, there are numerous factors that would discount its suitability in this setting. Typically wind turbines perform poorly in urban environments as surrounding buildings and features dissipate much of the useful energy of the wind before it can be extracted by the turbine. To be clear of the disturbance created by surrounding buildings, it would be necessary to provide a mounting tower in excess of 25m tall, which would also require a large amount of free space for the erecting and periodic maintenance of the turbine. This is likely to be an issue with this site.

5.17 Environmental concerns such as noise and shadow flicker are also problematic in populated areas. While modern turbines have low levels of noise generation, even at high rotational speeds, the noise generated may still be an issue for local residents, particularly given the close proximity of the turbine. Given the dense urban setting of this development, shadow flicker is likely to be a problem for the residents of the proposed development. A wind turbine would not be a viable option for this development.

Solar Thermal Hot Water Panels: Suitability – **LIMITED**

5.18 Solar hot water systems (SHW) use the energy radiated by the sun and convert it into useful heat in the form of hot water.

5.19 Heat is transferred and stored in a central thermal store. The solar panel system would ideally supply approximately 45-55% of the developments domestic hot water requirement; the remainder of energy required for domestic hot water would be supplied by the gas boilers within the individual residential unit.

5.20 Solar thermal panels are ideal for dwellings with a highly insulated building envelope as the energy demand for heating water is relatively high in comparison to space heating demand.

5.21 The roofs of the dwellings are flat and therefore the collectors would have to be mounted on frames tilted at least 30 degrees facing south, south-west or south-east leading to an optimum hot water output.

5.22 The proposed dwellings are located behind a 3 storey building that would cast a moderate shade on the flat roof allowing the panels to perform at their best only in warm spring and summer months when the sun shines at a higher angle.

5.23 Solar thermal panels could be specified to compliment the proposed gas heating strategy but would require a hot water storage tank located within each dwelling. Internal space of the dwellings is quite limited and therefore very valuable for both the Client and future tenants, therefore this system is not the Client's preferred option.

5.24 A SHW system alone would not reduce CO_2 emissions by 25% as required by Haringey's Local Plan Policy SP4.

5.25 For this reason a solar hot water system is only recommended in conjunction with other suitable renewable technology (PV panels) for the site and if other options prove to be technically challenging or too costly to incorporate.

Photovoltaic Panels: Suitability – **SUITABLE**

5.26 Photovoltaic cells directly convert sunlight into electrical current using semiconductors. The output of a cell is directly proportional to the intensity of the light received by the active surface of the cell. The location and positioning of PV cells is therefore critical to achieving acceptable performance. Exposure to sunlight causes electricity to flow through the cells. Mono-crystalline PV cells provide higher levels of electricity generating performance over other panel types. PV panels can be incorporated into a range of building designs and positions, provided they are located in a shade-free environment and facing as close to south as possible.

5.27 Photovoltaics are generally technically suitable for residential developments. Their use can be limited due to their high capital cost. However, with the introduction of the Feed in Tariff, the high capital cost could be balanced with the running cost savings and the fixed tariff offered during a set period of time.

5.28 The following issues are considered in relation to the feasible integration of PV:

- High capital cost;
- Electricity Feed in Tariffs are available for this type of installation, improving the Return on Investment and payback periods;
- Low maintenance;
- Simple installation;
- Photovoltaic panels are typically straightforward to integrate into a building's services strategy;
- Self cleaning if tilted at an angle of 10 degrees or more;
- Performance output and emissions reduction is greater for PV over solar thermal systems for this arrangement, panel area and specific project loads;
- Access issues / Mansafe system;
- Roof lights / Access hatch/ Amenity.

5.29 PV panels are a viable option for this development. The available roof area suitable for locating the PV panels is constrained by the orientation and roof layout of the development. The panels would have to be located away from the proposed roof light which limits the available roof area to approximately 16m² per dwelling. However, deduction for access, man safe systems and services termination should be included. As a 'rule of thumb' a usable roof area is 75% of the available roof area for each building.

5.30 It has been calculated that usable roof areas for the development are as follow:

- House 1: $16m^2 \times 75\% = 12m^2$
- House 2: $16m^2 \times 75\% = 12m^2$

5.31 Based on good practice 1kWp PV requires a spatial area of $12m^2$ (this takes into account access and shading requirements for panels at max. 15° inclination).

5.32 Based on calculation methodology included in SAP 2012 document, 1kWp of PV laid horizontally, slightly overshaded during some periods of the year (modest overshading of 20% - 60%) generates approximately 608kWh of electricity per year, which translates to 315.7kg of CO_2 savings per year.

5.33 The London Borough of Haringey policy target of 25% CO_2 reduction over the Building Regulations will be met by installing a 1.8kWp PV system across the site, or 0.9kWp system per dwelling, as detailed in Table 5.1 overleaf.

London Plan Energy Hierarchy	Regulated CO_2 emissions (kg/year)	CO_2 emissions reduction over 'Base Case' (kg/year)	CO_2 offset by 1kWp of flat mounted PV with modest overshading (kg/year)	PV system needed for the site (kWp)
Baseline: Part L 2013 of the Building Regulations Compliant Development (TER)	2,345.7	n/a	n/a	n/a
Be Lean - After energy demand reduction	2,324	21.7	n/a	n/a
25% CO_2 reduction target over BR (to be achieved)		586.4	n/a	n/a
Remaining CO_2 to be offset by PV to meet the 25% reduction target		564.7	315.7	**1.8**

Table 5.1: PV system size requirement for the site

5.34 A system of this size will need approximately 21.6m^2 of flat roof area for the site, or 10.8m^2 of roof area per dwelling, which can be comfortably achieved for this site.

5.35 Total electricity generation for the site based on 1.8kWp PV system will be in region of 1,094 kWh per year. This has an estimated carbon reduction of 567 kg /year.

5.36 Total CO_2 emissions reduction over the Building Regulations will be 25.1%, which complies with Haringey's Local Plan requirements for all new development (Policy SP4). The proposed LZC technology for the scheme (PV modules) achieves 23.9% CO_2 emissions reduction for the scheme over the 'Be Lean' scenario, which exceeds the requirements of the London Plan – Policy 5.7: 'Renewable Energy' and Haringey's Local Plan Policy SP4:' Working Towards a Low Carbon Haringey'. Please refer to table 5.2 below for results of the calculations.

London Plan Energy Hierarchy	Regulated CO_2 emissions (kg/year)	CO_2 emissions reduction over 'Base Case' (kg/year)	Percentage reduction over 'Base Case' (Part L)	Unregulated CO_2 emissions (kg/year)
Baseline: Part L 2013 of the Building Regulations Compliant Development (TER)	2,345.7	n/a	n/a	2,365
Be Lean - After energy demand reduction	2,324	21.7	0.93%	2,365
Be Green – with PV	1,767	**588.7**	**25.1%**	2,365

Table 5.2: London Plan - Energy Hierarchy - CO_2 emissions and CO_2 emissions reductions

6.0 CONCLUSION

6.1 This Energy Statement has been prepared following the principles of the London Plan Energy Hierarchy: 'Be Lean', 'Be Clean' and 'Be Green'. The overriding objective in the formulation of the energy strategy for the scheme has been to maximise the viable reductions in total carbon dioxide emissions from the development within the framework of the energy hierarchy.

6.2 **'Be Lean':** The proposed energy conservation measures will reduce the dwellings' Fabric Energy Efficiency (DFEE) below the Target Fabric Energy Efficiency (TFEE) as well as Dwellings Emission Rate (DER) below Target Emission Rate (TER) figures dictated by the Building Regulations. They will reduce the regulated CO_2 emissions in comparison to the 2013 Building Regulations Part L compliant case by **0.93%** for the scheme.

6.3 **'Be Clean':** The opportunity for the proposed development to link into an existing or planned decentralised energy network has been considered. The development is not located within immediate proximity of a proposed district heat network and its compact size makes the integration of centralised heating system extremely difficult, therefore this heating strategy has not been explored further.

6.4 **'Be Green':** A feasibility study has been undertaken to establish the most suitable renewable technology for integration at the proposed development. Due to the constraints of the site, Photovoltaic systems have been deemed the most viable and practical option for the scheme. A PV array of 1.8kWp is initially proposed for the site which, combined with the 'Be Lean' measures, would result in a **25.1%** reduction in CO_2 emissions reduction compared to a Part L 2013 compliant development for the regulated residential loads.

6.5 The incorporation of PV system into the design will also lead to 23.9% reduction in predicted ('Be Lean' case) CO_2 emissions from renewable sources, meeting the requirements of the London Plan Policy 5.7 and Haringey's Local Plan Policy SP4.

6.6 The energy strategy of the scheme has considered measures to adapt and mitigate effects of climate change, in particular through an optimised design minimising risk of overheating and the specification of energy efficiency systems and LZC leading to significant CO_2 emission reductions.

6.7 Based on the above results, it can be concluded that the requirements of the London Borough of Haringey planning policy, as detailed in Section 2 of this report, have been met.

7.0 DISCLAIMER

7.1 This report details information gathered from consultation with the design team and LOM Architecture and Design Ltd. All information provided has been accepted in good faith as being accurate and representative of the proposed scheme at the time of review.

7.2 Create Consulting Engineers disclaims any responsibility to the Client and others in respect of any matters outside the scope of this report.

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7.4 Create Consulting Engineers Ltd accepts no responsibility whatsoever to other parties to whom this report, or any part thereof, is made known. Any such other parties rely upon the report at their own risk.

APPENDICES

APPENDIX A

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	Miss Alicja Kreglewska	Assessor number	4134
Client		Last modified	13/01/2016
Address	92 Fortis Green, London, N2 9EY		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		30.13	(1a) x	2.36	(2a) =	71.11	(3a)
+1		25.96	(1b) x	2.64	(2b) =	68.53	(3b)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	56.09	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	139.64	(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) =	0.14	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		4.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.34 (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) =	0.29 (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	0.37	0.36	0.36	0.32	0.31	0.28	0.28	0.27	0.29	0.31	0.33	0.34	(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

0.57	0.57	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56	(24d)

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

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

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			12.93	x	1.24	=	15.98			(27)
Door			1.89	x	1.30	=	2.46			(26)
Roof window			0.81	x	1.24	=	1.00			(27a)
Ground floor			30.13	x	0.12	=	3.62			(28a)
External wall			85.59	x	0.20	=	17.12			(29a)
Party wall			5.57	x	0.00	=	0.00			(32)
Roof			24.73	x	0.15	=	3.71			(30)
Total area of external elements ∑A, m²			156.08							(31)

Fabric heat loss, W/K = ∑(A × U)	(26)...(30) + (32) =	43.88 (33)
Heat capacity Cm = ∑(A x κ)	(28)...(30) + (32) + (32a)...(32e) =	N/A (34)
Thermal mass parameter (TMP) in kJ/m²K		100.00 (35)
Thermal bridges: ∑(L x Ψ) calculated using Appendix K		16.70 (36)
Total fabric heat loss	(33) + (36) =	60.58 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)													
	26.23	26.10	25.98	25.41	25.31	24.81	24.81	24.72	25.00	25.31	25.52	25.75	(38)
Heat transfer coefficient, W/K (37)m + (38)m													
	86.81	86.68	86.56	85.99	85.89	85.39	85.39	85.30	85.58	85.89	86.10	86.33	
Average = ∑(39)1...12/12 =												85.99	(39)
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)													
	1.55	1.55	1.54	1.53	1.53	1.52	1.52	1.52	1.53	1.53	1.54	1.54	
Average = ∑(40)1...12/12 =												1.53	(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	1.87 (42)
Annual average hot water usage in litres per day Vd,average = (25 x N) + 36	78.59 (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)													
	86.45	83.31	80.17	77.02	73.88	70.73	70.73	73.88	77.02	80.17	83.31	86.45	
∑(44)1...12 =												943.13	(44)
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)													
	128.21	112.13	115.71	100.88	96.80	83.53	77.40	88.82	89.88	104.74	114.34	124.16	
∑(45)1...12 =												1236.59	(45)
Distribution loss 0.15 x (45)m													
	19.23	16.82	17.36	15.13	14.52	12.53	11.61	13.32	13.48	15.71	17.15	18.62	(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													

	31.15	28.12	31.12	30.09	31.08	30.06	31.05	31.07	30.08	31.10	30.12	31.14 (61)

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

	159.36	140.25	146.83	130.97	127.87	113.58	108.45	119.89	119.95	135.85	144.46	155.31 (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

	159.36	140.25	146.83	130.97	127.87	113.58	108.45	119.89	119.95	135.85	144.46	155.31

∑(64)1...12 = 1602.77 (64)

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

	50.42	44.31	46.25	41.06	39.95	35.29	33.50	37.30	37.40	42.60	45.55	49.07 (65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	93.46	93.46	93.46	93.46	93.46	93.46	93.46	93.46	93.46	93.46	93.46	93.46	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	14.53	12.91	10.50	7.95	5.94	5.01	5.42	7.04	9.45	12.00	14.01	14.93	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	162.99	164.68	160.42	151.35	139.89	129.13	121.94	120.24	124.51	133.58	145.03	155.80	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	(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)	-74.77	-74.77	-74.77	-74.77	-74.77	-74.77	-74.77	-74.77	-74.77	-74.77	-74.77	-74.77	(71)
Water heating gains (Table 5)	67.76	65.94	62.17	57.03	53.70	49.01	45.02	50.13	51.95	57.26	63.26	65.95	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	299.32	297.57	287.12	270.36	253.57	237.19	226.42	231.46	239.95	256.88	276.34	290.73	(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	
South	0.77	x	11.61	x	46.75	x 0.9 x	0.63	x	0.70	=	165.88	(78)
East	0.77	x	1.32	x	19.64	x 0.9 x	0.63	x	0.70	=	7.92	(76)
South	1.00	x	0.81	x	46.75	x 0.9 x	0.63	x	0.70	=	15.03	(78)

Solar gains in watts ∑(74)m...(82)m

	188.84	311.79	402.95	463.80	490.13	474.48	462.43	444.10	423.95	337.97	224.32	162.84 (83)

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

	488.16	609.36	690.07	734.16	743.71	711.67	688.85	675.56	663.90	594.85	500.67	453.57 (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)	0.94	0.90	0.86	0.80	0.71	0.59	0.47	0.49	0.65	0.81	0.91	0.95	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	18.22	18.63	19.14	19.72	20.24	20.65	20.85	20.83	20.55	19.85	18.92	18.13	(87)

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

19.65	19.65	19.66	19.66	19.66	19.67	19.67	19.67	19.67	19.66	19.66	19.66	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.93	0.89	0.84	0.76	0.66	0.51	0.35	0.38	0.57	0.77	0.89	0.94	(89)

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

16.05	16.63	17.35	18.16	18.87	19.38	19.59	19.57	19.26	18.36	17.05	15.93	(90)

Living area fraction — Living area ÷ (4) = 0.46 (91)

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

17.06	17.56	18.18	18.88	19.50	19.97	20.17	20.15	19.86	19.05	17.92	16.95	(92)

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

16.91	17.41	18.03	18.73	19.35	19.82	20.02	20.00	19.71	18.90	17.77	16.80	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.90	0.85	0.80	0.74	0.65	0.52	0.39	0.41	0.57	0.75	0.86	0.91	(94)
Useful gains, ηmGm, W (94)m x (84)m	438.48	519.98	553.63	539.86	479.70	369.75	265.47	275.69	379.76	444.94	430.98	412.57	(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]	1094.27	1083.99	998.14	845.60	657.38	445.58	292.36	307.44	479.87	712.63	918.33	1087.47	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	487.91	379.01	330.71	220.13	132.20	0.00	0.00	0.00	0.00	199.16	350.89	502.13	

∑(98)1...5, 10...12 = 2602.13 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 46.39 (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 (%) — 93.70 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	520.71	404.50	352.95	234.93	141.08	0.00	0.00	0.00	0.00	212.55	374.48	535.89	

∑(211)1...5, 10...12 = 2777.09 (211)

Water heating

Efficiency of water heater

89.76	89.67	89.53	89.28	88.84	87.00	87.00	87.00	87.00	89.16	89.59	89.80	(217)

Water heating fuel, kWh/month

177.54	156.41	164.00	146.69	143.93	130.56	124.65	137.80	137.88	152.36	161.25	172.95	

∑(219a)1...12 = 1806.02 (219)

Annual totals

Space heating fuel - main system 1 — 2777.09

Water heating fuel — 1806.02

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)		256.62	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	4914.72	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2777.09	x	3.48	x 0.01 =	96.64	(240)
Water heating	1806.02	x	3.48	x 0.01 =	62.85	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	256.62	x	13.19	x 0.01 =	33.85	(250)
Additional standing charges					120.00	(251)
Total energy cost				(240)...(242) + (245)...(254) =	323.23	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.34	(257)
SAP value	81.27	
SAP rating (section 13)	81	(258)
SAP band	B	

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

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	2777.09	x	0.22	=	599.85	(261)
Water heating	1806.02	x	0.22	=	390.10	(264)
Space and water heating			(261) + (262) + (263) + (264) =		989.95	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	256.62	x	0.52	=	133.18	(268)
Total CO_2, kg/year				(265)...(271) =	1162.06	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	20.72	(273)
EI value					84.60	
EI rating (section 14)					85	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	2777.09	x	1.22	=	3388.05	(261)
Water heating	1806.02	x	1.22	=	2203.34	(264)
Space and water heating			(261) + (262) + (263) + (264) =		5591.39	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	256.62	x	3.07	=	787.81	(268)
Primary energy kWh/year					6609.45	(272)
Dwelling primary energy rate kWh/m2/year					117.84	(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	Miss Alicja Kreglewska	Assessor number	4134
Client		Last modified	13/01/2016
Address	92 Fortis Green, London, N2 9EY		

1. Overall dwelling dimensions

		Area (m²)		Average storey height (m)		Volume (m³)	
Lowest occupied		30.13	(1a) x	2.36	(2a) =	71.11	(3a)
+1		25.96	(1b) x	2.64	(2b) =	68.53	(3b)
Total floor area	(1a) + (1b) + (1c) + (1d)...(1n) =	56.09	(4)				
Dwelling volume					(3a) + (3b) + (3c) + (3d)...(3n) =	139.64	(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) =	0.14	(8)

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

Air permeability value, q50, expressed in cubic metres per hour per square metre of envelope area		4.00 (17)
If based on air permeability value, then (18) = [(17) ÷ 20] + (8), otherwise (18) = (16)		0.34 (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) =	0.29 (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	0.37	0.36	0.36	0.32	0.31	0.28	0.28	0.27	0.29	0.31	0.33	0.34	(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

	0.57	0.57	0.56	0.55	0.55	0.54	0.54	0.54	0.54	0.55	0.55	0.56	(24d)

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

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

3. Heat losses and heat loss parameter

Element	Gross area, m²	Openings m²	Net area A, m²		U-value W/m²K		A x U W/K	κ-value, kJ/m².K	A x κ, kJ/K	
Window			12.93	x	1.24	=	15.98			(27)
Roof window			0.81	x	1.24	=	1.00			(27a)
Door			1.89	x	1.30	=	2.46			(26)
Ground floor			30.13	x	0.12	=	3.62			(28a)
External wall			85.59	x	0.20	=	17.12			(29a)
Party wall			5.57	x	0.00	=	0.00			(32)
Roof			24.73	x	0.15	=	3.71			(30)
Total area of external elements ∑A, m²			156.08							(31)

Fabric heat loss, W/K = ∑(A × U) (26)...(30) + (32) = 43.88 (33)

Heat capacity Cm = ∑(A x κ) (28)...(30) + (32) + (32a)...(32e) = N/A (34)

Thermal mass parameter (TMP) in kJ/m²K 100.00 (35)

Thermal bridges: ∑(L x Ψ) calculated using Appendix K 16.70 (36)

Total fabric heat loss (33) + (36) = 60.58 (37)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Ventilation heat loss calculated monthly 0.33 x (25)m x (5)													
	26.23	26.10	25.98	25.41	25.31	24.81	24.81	24.72	25.00	25.31	25.52	25.75	(38)
Heat transfer coefficient, W/K (37)m + (38)m													
	86.81	86.68	86.56	85.99	85.89	85.39	85.39	85.30	85.58	85.89	86.10	86.33	
Average = ∑(39)1...12/12 = 85.99 (39)													
Heat loss parameter (HLP), W/m²K (39)m ÷ (4)													
	1.55	1.55	1.54	1.53	1.53	1.52	1.52	1.52	1.53	1.53	1.54	1.54	
Average = ∑(40)1...12/12 = 1.53 (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 1.87 (42)

Annual average hot water usage in litres per day Vd,average = (25 x N) + 36 78.59 (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)													
	86.45	83.31	80.17	77.02	73.88	70.73	70.73	73.88	77.02	80.17	83.31	86.45	
∑(44)1...12 = 943.13 (44)													
Energy content of hot water used = 4.18 x Vd,m x nm x Tm/3600 kWh/month (see Tables 1b, 1c 1d)													
	128.21	112.13	115.71	100.88	96.80	83.53	77.40	88.82	89.88	104.74	114.34	124.16	
∑(45)1...12 = 1236.59 (45)													
Distribution loss 0.15 x (45)m													
	19.23	16.82	17.36	15.13	14.52	12.53	11.61	13.32	13.48	15.71	17.15	18.62	(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													

31.15	28.12	31.12	30.09	31.08	30.06	31.05	31.07	30.08	31.10	30.12	31.14	(61)

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

159.36	140.25	146.83	130.97	127.87	113.58	108.45	119.89	119.95	135.85	144.46	155.31	(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

159.36	140.25	146.83	130.97	127.87	113.58	108.45	119.89	119.95	135.85	144.46	155.31	

∑(64)1...12 = 1602.77 (64)

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

50.42	44.31	46.25	41.06	39.95	35.29	33.50	37.30	37.40	42.60	45.55	49.07	(65)

5. Internal gains

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Metabolic gains (Table 5)	93.46	93.46	93.46	93.46	93.46	93.46	93.46	93.46	93.46	93.46	93.46	93.46	(66)
Lighting gains (calculated in Appendix L, equation L9 or L9a), also see Table 5	14.53	12.91	10.50	7.95	5.94	5.01	5.42	7.04	9.45	12.00	14.01	14.93	(67)
Appliance gains (calculated in Appendix L, equation L13 or L13a), also see Table 5	162.99	164.68	160.42	151.35	139.89	129.13	121.94	120.24	124.51	133.58	145.03	155.80	(68)
Cooking gains (calculated in Appendix L, equation L15 or L15a), also see Table 5	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	32.35	(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)	-74.77	-74.77	-74.77	-74.77	-74.77	-74.77	-74.77	-74.77	-74.77	-74.77	-74.77	-74.77	(71)
Water heating gains (Table 5)	67.76	65.94	62.17	57.03	53.70	49.01	45.02	50.13	51.95	57.26	63.26	65.95	(72)
Total internal gains (66)m + (67)m + (68)m + (69)m + (70)m + (71)m + (72)m	299.32	297.57	287.12	270.36	253.57	237.19	226.42	231.46	239.95	256.88	276.34	290.73	(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	
South	0.77	x	11.61	x	46.75	x 0.9 x	0.63	x	0.70	=	165.88	(78)
South	1.00	x	0.81	x	46.75	x 0.9 x	0.63	x	0.70	=	15.03	(78)
West	0.77	x	1.32	x	19.64	x 0.9 x	0.63	x	0.70	=	7.92	(80)

Solar gains in watts ∑(74)m...(82)m

188.84	311.79	402.95	463.80	490.13	474.48	462.43	444.10	423.95	337.97	224.32	162.84	(83)

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

488.16	609.36	690.07	734.16	743.71	711.67	688.85	675.56	663.90	594.85	500.67	453.57	(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)	0.94	0.90	0.86	0.80	0.71	0.59	0.47	0.49	0.65	0.81	0.91	0.95	(86)
Mean internal temp of living area T1 (steps 3 to 7 in Table 9c)	18.22	18.63	19.14	19.72	20.24	20.65	20.85	20.83	20.55	19.85	18.92	18.13	(87)

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

19.65	19.65	19.66	19.66	19.66	19.67	19.67	19.67	19.67	19.66	19.66	19.66	(88)

Utilisation factor for gains for rest of dwelling n2,m

0.93	0.89	0.84	0.76	0.66	0.51	0.35	0.38	0.57	0.77	0.89	0.94	(89)

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

16.05	16.63	17.35	18.16	18.87	19.38	19.59	19.57	19.26	18.36	17.05	15.93	(90)

Living area fraction — Living area ÷ (4) = 0.46 (91)

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

17.06	17.56	18.18	18.88	19.50	19.97	20.17	20.15	19.86	19.05	17.92	16.95	(92)

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

16.91	17.41	18.03	18.73	19.35	19.82	20.02	20.00	19.71	18.90	17.77	16.80	(93)

8. Space heating requirement

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Utilisation factor for gains, ηm	0.90	0.85	0.80	0.74	0.65	0.52	0.39	0.41	0.57	0.75	0.86	0.91	(94)
Useful gains, ηmGm, W (94)m x (84)m	438.48	519.98	553.63	539.86	479.70	369.75	265.47	275.69	379.76	444.94	430.98	412.57	(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]	1094.27	1083.99	998.14	845.60	657.38	445.58	292.36	307.44	479.87	712.63	918.33	1087.47	(97)
Space heating requirement, kWh/month 0.024 x [(97)m - (95)m] x (41)m	487.91	379.01	330.71	220.13	132.20	0.00	0.00	0.00	0.00	199.16	350.89	502.13	

∑(98)1...5, 10...12 = 2602.13 (98)

Space heating requirement kWh/m²/year — (98) ÷ (4) = 46.39 (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 (%) — 93.70 (206)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
Space heating fuel (main system 1), kWh/month	520.71	404.50	352.95	234.93	141.08	0.00	0.00	0.00	0.00	212.55	374.48	535.89	

∑(211)1...5, 10...12 = 2777.09 (211)

Water heating

Efficiency of water heater

89.76	89.67	89.53	89.28	88.84	87.00	87.00	87.00	87.00	89.16	89.59	89.80	(217)

Water heating fuel, kWh/month

177.54	156.41	164.00	146.69	143.93	130.56	124.65	137.80	137.88	152.36	161.25	172.95	

∑(219a)1...12 = 1806.02 (219)

Annual totals

Space heating fuel - main system 1 — 2777.09

Water heating fuel — 1806.02

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)		256.62	(232)
Total delivered energy for all uses	(211)...(221) + (231) + (232)...(237b) =	4914.72	(238)

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

	Fuel kWh/year		Fuel price		Fuel cost £/year	
Space heating - main system 1	2777.09	x	3.48	x 0.01 =	96.64	(240)
Water heating	1806.02	x	3.48	x 0.01 =	62.85	(247)
Pumps and fans	75.00	x	13.19	x 0.01 =	9.89	(249)
Electricity for lighting	256.62	x	13.19	x 0.01 =	33.85	(250)
Additional standing charges					120.00	(251)
Total energy cost			(240)...(242) + (245)...(254) =		323.23	(255)

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

Energy cost deflator (Table 12)	0.42	(256)
Energy cost factor (ECF)	1.34	(257)
SAP value	81.27	
SAP rating (section 13)	81	(258)
SAP band	B	

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

	Energy kWh/year		Emission factor kg CO_2/kWh		Emissions kg CO_2/year	
Space heating - main system 1	2777.09	x	0.22	=	599.85	(261)
Water heating	1806.02	x	0.22	=	390.10	(264)
Space and water heating			(261) + (262) + (263) + (264) =		989.95	(265)
Pumps and fans	75.00	x	0.52	=	38.93	(267)
Electricity for lighting	256.62	x	0.52	=	133.18	(268)
Total CO_2, kg/year				(265)...(271) =	1162.06	(272)
Dwelling CO_2 emission rate				(272) ÷ (4) =	20.72	(273)
EI value					84.60	
EI rating (section 14)					85	(274)
EI band					B	

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

	Energy kWh/year		Primary factor		Primary Energy kWh/year	
Space heating - main system 1	2777.09	x	1.22	=	3388.05	(261)
Water heating	1806.02	x	1.22	=	2203.34	(264)
Space and water heating			(261) + (262) + (263) + (264) =		5591.39	(265)
Pumps and fans	75.00	x	3.07	=	230.25	(267)
Electricity for lighting	256.62	x	3.07	=	787.81	(268)
Primary energy kWh/year					6609.45	(272)
Dwelling primary energy rate kWh/m2/year					117.84	(273)