Thornley & Lumb

Stephenson Way Euston

Energy Strategy

Project

Stephenson Way Euston

Document

Energy Strategy

Client

Churchgate

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Executive Summary

This Energy Strategy produced by Thornley & Lumb on behalf of Churchgate details aspects of sustainable building design relating to energy and carbon emissions of the proposed Student Accommodation development on Stephenson Way in Euston. The building fabric first design philosophy and efficient building services analysis are combined with the available Low and Zero Carbon LZC technology to provide a methodology for achieving a sustainable low energy use development. This process is illustrated by following the Energy Hierarchy which details the measures included at each stage. The Energy Hierarchy helps qualify the carbon emissions due to various measures by reporting the emission reductions at each stage.

The current target for carbon emissions of new-build non-domestic developments in London is a 35% reduction in carbon emissions when compared to the Part L 2013 Baseline building (gas boilers providing heating). The measures included are detailed below with the results of the energy modelling and details of carbon reduction given in the Chart below.

Be Lean Measures

- Low external envelope u-values with green roof
- Low air permeability
- Natural ventilation to studio bedrooms
- Low energy LED lighting
- Low energy bathroom ventilation system dMEV with trickle ventilation

Be Clean Measures

- Provision for future connection to a heat network

Be Green Measures

- High efficiency CO_2 Heat Pump for hot water services HWS
- Solar PV on site renewable electricity generation 10 kW

These measures enable the development to achieve a 40% reduction in carbon emissions using Part L carbon emissions factors (the reduction will increase using SAP 10 carbon factors which reflect realistic carbon emissions of grid electricity).

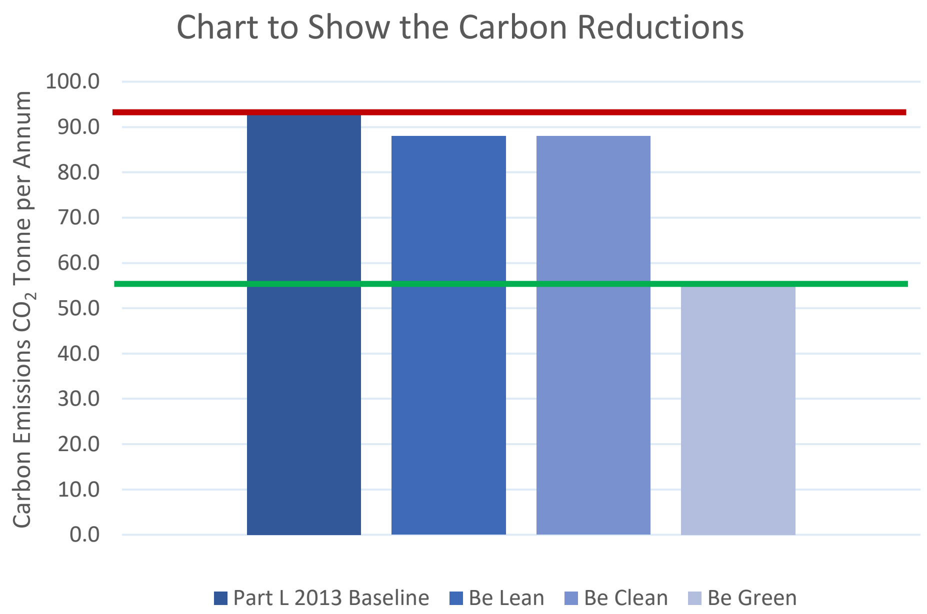


Chart to show the overall carbon reductions of the proposed development

Carbon Dioxide Emissions Per Annum for non-domestic Buildings

	Regulated CO_2 Tonnes CO_2 per annum	Unregulated CO_2 Tonnes CO_2 per annum
Baseline Part L (2013)	93.2	51.9
Including Be Lean Measures	88.0	51.9
Including Be Clean Measures	88.0	51.9
Including Be Green Measures	55.8	51.9

Regulated Carbon Dioxide Savings Per Annum for non-domestic Buildings

	Tonnes CO_2 Per annum	Percentage Reduction %
Savings from Be Lean Measures	5.3	5.6%
Savings from Be Clean Measures	0.0	0%
Savings from Be Green Measures	32.2	36.6%
Reduction Compared to Baseline	37.4	40.1%
Annual Deficit / Contribution £	0.0	£0

Contents

1.0 Introduction

The proposed development on Stephenson Way in Euston will consist of a seven-storey building plus basement for dual student accommodation (C2) and hotel (C1) use. The development will involve 78 rooms of accommodation on the upper floors with shared amenity space at ground level and basement level storage. In addition, the development will be designed to retain vehicular easement from Stephenson Way to the rear of 222 Euston Road.

The proposed development will be designed with sustainability as the principle design metric and accordingly this Energy Strategy will detail how energy usage and carbon emission have been minimised using the energy hierarchy, as developed by the Greater London Authority GLA and detailed in the document “Guidance on Preparing Energy Assessments”.

The carbon reductions detailed in this energy strategy have been calculated using Part L accredited compliance dynamic simulation modelling DSM software IES VE Compliance DSM. This ensures that the proposed development’s carbon emissions have been calculated using a more sophisticated carbon calculations methodology, as opposed to the less sophisticated standard SBEM methodology. Accordingly, this Energy Strategy will detail how the proposed development will be a low carbon sustainable development by following the four energy strategy design principles as detailed in Section 1.1 Sustainable Low Carbon Design.

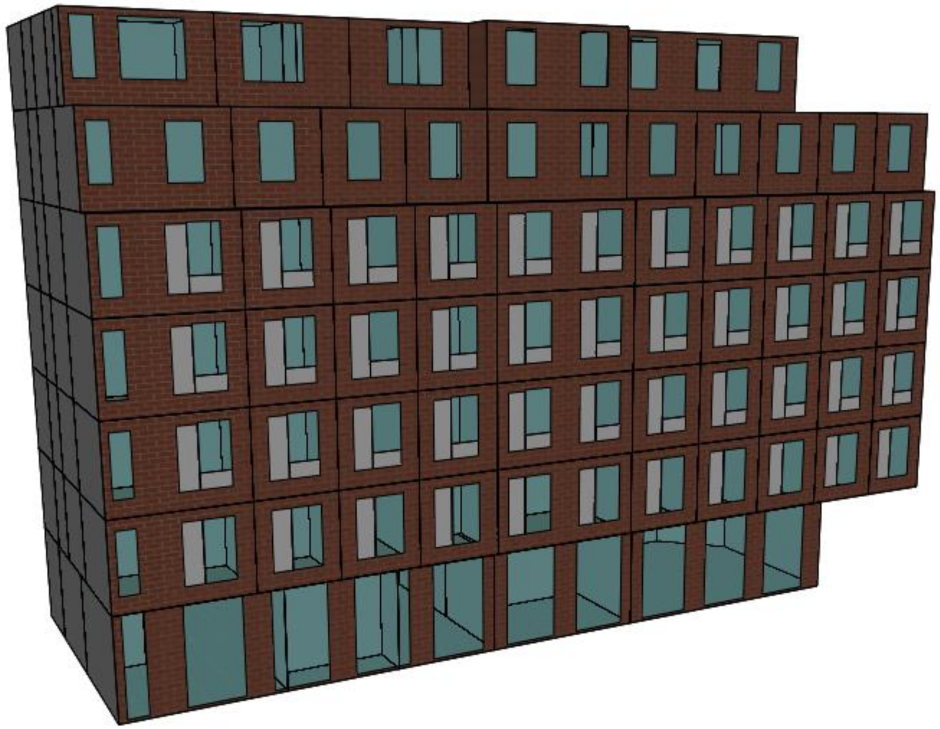


Figure 1.0 Image to show the proposed development building energy model

1.1 Sustainable Low-Carbon Design

Thornley and Lumb will consider the sustainability of the proposed development and the building's energy usage throughout the design process by developing an energy strategy design philosophy. This will consist of four underling design principles which will be implemented to ensure the sustainability of the proposed development. The principles used to develop the energy strategy are: reduce demand, meet demand efficiently, supply from low carbon sources, supply from renewables.

Energy Strategy Design Principles

Reduce Demand

The energy demand of the building is intrinsically linked to the design of the building envelope and its services. Therefore, ensuring a thermally efficient and relatively air tight building envelope will enable reduction in energy usage.

Meet Demand Efficiently

The application of building services which improve upon the minimum efficiencies detailed in the government's document the Non-Domestic Building Services Compliance Guide NDBSCG, will ensure that where energy is used for servicing the building, it is used efficiently with minimal wastage.

Supply from Low Carbon Sources

Where energy is used to service the building, the carbon emissions of the source will be taken into account as part of the design process. This involves using carbon factors of energy sources to calculate potential carbon emissions.

Supply from Renewable Sources

The further reduction of carbon emissions will be met with energy supply from renewable sources. These are zero carbon energy sources which provide servicing for the building without increasing the carbon emissions of the building.

2.0 Design Considerations

This section discusses the design considerations for the proposed Student Accommodation development on Stephenson Way in Euston. This section will detail the design methodology and detail the planning criteria established by national and local policy.

2.1 Design Methodology

The energy usage figures used in this Energy Strategy have all been calculated using industry recognised software. The geometry of the building is modelled in the software and then all fixed building service efficiencies are integrated with the model to provide energy usage figures.

2.1.1 Energy Modelling Software

The IES VE software is dynamic building simulation modelling DSM application which includes industry standard thermal modelling and Part L compliance software. The IES VE uses local climate weather data for the specific locations and then combines these with the building geometry and fixed building services efficiencies to calculate an hourly annual analysis of the building's energy usage.

2.1.2 Carbon Emissions Calculations

Following annual energy rate calculations, the carbon factors for each fuel type then allow for a prediction of the annual carbon emission of the development. The carbon factors currently used in Part L are detailed in the Standard Assessment Procedure SAP 2012 documents. Given that the carbon factors haven't been updated in recently years following the reduction in coal electricity generation and increase in renewable energy sources, it is likely the calculations will overestimate carbon emissions generated by electrical equipment.

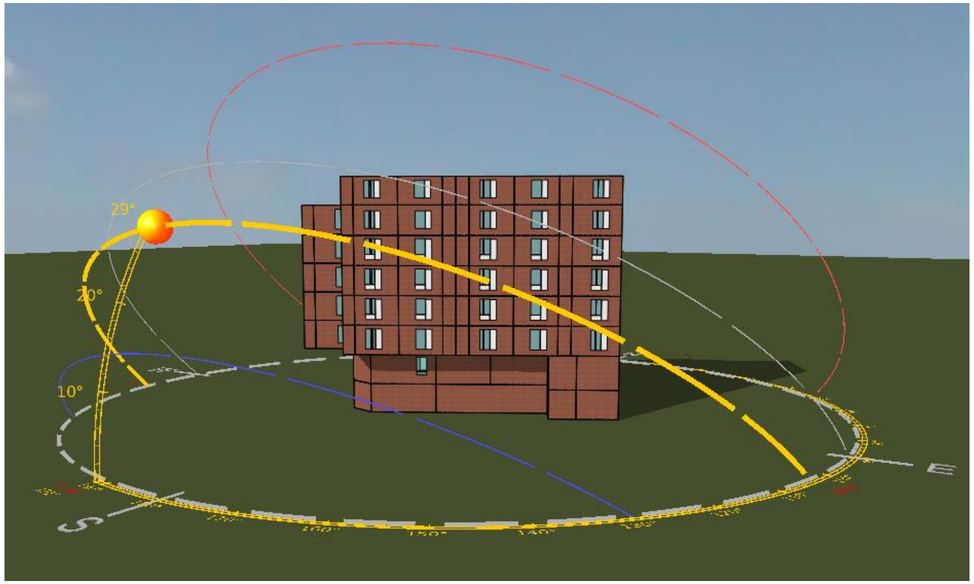


Figure 2.0 Image to show the orientation of the building in energy modelling software IES VE

2.2 National Planning Policy

The National Planning Policy Framework NPPF was most recently published in March 2012. The document details that the purpose of planning is "to help achieve sustainable development". Applications for planning permission are determined in accordance with the development plan and local planning policy. The National Planning Policy Framework states that there are three dimensions to achieving sustainable development.

Economic

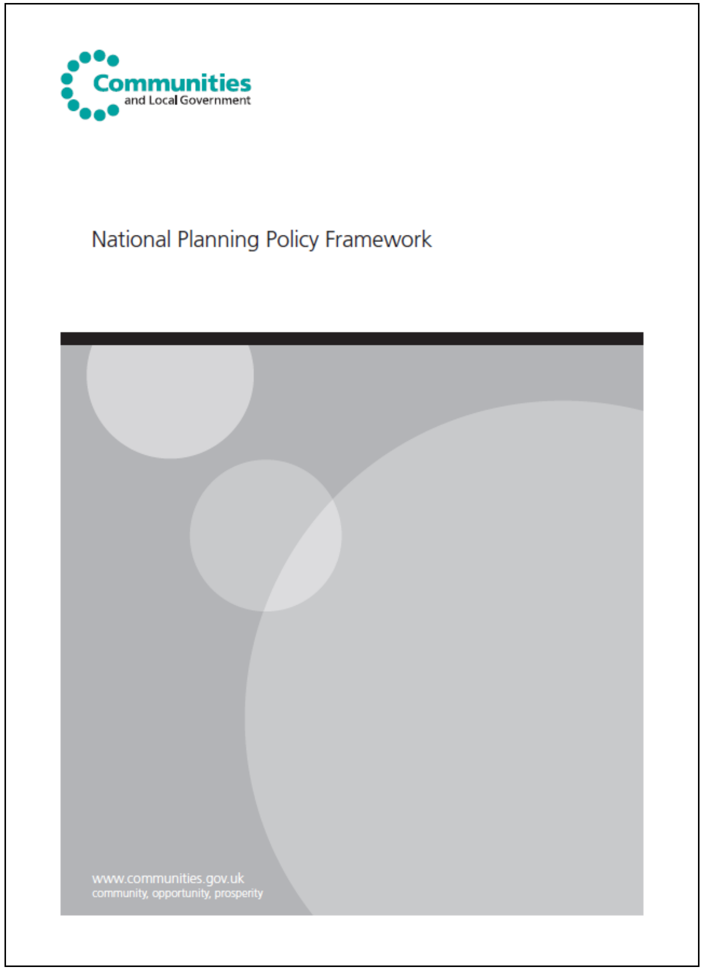
Contributing to building a strong, responsive and competitive economy, by ensuring that sufficient land of the right type is available in the right places and at the right time to support growth and innovation; and by identifying and coordinating development requirements, including the provision of infrastructure.

Social

Supporting strong, vibrant and healthy communities, by providing the supply of housing required to meet the needs of present and future generations; and by creating a high quality built environment, with accessible local services that reflect the community's needs and support its health, social and cultural well-being;

Environmental

Contributing to protecting and enhancing our natural, built and historic environment; and, as part of this, helping to improve biodiversity, use natural resources prudently, minimise waste and pollution, and mitigate and adapt to climate change including moving to a low carbon economy.



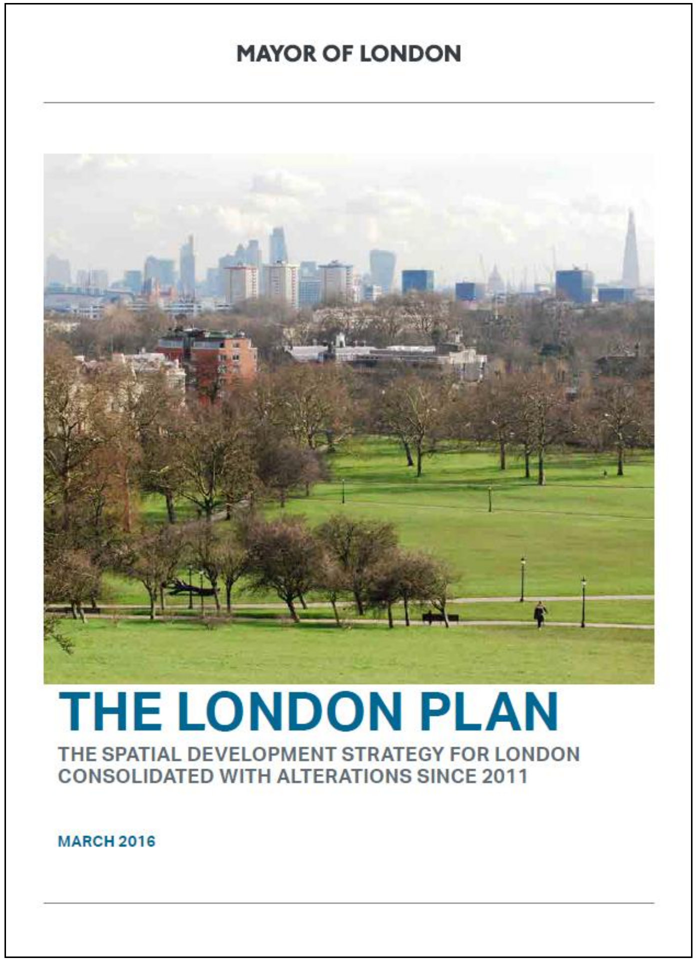
2.3 Local Planning Policy

2.3.1 The London Plan

The City of London has a very progressive spatial development strategy which includes detailed energy and carbon policy defined as The London Plan. The strategic planning in the capital is the shared responsibility of the Mayor of London and the 32 London boroughs. The Greater London Authority GLA and the Mayor have developed a spatial development strategy SDS. The aim of The London Plan is to provide integrated economic, environmental, transport and social framework for the development of London over the next 20-25 years.

The energy and carbon requirements of The London Plan are detailed in Chapter 5 London's Response to Climate Change. Policy 5.2 Minimising Carbon Dioxide Emissions, coupled with GLA's guidance on preparing energy assessments, requires all new-build non-domestic developments to reduce carbon emissions by 35% against the Part L 2013 Baseline.

The Greater London Authority Guidance on Preparing Energy Assessments details the GLA's expectation that all non-domestic developments seek to achieve a 35% reduction in carbon emission against the Part L 2013 baseline. The document details the Energy Hierarchy which states how the carbon reduction needs to be reported at each stage Be Lean, Be Clean, Be Green. The London Plan and Guidance on Preparing Energy Assessments therefore both define the requirements and metrics for this Energy Strategy.


MAYOR OF LONDON

THE LONDON PLAN

THE SPATIAL DEVELOPMENT STRATEGY FOR LONDON CONSOLIDATED WITH ALTERATIONS SINCE 2011

MARCH 2016

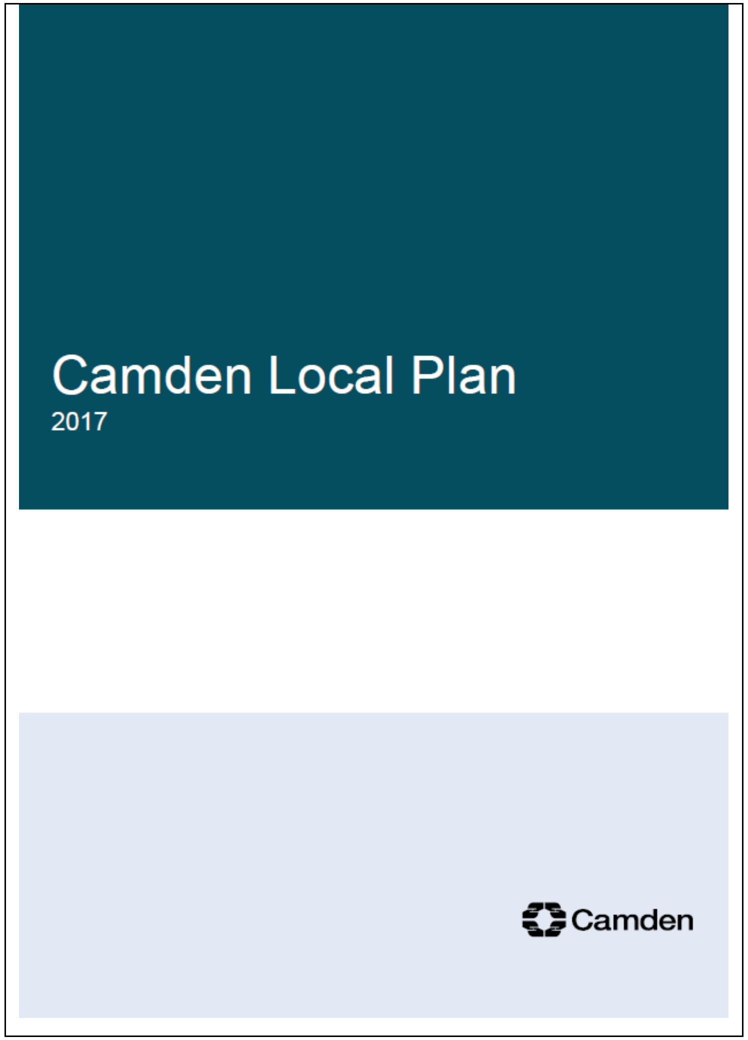
2.3.2 Camden Local Plan

The Brough of Camden has developed The Camden Local Plan which sets out the Council's planning policies. The Camden Local Plan details the borough's planning policies from 2016 to 2031 this is summarised into three objectives.

1. Developing new solutions with partners to reduce inequality and improve health and wellbeing
2. Create conditions for and harnessing the benefits of economic growth
3. Investing in our communities to ensure sustainable neighbourhood

The Camden Local Plan aims to tackle the causes of climate change in the borough by ensuring developments use less energy and assess the feasibility of decentralised energy and renewable energy technologies. Camden Council will require all developments to minimise the effects of climate change by to following:

i. Require all developments to reduce carbon emissions via steps in the energy hierarchy.
ii. Require all development to demonstrate how London Plan targets for carbon emissions have been met
iii. Expect all developments to optimise resource efficiently.


Camden Local Plan
2017
Camden

3.0 Be Lean: Reducing Energy Demand

Consideration of energy usage is an integral part of any proposed Accommodation and each aspect of the Low Energy Building Design includes methods of conserving energy and promoting sustainability. This section of the Energy Strategy looks at how demand has been reduced by the minimum required efficiency defined by building regulations, known as the 'limiting parameter'. This minimum efficiency or limiting parameter is then compared with the Low Energy Building Design to assess the energy use of proposed Accommodation development on Stephenson Way in Euston.

3.1 Building Envelope and Fabric

The energy usage of a building is intrinsically linked to the efficiency of the building envelope design, accordingly this section details how energy use is minimised by following energy strategy design principles in Section 1.1 and using a Passivhaus influenced fabric first design philosophy. The reduction of heat loss through the building fabric is the most effective method of passively reducing energy usage. Building services will be replaced multiple times over the life of the building but it is less likely that the building fabric will be upgraded. Therefore, the reduction of u-value and the adoption of the Passivhaus design philosophy is the most effective method of reducing energy usage and carbon emissions over the full life cycle of the building.

In addition to low u-value the development will also incorporate a green roof to minimise heat loss and impact on the environment.

3.1.1 Thermal Properties of Building Fabric

The energy usage of the building services associated with controlling the space temperature is dependent on the building envelope. The efficiency of the building envelope significantly affects energy usage as this is essentially a measure of how efficiently the internal building environment is thermally isolated form the external environment. The more efficient the isolation of internal from external environment, the less energy will be required for use in servicing the internal environment to meet optimum comfort levels. The proposed green roof will also limit heat loss through the roof of the development reducing energy and carbon emissions.

3.1.2 Thermal Bridging

The proposed development had been designed to use accredited construction details ACD which will limit thermal bridging and reduce heat loss through the building envelope.

	Limiting Fabric Parameters $W\ m^{-2}\ k^{-1}$	Low Energy Design Parameters $W\ m^{-2}\ k^{-1}$	Percentage Improvement %
Roof	0.25	0.10	60
External Walls	0.35	0.19	46
Ground Floor	0.25	0.15	40
External Glazing	2.20	1.6	27

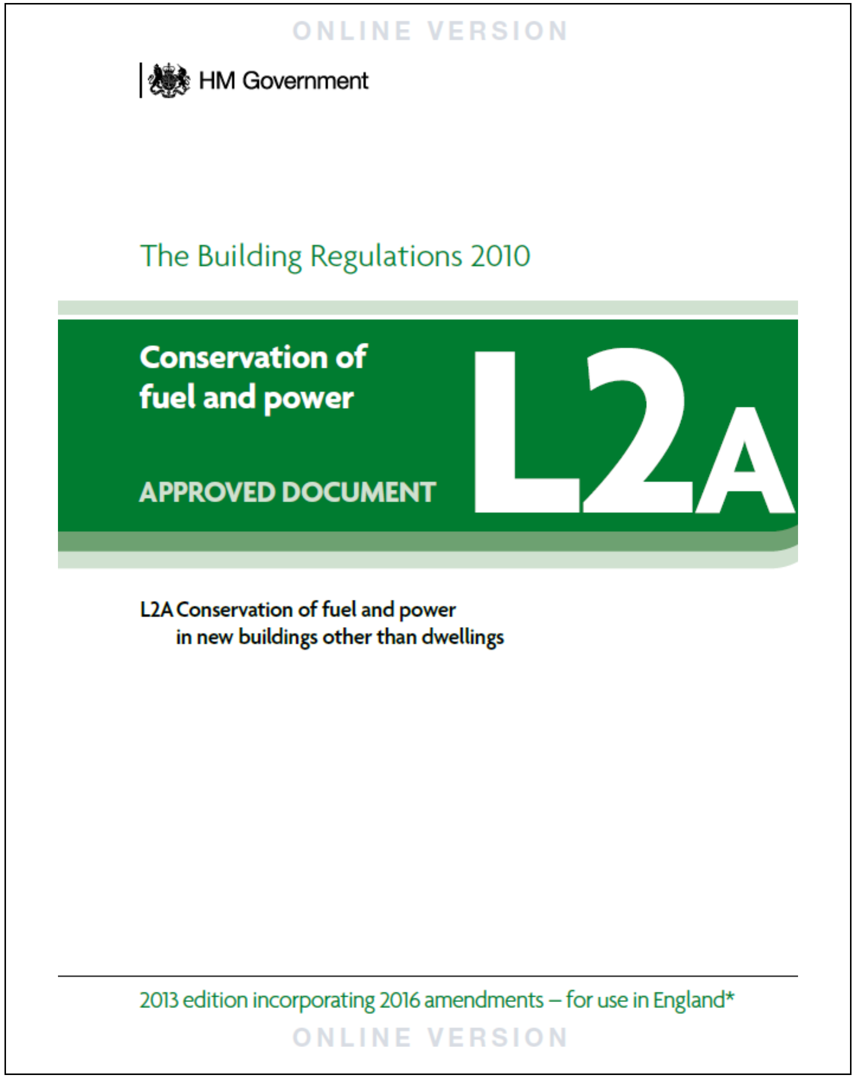
Table 3.1.1: Table comparing the limiting fabric from Part L2A of the building regulations with the proposed Low Energy Design

3.1.3 Air-Tightness of Structure

The energy usage of the building services associated with controlling internal environment are heavily dependent on the air-tightness of the building, which is essentially a measure of how efficient the building envelope is at resisting ingress of air from the external environment. Any ingress of air from the external environment will need to be conditioned by the building services to ensure the internal environment stays at the optimum level of comfort. Accordingly, the reduction in air permeability and thereby external air ingress will reduce the demand upon the building services conditioning the area and proportionally reduce energy usage.

	Limiting Air Permeability $m^3 hr^{-1} m^{-2}$	Low Energy Design Permeability $m^3 hr^{-1} m^{-2}$	Percentage Improvement %
Air Permeability	10.0	3.0	70

Table 3.1.2: Table comparing the limiting air permeability from Part L2A with the proposed Low Energy Design.



3.1.4 Natural Ventilation

The proposed accommodation development on Stephenson Way in Euston has been designed to use passive natural ventilation to improve Indoor Air Quality IAQ by providing 'fresh' air to occupants.

The openable panel provided for purposes of natural ventilation has been sized to exceed what is required in Building Regulations Part F. The minimum allowed by building regulations is 1/20th (5%) of the floor area of the space. However, the openable panel proposed will exceed this allowing for greater air flow and more flexibility in managing IAQ and internal summer temperatures.

The natural ventilation of the space will ensure the IAQ and summer temperatures are managed passively. The bathroom spaces also have trickle ventilation and a decentralised mechanical ventilation dMEV system which is designed to provide fresh air to the space and ensure occupant comfort throughout the year. The flow rate and SFP of the ventilation system has been selected to minimise energy usage and provide 'background' ventilation to ensure occupant comfort.

	Limiting Specific Fan Power SFP $W\ l^{-1}\ s^{-1}$	Low Energy Design SFP $W\ l^{-1}\ s^{-1}$	Percentage Improvement %
Specific Fan Power SFP	0.5	0.25	50

Table 3.1.3 Table comparing the limiting specific fan power with the proposed Low Energy Design

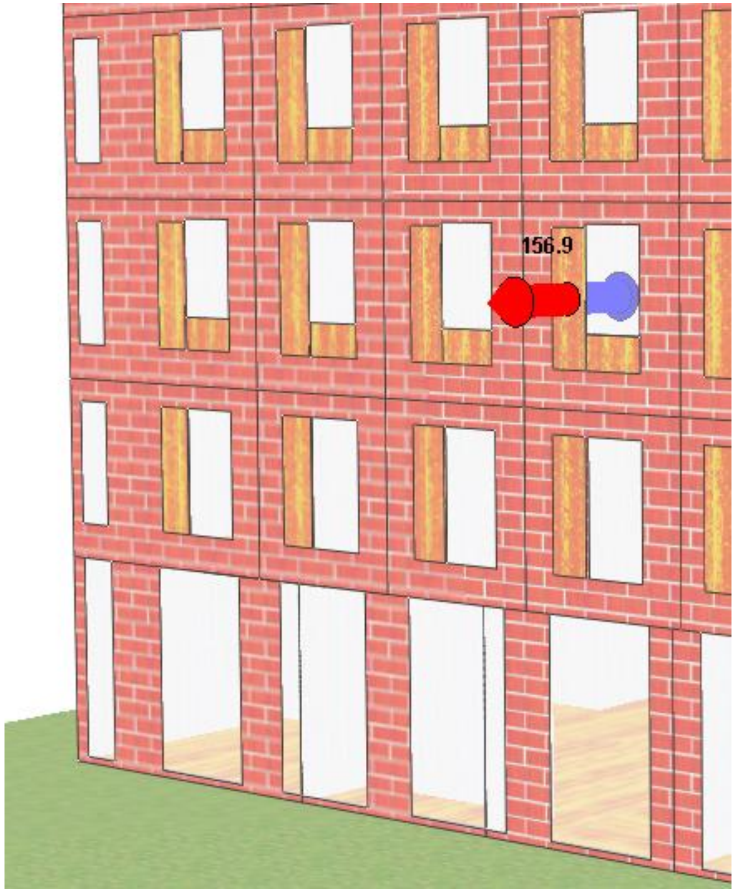


Figure 3.1.3 Figure to show the inlet and outlet flow of naural ventlation for a bedroom

3.2.2 Low Energy Lighting, Control & Metering

The energy required to illuminate the spaces of the development can be minimised by using low energy LED light fittings that minimise the energy and carbon emission used in artificial lighting. The artificial lighting has also been designed to incorporate lighting controls which will ensure that no electricity used for artificial lighting is wasted.

The lighting controls

- Bedroom, bathrooms – auto on/off control
- Corridor & Stairs – auto on/off control
- Laundry – auto on/off control
- Public Toilet – auto on/off control

	Limiting Lumens per Circuit Watt $Lm.W^{-1}$	Low Energy Deign Value $Lm.W^{-1}$	Percentage Improvement %
Lighting Efficiency	60	110	83

Table 3.2.2 Table comparing the limiting lighting efficiency with the proposed Low Energy Design Value

Provision for Metering

- Meter 90% of all annual energy consumption and 100% of generation by renewables in accordance with TM39 Building Energy Metering.
- Metering to include auto M&T as per TM46 Energy Benchmarks.

4.0 Overheating Risk Analysis

The potential for over overheating is generally increasing in modern buildings because of a contribution of rising ambient temperatures due to anthropogenic climate change and increased building envelope performance. Accordingly, each new development should be assessed for overheating risk.

The proposed development on Stephenson Way in Euston has been modelled using building physics simulation software IES VE. This is a separate simulation model created specifically for assessing overheating risk. The simulation model shows overheating risk can be mitigated through the application of Passive and Active Measures as detailed below.

Building Fabric Measures

- Low external element u-values preventing excessive heat conduction through the fabric in high ambient temperatures
- Low window g-value of 0.4 which will prevent excessive solar gains
- Glazing percentage of the building is 13%

Passive Measures

- Natural ventilation via openable insulated panels
- Internal blinds applied to glazing to minimise solar gains
- Glazing to have fixed panes and insulated openable panels as separate sections, to ensure the blinds do not prevent air movement
- Low internal gains via specification of low energy small power equipment

Active Measures

- The bedrooms have been designed with trickle ventilation and decentralised mechanical ventilation system dMEV to remove excessive internal gains during periods of high ambient temperature.

Figure 4.1 to show the air flow rates due to the natural ventilation of bedrooms

4.1 CIBSE TM52 Calculations

The proposed development is required to comply with CIBSE TM52 overheating calculations to determine overheating risk in naturally ventilated buildings. CIBSE TM52 assesses overheating risk using three parameters (as per the below). The building will be assessed using Category II normal expectation with the DSY weather file for London, including typical people, equipment and lighting gains.

	TM52 Calculation Requirement
Criterion 1 (C1)	The first criterion sets a limit for the number of hours that the operative temperature can exceed the threshold comfort temperature (upper limit of the range of comfort temperature) by 1 K or more during the occupied hours of a typical non-heating season (1st May to 30th September).
Criterion 2 (C2)	The second criterion deals with the severity of overheating within any one day, which can be as important as its frequency, the level of which is a function of both temperature rise and its duration. This criterion sets a daily limit for acceptability.
Criterion 3 (C3)	The third criterion sets an absolute maximum daily temperature for a room, beyond which the level of overheating is unacceptable.

The results of the TM52 calculations show that all 78 bedrooms in the development pass the overheating risk test. The worst-case rooms are given in the table below, these results illustrate how the worst-case rooms pass the TM52 calculation therefore qualifying the overheating risk.

Room Ref	C1	C2	C3	Result
5F Threedio 01 TH05	1.1	21	3	Pass
5F Threedio 02 TH05	1.5	23	3	Pass
5F Threedio 03 TH05	1.4	23	3	Pass
5F Microstudio MS01	0.9	19	3	Pass
5F Microstudio MS02	0.8	15	3	Pass
5F Microstudio MS03	0.8	17	3	Pass
5F Microstudio MS04	1	19	3	Pass
5F Microstudio MS05	0.8	18	3	Pass
5F Microstudio MS06	0.8	17	3	Pass
5F Microstudio MS07	0.9	20	3	Pass
5F Microstudio MS08	0.8	20	3	Pass
5F Microstudio MS09	0.8	20	3	Pass
5F Microstudio MS10	0.8	20	3	Pass
5F Studio UA DS05	0.7	14	2	Pass
6F Microstudio MS01	0.7	17	3	Pass
6F Microstudio MS02	0.8	20	3	Pass
6F Microstudio MS03	0.8	20	3	Pass
6F Microstudio MS04	0.8	20	3	Pass
6F Microstudio MS05	0.8	20	3	Pass
6F Studio MS01	0.7	15	3	Pass

5.0 Be Clean: Analysis of Decentralised Energy

The London Plan details the Mayor's expectation that 25% of the future heat and power will be provided by decentralised systems by 2025. Decentralising the energy supply will improve the robustness of the power to the city by placing less reliance on the grid. As the carbon factor of grid electricity decreases an increased demand will be placed on the grid for low carbon electricity. This could potentially cause issues with supply and as such the Mayors expectation is designed to future proof the City's supply.

5.1 Heat Distribution Network

The proposed student accommodation development will have an energy demand for hot water services throughout the year. This consistent requirement for thermal energy for hot water services could be supplied by a heat network. The Figure 5.1 is taken from The London Heat Map which details potential heat networks around the city. The London Heat Map does identify a potential network 'Euston Road' running from St Pancreas down past Euston station along Euston Road.
Given that there is potential for a district heating network in the area the proposed accommodation development on Stephenson Way in Euston will provide provision for a future connection, this will enable the space heating and hot water services to be connected to a future heat network.

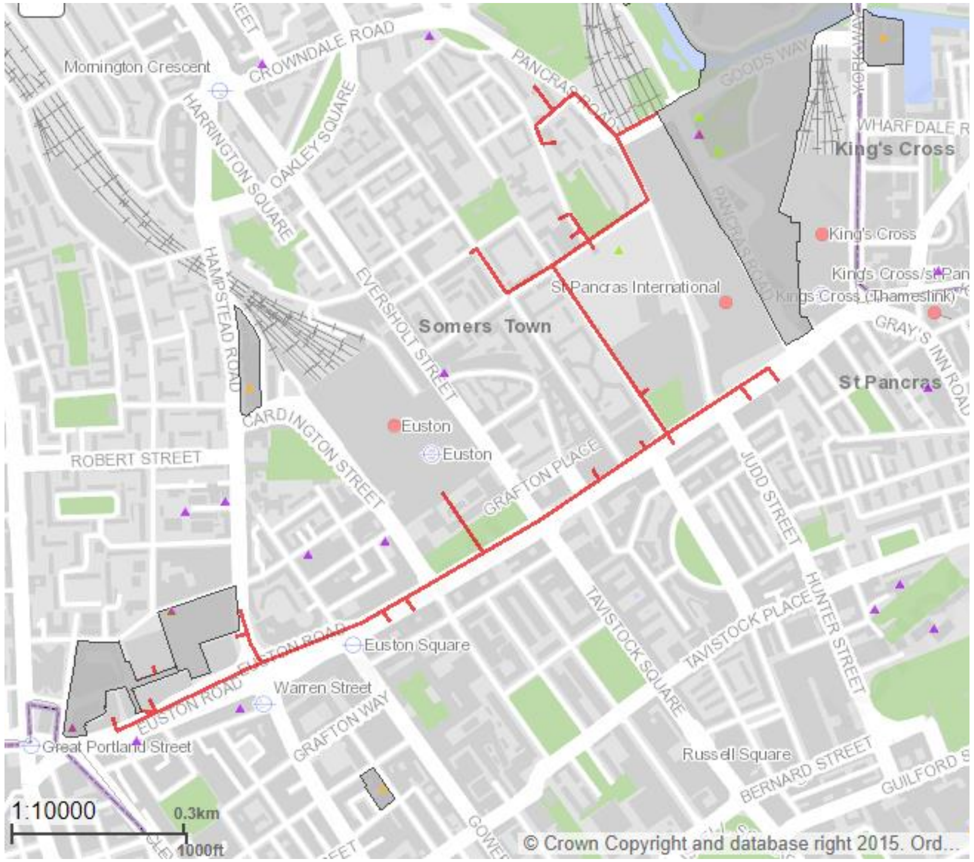


Figure 5.1 to show the proposed heat networks in the area

5.2 Existing Heat Network

The proposed development is in a prime central location in London City Centre near Euston Road however when looking at the London Heat Map no current existing heat networks are operating in the area.

The nearest heat networks to the site are the Citigen network operated by EON which is a significant distance from the site, however EON have been contacted to confirm the feasibility of a connection to the Citigen network.

The financial viability of a connection to the network is directly related to the distance the heat pipes must run on order to provide the proposed development with thermal energy generated by the centralised plant. The heat network to the South is the Existing Whitehall network which is currently 3 km from the proposed development on Stephenson Way in Euston. This would require an investment of £1.0M to £1.5M which will not be finically viable for the District Energy Network Operator.

Similarly, the connection to the Citigen network is approximately 4 km distance from the proposed development on Stephenson Way. The Citigen network would need an investment of 1.5M to 2.0M to supply the proposed development which is again unfortunately not financially viable for this project.

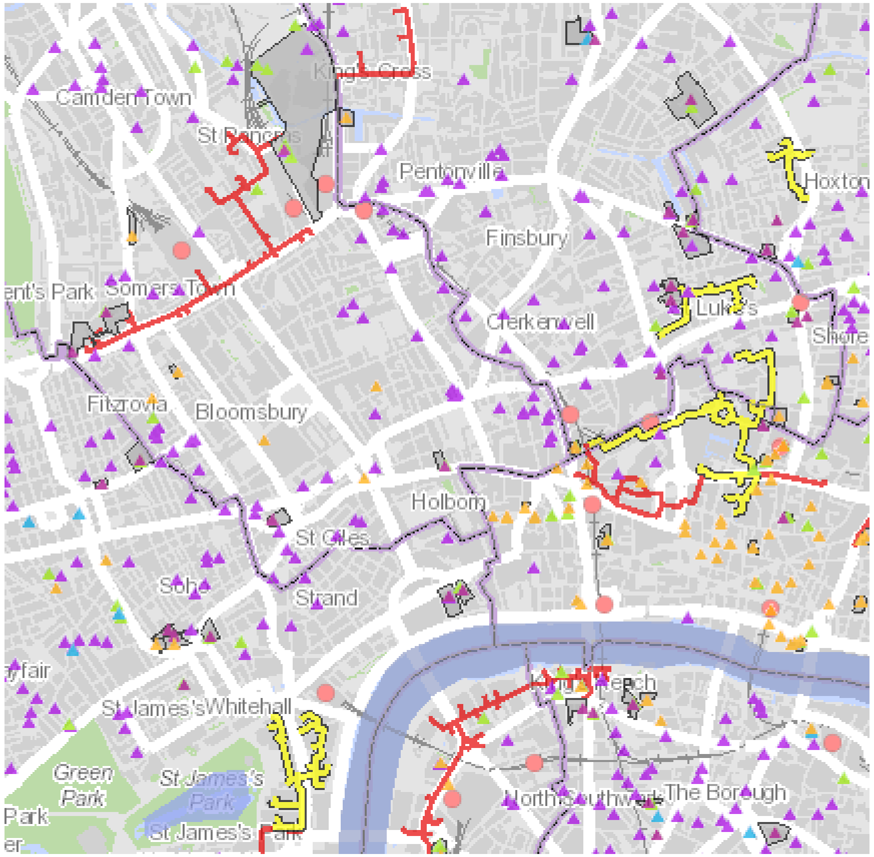


Figure 5.2 tob show the location of the existing heat netwroks in the area

5.3 Future Heat Network

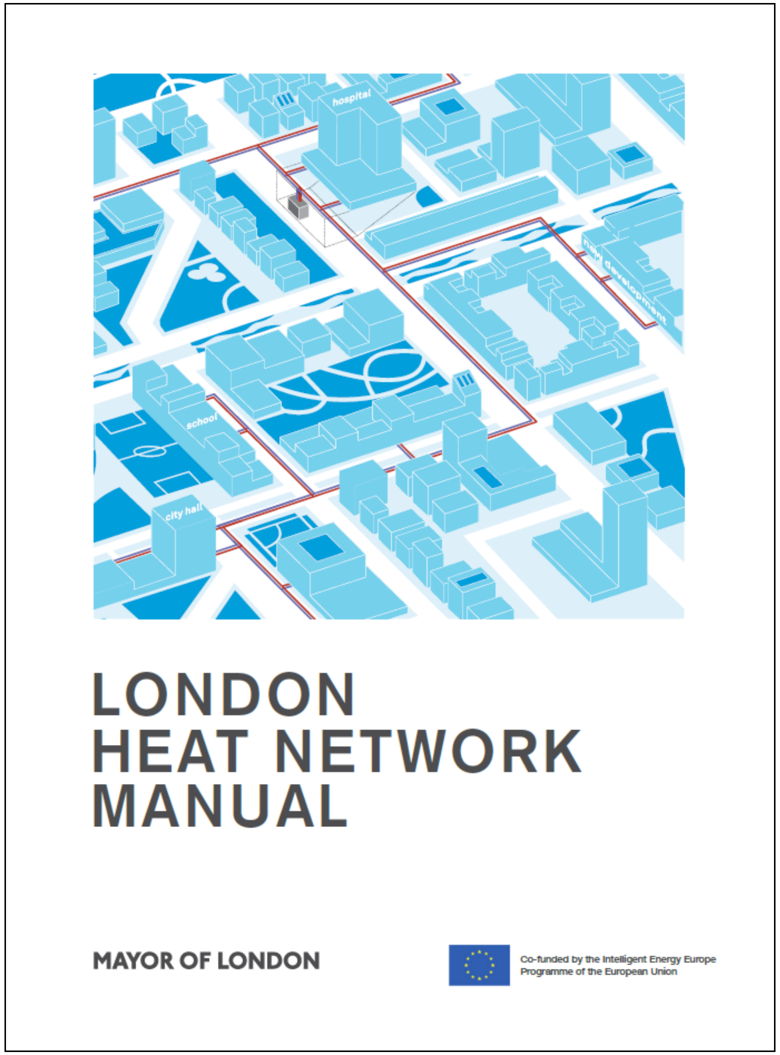
The proposed development will facilitate future connection to a heat network by incorporating architectural and building services strategy design improvements. The design improvements will minimise the impact of a future heat network connection works required in the existing building, thereby making the switch to a district heating network less costly and less disruptive.

- The future heat network will supply heating energy to the development via district heating mains pipes. These pipes will need to be brought into the existing plant room to a plate heat exchanger which will enable the space heating to be provided via the district heating network.

- The future routes of the heat network mains will be brought in to the development will be safeguarded. In addition isolation valves will be installed on the hot water services pipework to enable connection of a future district heat network to a plate heat exchanger in the plantroom.

- The trigger for connecting to a wider network will be the availability of a network in the area followed by a life cycle cost analysis.

- The London Heat Network Manual will be used as a design guide to facilitate the future connection to a heat network.



6.0 Be Clean: Analysis of Renewable Technology

6.1 Analysis of Available Renewable Technology

The available renewable technology which will be considered for the proposed accommodation development on Stephenson Way in Euston is detailed in the table below, along with potential benefits and any foreseeable issues. The table is provided to give a visual overview of the appropriate renewable technology and hence determine suitable renewable technology.

Technology Type	Description of Technology	Potential Benefits	Potential Issues	Valid for Application
PV Panels (Photovoltaic)	Photovoltaic solar arrays use solar radiation to create electricity, using a similar process to photosynthesis. Electrons are freed from atoms and the subsequent flow of electrons results in electric current.	Zero carbon emissions, 100% renewable technology Additional income due to government incentives Relatively maintenance free as no moving parts Visual impact can be low as can be placed out of sight. Noise free operation	Panels should face south and have sufficient angle to maximise capture Shadowing and detritus can lower performance over time Structure must be able to accommodate the weight of the panels. Required maintenance for cleaning panels	Yes (valid and recommended)

Technology Type	Description of Technology	Potential Benefits	Potential Issues	Valid for Application
Solar Thermal (Solar water heating)	Soar thermal installations use solar radiation to heat water. Evacuated tubes are installed in an area of maximum solar radiation. The heat is then transferred to the water and the heated water is then used to supplement the hot water requirement of the building.	Zero carbon emissions, 100% renewable technology Additional income due to government RHI scheme Relatively low maintenance as few moving parts Visual impact can be low as can be placed out of sight. Noise free operation	Tubes should face south and have sufficient angle to maximise capture Shadowing can affect energy generation performance The structure of the building must be able to accommodate the weight of the filled tubes. More benefit seen during the summer months	Yes (valid but not recommended due to area required to achieve required carbon reduction)

Technology Type	Description of Technology	Potential Benefits	Potential Issues	Valid for Application
Wind Turbine Generation	Wind turbines installed on or around the building can generate renewable electricity. This process utilises the kinetic energy of the wind to drive electricity generating alternators.	Zero carbon emissions, 100% renewable technology Additional income due to government incentives FIT	Visual impact potentially high due to ideal location of installation Potential planning issues Requires regular maintenance Air turbulence generates a significant amount of noise	No (not valid for this site)
Ground Source Heat Pump GSHP	Ground source heat pumps use the Earth as a heat sink and transfer low grade thermal energy from the ground for use in the building. This energy can then be used for space heating/cooling or water heating.	Additional income generated due to RHI government incentives Efficient operation utilising low grade heat in the ground Noise free operation	Not 100% renewable as electricity creates carbon emissions Ground survey required to determine feasibility of installation. Carbon emissions due to electricity as fuel	No (not valid for this site)

Technology Type	Description of Technology	Potential Benefits	Potential Issues	Valid for Application
Air Source Heat Pump ASHP (Hot Water Heating)	Air source heat pumps transfer low grade thermal energy in the atmosphere for use in heating spaces or water heating.	RHI available for each kWh of energy generated Efficient operation utilising the low grade heat in the atmosphere. Proven and reliable technology	Potential for leak of refrigerant with high GWP relative to CO2 Specialist maintained due to refrigerant handling laws External condenser fans create noise.	Yes (valid and recommended)
CHP (Cogeneration)	A cogeneration plant is a combustion engine using natural gas or biogas fuel to drive an alternator which produces electricity. The combustion process is cooled using water as a refrigerant. This low-grade heat can then be transferred for use in building services.	Income generated by RHI (if served by renewable gas) Efficient generation of energy, minimising losses. Potential to export Electricity	Need to have sufficient heat and electrical load Needs to operate for a majority percentage of the year	Yes (valid but not recommended due to NOx emissions and effect on air quality)

Table 6.1 Detailing the Low and Zero carbon technology options available for the proposed development on Stephenson Way in Euston.

7.0 Carbon Emissions Reductions Energy

7.1 Low Energy Building Design and Energy Hierarchy

The Low Energy Building Design building and services design process uses the design principles outlined in Section 1.1 to ensure the energy use of the proposed development is as low as possible and that where energy is used, as little as possible is wasted. The design concepts used in the Low Energy Building Design has taken elements of the Passivhaus fabric first approach to the building design process. This approach significantly lowers the energy demand before the building services are considered in the design process. Once the energy use of the building is sufficiently minimised, low energy building services and LZC technology are then utilised in the design. This ensures the carbon targets can be met and that energy needed to provide services and control the building internal environment is minimised.

The energy strategy has shown passive and active carbon reduction measures as part of the Low Energy Building Design. The carbon reductions for these measures will now be illustrated using the Energy Hierarchy. This is a carbon reduction methodology consisting of three main stages: Be Lean, Be Clean, Be Green.

Be Lean

The first stage in the energy hierarchy is 'Be Lean' which includes demand reduction measures designed to reduce energy usage passively.

Be Clean

The second stage in the energy hierarchy is 'Be Clean' assessment of clean energy sources district heating and CHP.

Be Green

The third and final stage is the application of renewable energy technologies.

7.2 Establishing Baseline Emissions

The baseline carbon emissions are determined by assessing the proposed development against the building regulations Part L compliance software. The regulated carbon emissions for this project have been calculated using Part L compliance software IES VE 2018 VE Compliance DSM.

This software uses the design information for the proposed development to create a notional 'target building' development. The carbon emissions for the notional building are then compared with the actual building's carbon emissions. Accordingly, a compliant development is then deemed to be one which the actual emissions BER is less than or equal to the notional 'target building' carbon emissions TER.

The regulated carbon emissions are calculated for Part L compliance while unregulated carbon emissions for small power items like laptops, televisions and chargers are not currently assessed for Part L building regulations compliance.

The baseline carbon emissions are qualified by multiplying the TER generated using Part L compliance software and the floor area of the development. The TER has been calculated using a notional baseline development which includes heating provided by gas boilers. This will provide the baseline metric, for which all additional carbon emissions reductions are calculated against.

The proposed baseline carbon emissions

The baseline carbon emission are 93.2 tonnes per annum

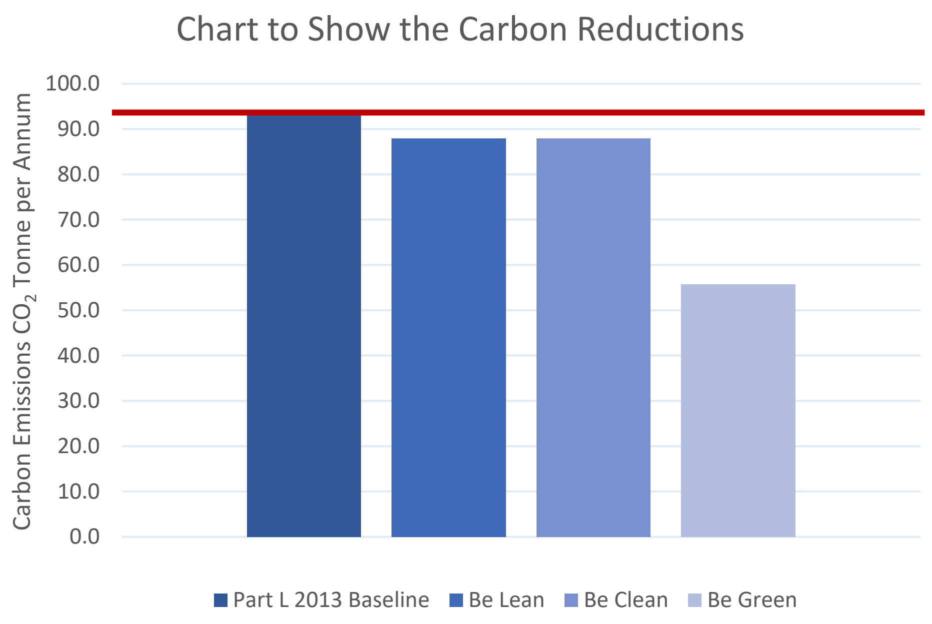


Chart to show the baseline carbon emissions of the proposed development

The red line shows the baseline building carbon emissions TER

7.3 Be Lean

The carbon emissions baseline has been calculated as detailed in Section 7.2. The Demand reduction phase of the energy hierarchy now uses the measures discussed in Section 3.0 to illustrate the passive measures which have enabled the development to reduce carbon emissions.
The passive measures used in the proposed development are designed to reduce energy demand without using fuel in the process.

The Passive Measures included in the development design are summarised below

- Low external element u-values with green roof
- Low air permeability
- Natural Ventilation
- Low energy LED lighting with lighting controls
- Low energy bathroom ventilation system dMEV with trickle ventilation

The carbon reductions due to the Be Lean measures

The Be Lean measures achieve a carbon reduction of 5.6%

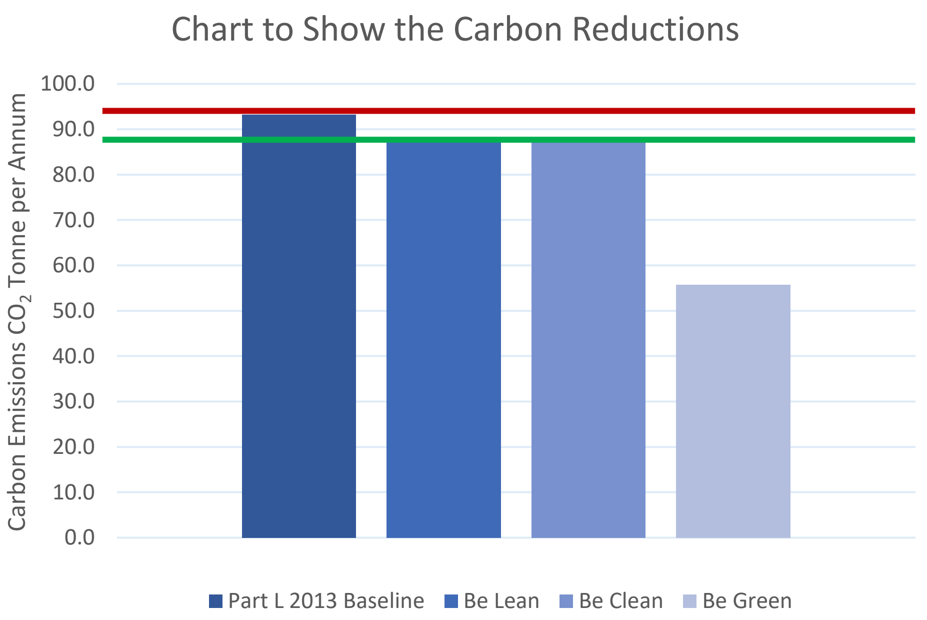


Chart to show the Be Lean carbon emissions reductions of the proposed development

The red line shows the baseline building carbon emissions TER

The green line shows the actual building carbon emissions BER

7.4 Be Clean

The analysis presented in Section 5.0 detailed the availability of heat networks which are currently in the vicinity of the proposed development on Stephenson Way in Euston. In addition, the details of potential heat networks were discussed and given that the development will be in an area which is likely to have a heat network in the future, provision will be made in the building services design to allow a connection to the network in the future. This building services design strategy will allow space heating and hot water services to be provided by a district heating network in the future.

The feasibility of utilising CHP for providing the hot water services in the proposed development has been assessed at part of the preliminary building services design. However, this option for reducing carbon emissions was not deemed to be the most appropriate method of meeting the carbon reduction targets, due to the adverse effect on NOx emissions and hence air quality in the area.

The application of a district heating network will have no effect on local air quality and such, the space heating and hot water services design will enable provision for a connection to a district heat network in the future. This will allow the dominant energy demands of the building both the space heating and hot water services to be provided by a district heating network once one is available in the local area.

The carbon reductions due to the Be Clean measures

The Be Clean carbon emissions are constant at 5.6% reduction

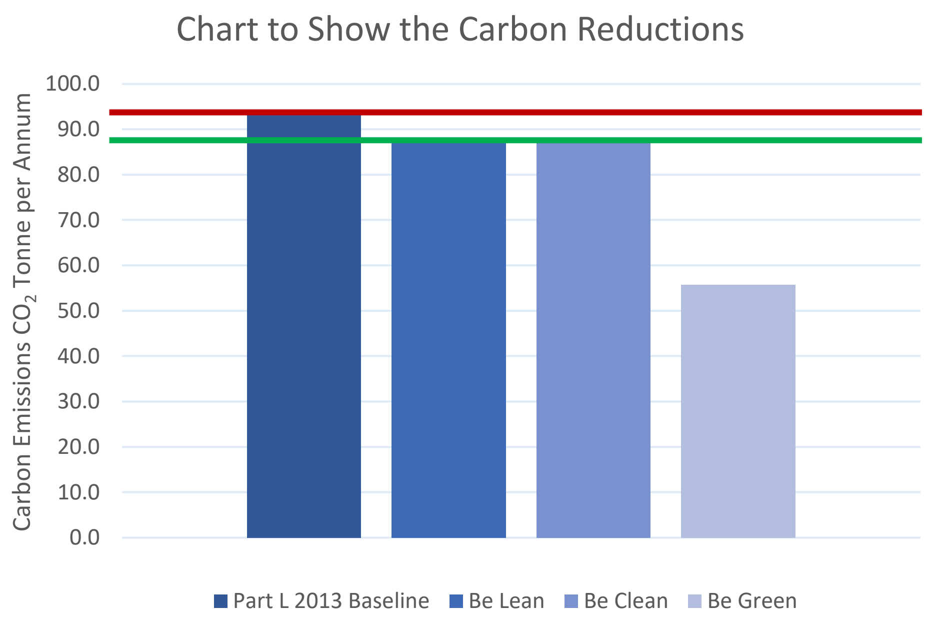


Chart to show the Be Clean carbon emissions reductions of the proposed development

The red line shows the baseline building carbon emissions TER

The green line shows the actual building carbon emissions BER

7.5 Be Green

The final stage of the energy hierarchy utilises renewable technology to further lower the carbon emissions of the development. Given that the measures in the Be Clean stage are unfeasible or would have an adverse effect on the air quality in the area, the carbon emissions reductions have been achieved using measures detailed as part of the Be Green stage of the energy hierarchy.

The building services design for the proposed development on Stephenson Way in Euston enables a significant reduction in carbon emissions by utilising a CO_2 cascade refrigeration cycle air source heat pump ASHP to provide 100% of the hot water services. The refrigeration circuit design of the heat pump is such that the cascade refrigeration circuit and CO_2 refrigerant enable higher water temperatures than traditional R410a refrigerant heat pumps. In addition, CO_2 is a natural refrigerant and therefore has the advantage of having a very low global warming potential GWP of 1, compared to the GWP of traditional R410a at 2,088.

The development has also been designed to utilise renewable zero carbon electric for the ASHP HWS by on site solar PV electricity generation. The development will incorporate 10 kW of solar PV to generate electricity which will power the HWS ASHP providing renewable and zero carbon hot water services.

The Be Green stage of the Energy Hierarchy enable the development to meet the carbon reduction targets as detailed in The London Plan and the GLA's Advice on Preparing Energy Assessments and as such provides a sustainable low carbon development.

The carbon reductions due to the Be Green measures

The Be Green measures achieve a carbon reduction of 40.1%

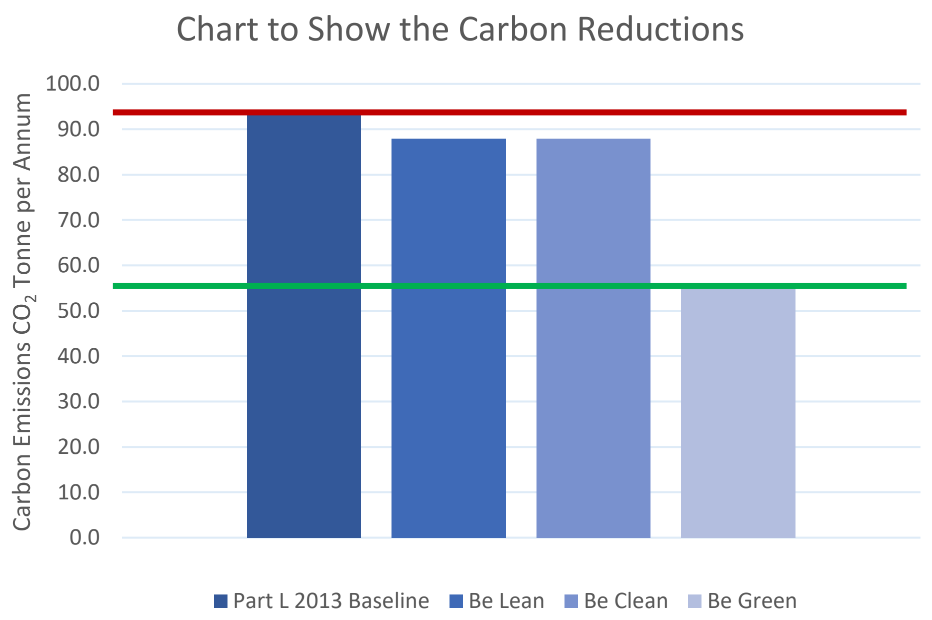


Chart to show the Be Green carbon emissions reductions of the proposed development

The red line shows the baseline building carbon emissions TER

The green line shows the actual building carbon emissions BER

7.6 Overall Carbon Reductions

Carbon Dioxide Emissions Per Annum for non-domestic Buildings

	Regulated CO_2 Tonnes CO_2 per annum	Unregulated CO_2 Tonnes CO_2 per annum
Baseline Part L (2013)	93.2	51.9
Including Be Lean Measures	88.0	51.9
Including Be Clean Measures	88.0	51.9
Including Be Green Measures	55.8	51.9

Figure 7.6.1 to show the carbon emissions of the proposed development

Regulated Carbon Dioxide Savings Per Annum for non-domestic Buildings

	Tonnes CO_2 Per annum	Percentage Reduction %
Savings from Be Lean Measures	5.3	5.6%
Savings from Be Clean Measures	0.0	0%
Savings from Be Green Measures	32.2	36.6%
Reduction Compared to Baseline	37.4	40.1%
Annual Deficit / Contribution £	0.0	£0

Figure 7.6.2 to show the carbon emissions reductions of the proposed development

8.0 Conclusion

The proposed development on Stephenson Way in Euston has followed the GLA's energy hierarchy to qualify the carbon emissions reduction targets have been met. This process has involved calculation of carbon emissions at each stage of the hierarchy using IES VE Compliance DSM.

The First Stage Be Lean of the energy hierarchy incorporates the below measures

- Low external element u-values with green roof
- Low air permeability
- Natural Ventilation to bedrooms
- Low energy LED lighting with lighting controls
- Low energy bathroom ventilation system dMEV with trickle ventilation

The Be Lean measures facilitate a carbon reduction of 5.6%

The Second stage is detailed in Section 7.4 allowing provision for future connection to a heat network to provide space heating and hot water services.

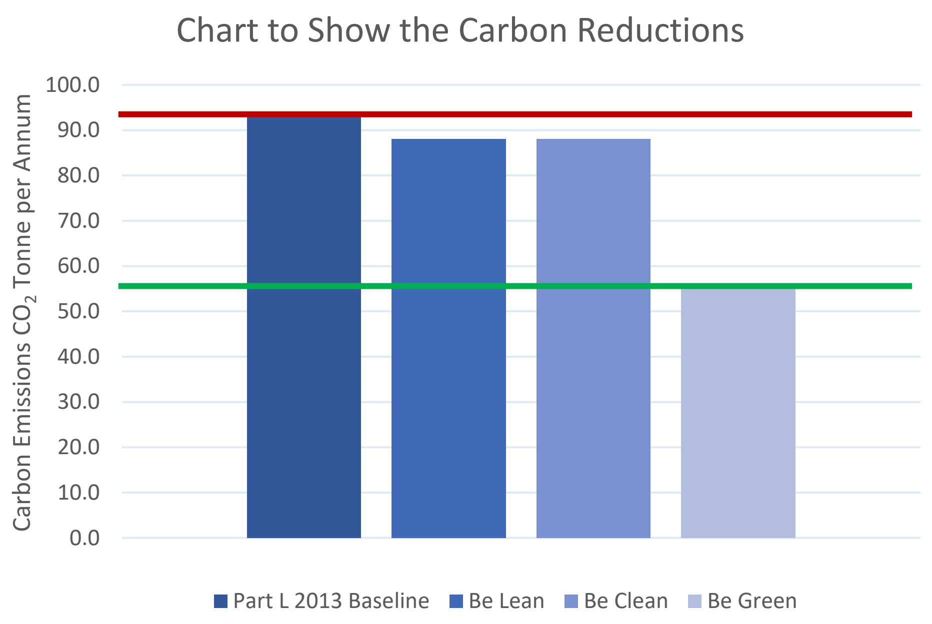
Third Stage of the energy hierarchy includes

- Air Source Heat Pump ASHP hot water services HWS
- Solar PV on site renewable electricity generation 10 kW

The Be Green measures facilitate a carbon reduction of 40.1%

This Energy Strategy therefore confirms that the overall development's carbon emissions will be reduced 40.1% below the Part L 2013 baseline.

The energy hierarchy carbon reduction methodology has minimised energy usage and carbon emissions of the development on Stephenson Way in Euston to provide a sustainable low energy building. (it should be noted that the carbon reduction will increase when assessed using SAP 10 carbon factors as per the Draft London Plan which better reflect realistic carbon emissions of grid electricity)



Appendix

Part L brukl report 2013 Baseline

Part L brukl report Be Green

Response From EON District Heating

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Stephenson Way Euston

As designed

Date: Fri Apr 06 10:42:43 2018

Administrative information

Building Details

Address: Euston,

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.9

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.9

BRUKL compliance check version: v5.4.a.1

Owner Details

Name:

Telephone number:

Address: , ,

Certifier details

Name: Nikolas Sotnyk

Telephone number: 01274 687755

Address: Century House, 257 Cutler Heights Lane, Bradford, BD4 9JG

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	42.6
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	42.6
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	40.5
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.19	0.29	RM00000B:Surf[0]
Floor	0.25	0.15	0.15	RM000000:Surf[0]
Roof	0.25	0.1	0.1	RM000004:Surf[0]
Windows***, roof windows, and rooflights	2.2	1.4	1.4	RM000006:Surf[1]
Personnel doors	2.2	2.2	2.2	RM000003:Surf[1]
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m²K)]
$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
$m^3/(h.m^2)$ at 50 Pa	10	3

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	2188.3	2188.3
External area [m^2]	2432.6	2432.6
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	3	3
Average conductance [W/K]	710.46	1507
Average U-value [W/m^2K]	0.29	0.62
Alpha value* [%]	10	10

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
100	**C2 Residential Institutions: Universities and colleges**
	C2A Secure Residential Institutions
	Residential spaces
	D1 Non-residential Institutions: Community/Day Centre
	D1 Non-residential Institutions: Libraries, Museums, and Galleries
	D1 Non-residential Institutions: Education
	D1 Non-residential Institutions: Primary Health Care Building
	D1 Non-residential Institutions: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others: Stand alone utility block

Energy Consumption by End Use [kWh/m^2]

	Actual	Notional
Heating	53.38	71.12
Cooling	0	0
Auxiliary	3.48	2.2
Lighting	10.73	13.32
Hot water	101.03	89.65
Equipment*	23.73	23.73
TOTAL**	**168.63**	**176.29**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	0	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	145.76	220.71
Primary energy* [kWh/m^2]	230.93	242.59
Total emissions [kg/m^2]	40.5	42.6

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2013

Project name

Stephenson Way Euston

As designed

Date: Tue Nov 06 16:45:45 2018

Administrative information

Building Details

Address: Stephenson Way, Euston, NW1 2HX

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.10

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.10

BRUKL compliance check version: v5.4.b.0

Owner Details

Name: Churchgate

Telephone number:

Address: , ,

Certifier details

Name: Nikolas Sotnyk

Telephone number: 01274 687755

Address: Century House, 257 Cutler Heights Lane, Bradford, BD4 9JG

Criterion 1: The calculated CO_2 emission rate for the building must not exceed the target

CO_2 emission rate from the notional building, $kgCO_2/m^2$.annum	38.5
Target CO_2 emission rate (TER), $kgCO_2/m^2$.annum	38.5
Building CO_2 emission rate (BER), $kgCO_2/m^2$.annum	25.5
Are emissions from the building less than or equal to the target?	BER =< TER
Are as built details the same as used in the BER calculations?	Separate submission

Criterion 2: The performance of the building fabric and fixed building services should achieve reasonable overall standards of energy efficiency

Values which do not achieve the standards in the Non-Domestic Building Services Compliance Guide and Part L are displayed in red.

Building fabric

Element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	Surface where the maximum value occurs*
Wall**	0.35	0.19	0.29	RM00000B:Surf[0]
Floor	0.25	0.15	0.15	RM000000:Surf[0]
Roof	0.25	0.1	0.1	RM000004:Surf[0]
Windows***, roof windows, and rooflights	2.2	1.6	1.6	RM000006:Surf[1]
Personnel doors	2.2	2.2	2.2	RM000003:Surf[1]
Vehicle access & similar large doors	1.5	-	-	No Vehicle access doors in building
High usage entrance doors	3.5	-	-	No High usage entrance doors in building

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [W/(m²K)]
$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m²K)]
$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [W/(m²K)]

* There might be more than one surface where the maximum U-value occurs.
** Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.
*** Display windows and similar glazing are excluded from the U-value check.
N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air Permeability	Worst acceptable standard	This building
m³/(h.m²) at 50 Pa	10	3

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Area [m^2]	2188.3	2188.3
External area [m^2]	2432.6	2432.6
Weather	LON	LON
Infiltration [m^3/hm^2@ 50Pa]	3	3
Average conductance [W/K]	757.45	1507
Average U-value [W/m^2K]	0.31	0.62
Alpha value* [%]	10	10

* Percentage of the building's average heat transfer coefficient which is due to thermal bridging

Building Use

% Area	Building Type
	A1/A2 Retail/Financial and Professional services
	A3/A4/A5 Restaurants and Cafes/Drinking Est./Takeaways
	B1 Offices and Workshop businesses
	B2 to B7 General Industrial and Special Industrial Groups
	B8 Storage or Distribution
	C1 Hotels
	C2 Residential Institutions: Hospitals and Care Homes
	C2 Residential Institutions: Residential schools
100	**C2 Residential Institutions: Universities and colleges**
	C2A Secure Residential Institutions
	Residential spaces
	D1 Non-residential Institutions: Community/Day Centre
	D1 Non-residential Institutions: Libraries, Museums, and Galleries
	D1 Non-residential Institutions: Education
	D1 Non-residential Institutions: Primary Health Care Building
	D1 Non-residential Institutions: Crown and County Courts
	D2 General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger terminals
	Others: Emergency services
	Others: Miscellaneous 24hr activities
	Others: Car Parks 24 hrs
	Others: Stand alone utility block

Energy Consumption by End Use [kWh/m^2]

	Actual	Notional
Heating	45.72	70.11
Cooling	0	0
Auxiliary	2.9	2.12
Lighting	10.73	13.32
Hot water	20.54	30.23
Equipment*	23.73	23.73
TOTAL**	**79.9**	**115.77**

* Energy used by equipment does not count towards the total for consumption or calculating emissions.
** Total is net of any electrical energy displaced by CHP generators, if applicable.

Energy Production by Technology [kWh/m^2]

	Actual	Notional
Photovoltaic systems	4.32	0
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m^2]	148.01	217.58
Primary energy* [kWh/m^2]	222.95	312.35
Total emissions [kg/m^2]	25.5	38.5

* Primary energy is net of any electrical energy displaced by CHP generators, if applicable.

Nikolas Sotnyk

From: Ford, Natalie <Natalie.Ford@eonenergy.com>
Sent: Wednesday, April 18, 2018 1:38 pm
To: Nikolas Sotnyk
Subject: RE: District Heating Query - Stephenson Way, Euston [Filed 19 Apr 2018 09:27]

Categories: Look as ASAP

Hi Nik,

Unfortunately we won't be able to assist on this occasion due to the small size of the development.

It would be best for you to speak with the facilities agent looking after the site and they will be able to advise.

Thank you for making contact and please feel free to contact me should you need to in the future.

Kindest regards

Natalie

Natalie Ford
Business Development Coordinator
T 07976 747521
E natalie.ford@eonenergy.com

E.ON Energy Solutions Ltd
Business & Community Solutions
Westwood Way
Westwood Business Park
Coventry
CV4 8LG

Follow us @EON_UKBusiness

From: Nikolas Sotnyk [mailto:nikolas.sotnyk@thornleylumb.co.uk]
Sent: 18 April 2018 09:51
To: Ford, Natalie <Natalie.Ford@eonenergy.com>
Subject: RE: District Heating Query - Stephenson Way, Euston

Hi Natalie