373-375 Euston Road

Energy Strategy

Prepared by Hoare Lea
20 January 2014

Contents

Executive Summary

This report has been produced by Hoare Lea Consulting Engineers on behalf of the Client to support the planning application for the proposed redevelopment of Cambridge House located on Euston Road, London.

The development incorporates areas of retained and upgraded storeys along with an element of new build, therefore the strategy has been developed to take into account the inherent limitations of an existing façade along with planning issues within which the new façade is being developed.

This Energy Strategy has been developed in line with the Energy Hierarchy of “Be Lean”, “Be Clean”, and “Be Green” stages to reduce the energy consumption and carbon emissions of the development. Passive design features, energy-efficient systems and low carbon technology will be incorporated into the scheme.

There is consideration of a number of iterations which demonstrate that the overall performance of the development will be significantly better than its current façade and systems.

The following low or zero carbon (LZC) technologies have been appraised in terms of technical and physical feasibility:

- Gas-fired combined heat and power
- Wind turbines
- Solar water heating panels
- Biomass heating boilers
- Ground source heat pumps
- Photovoltaic (PV) modules for electricity generation

Combined heat and power (CHP) technology with thermal storage has been assessed to be the most appropriate ‘Be Clean’ method by which to reduce site wide CO_2 emissions. A decentralised heat and power network will provide electricity, heating and hot water to all residential and landlord elements of the site.

Acoustics and air quality performance of the CHP unit and all site services shall be carefully considered throughout the design to ensure compliance with planning requirements thus minimising impact on the surrounding environment.
‘Be Green’ renewable energy in the form of photovoltaic (PV) panels could be incorporated at roof level to further reduce the carbon footprint. Placement and configuration of the panels would need to be designed to reduce sight lines in acknowledgment of the site’s location. However due to the limited available space on the roof of the development it has been decided that photovoltaic panels will not be feasible to incorporate.

Table 1 below summarises the predicted CO_2 reductions relative to the existing building. The relative improvements are calculated incrementally in accordance with the GLA Toolkit methodology.

The predicted overall CO_2 reductions for the site through the proposed regeneration of the site are 60%, with incremental improvements of 31% at the Be Clean stage compared to the Be Lean stage. The site-wide CO_2 reduction figures include the overall energy used for space heating, hot water generation and comfort cooling.

CO_2 reduction measures	CO_2 Emissions tonnes CO_2/Annum	Incremental Reduction
Existing Building Performance	42	-
+ Energy Efficiency	24	42%
+ Energy Efficiency + CHP	17	31%

1.0 Introduction

This Energy Strategy, prepared by Hoare Lea describes the energy efficient design measures and LZC technology that shall be incorporated for the proposed redevelopment of Cambridge House on Euston Road, London. The development consists of 16 apartments, 11 of which will be considered to be refurbishments as they sit within the existing building and the remaining 5 to be considered as new build as they are within the top storeys on the building which will be new build construction.

The report provides details of the carbon emissions reductions that shall be achieved by the incorporation of Be Lean (energy efficiency), Be Clean (CHP) and Be Green (Renewable Energy) measures to meet with the requirements of the Building Regulations and Core Strategy policies of the London Borough of Camden Planning Department.

The objective for the site is to reduce energy use and to improve the building's carbon footprint in a sustainable way. Solutions have been explored to identify the most effective and suitable means of providing on-site energy that are sensitive to the building's situation within Camden. The ground and first to third storeys of the residential part of the building are to be retained and upgraded to high standards.

This report is structured as follows:

- Section 2 describes the stages of the Assessment Methodology.
- Section 3 outlines the energy efficient and passive design approaches to be used for the design of the buildings and engineering systems.
- Sections 4, 5 and 7 provide the results of each step of energy modelling.
- Section 6 includes a review of renewable technologies considered.

2.0 Assessment Methodology

Due to the mixture of refurbishment and new build within the development, the building energy assessment will include calculations to illustrate the improvements that will be made over the existing site's carbon footprint, in order to recognize the improved performance of the elements on the lower storeys as well as those which can benefit from an entirely new build on the top three storeys.

This will follow with the proposed sustainable assessment methods by which the apartments within the retained building will be assessed under BREEAM Domestic Refurbishment 2012 and those within the new development via Code for Sustainable Homes 2010.

In line with the London Plan methodology the assessment will look at the performance of the building as a whole combining the new and refurbished elements.

The assessment is comprised of the following stages:

Benchmark Building

For comparative purposes and to follow the BREEAM Domestic Refurbishment energy assessment process the baseline model is based on an analysis of the current building’s system efficiencies and thermal performance using SAP Appendix S.

The apartments which are within the extent of the new construction have been modelled with typical Part L compliant performances.

The overall performance of the combination of existing and new spaces forms the Baseline performance figure.

Energy Efficiency (Be Lean)

The second step is to assign target percentage reductions to the Baseline energy consumption figures, which shall be achieved through energy efficiency measures and passive design. These factors are applied to the estimated annual energy consumption figures to demonstrate energy efficiency through passive measures.

This step involves identifying methods to maximize building fabric performance and optimize system efficiency to reducing heating and cooling loads.

Combined Heat and Power (Be Clean)

The third step is to assess the viability and carbon reduction benefit of providing a decentralized combined heat and power network in association with a community heating scheme serving the building.

Energy profiles for heating and hot water are used to assess base thermal loads, while the potential for using electricity on-site.

Renewable Energy Technology (Be Green)

Once sustainable and energy efficiency measures which reduce energy demand through energy efficiency have been maximized, the final step is to investigate the technical and practical feasibility of renewable energy technologies (LZCs).

For the purpose of this study, the energy consumption and carbon dioxide emissions have been calculated in accordance with the SAP 2009 methodology using accredited software (NHER Plan Assessor v5.4.2); the assessment of the pre-development building has been based on the BREEAM Domestic Refurbishment energy assessment methodology and uses SAP Appendix S to inform unknown thermal element performances.

3.0 Benchmark Building (Baseline) Assessment

Apartments within the existing façade are considered as existing builds and apartments within the new façade are considered as new builds. This has provided an overall baseline CO_2 emissions figure which takes into account the presence of both the existing and newly constructed elements of the development.

The results sheets in Appendix A summarize the thermal performance and system efficiencies used in order to establish the pre-development performance of the building:

The overall benchmark building emissions are summarized in the table below:

CO_2 reduction measures	CO_2 Emissions tonnes CO_2/Annum
Existing Building Performance	42

4.0 Energy Efficiency (Be Lean) Assessment

The energy consumption of the building will be reduced from that of the baseline scheme, by the incorporation of sustainable passive design features and energy efficiency measures in the design of both the building fabric and the mechanical and electrical engineering systems.

Due to the retention of the façade and the restrictions on the design of the new façade in order to accomplish the continuity of the scheme with the surrounding buildings it has been possible to optimize the thermal performance of the building through the use of high performance glazing or very low air tightness targets.

Be Lean measures have been carefully considered in the design development to ensure that the building's thermal performance is improved wherever feasible.

The energy efficiency and sustainable design measures described in sections 4.1 and 4.2 shall be further investigated during the detail design stage in conjunction with the Design Team to achieve an overall low carbon approach for the building and systems as a whole.

4.1 Passive Design of the Building

We have assumed:

- Average U-values that are significantly better than the existing thermal performance of the building and are in line with the current Building Regulations. This shall apply to both new and upgraded elements to limit heat loss and heat gain to outside through the building fabric.
- Enhanced air tightness in the new builds to reduce wasteful air leakage with target air permeability not exceeding $8m^3/hr/m^2$@50Pa
- Draught proofing to windows, doors and other building openings
- Avoidance of excessive 'Thermal Bridging' by using appropriate design details and fixings
- Recommendation to future occupiers of heavy weight curtains/window dressings with thermal characteristics which may be used to mitigate solar heat gain in summer and retain heat in winter, to be included in the Home User Guide.
- Benefit of high ceilings and relatively heavyweight construction afforded by masonry external wall construction and concrete floor slabs
- Utilization of solar heat gains in winter to benefit the space

4.2 Energy Efficient Building Systems

- We have assumed:
- Inefficient existing building systems and boiler plant to be stripped out and replaced
- High efficiency, low NOX, gas-fired, condensing and modulating boilers serving a community heating scheme for the benefit of all residential apartments and landlord areas. The CHP unit shall act as lead heat emitter for the heating system (refer to section 5).
- Insulation of pipework, ductwork and hot water systems to current and proposed future highest standards
- Inverter driven pumps to reduce electricity consumption
- Inverter driven fans to be considered on major ventilation plant
- Energy efficient motors and drives to be specified
- Ventilation in apartments via SAP eligible mechanical ventilation units with heat recovery (MVHR) having low specific fan power (SFP) and variable speed fan control.
- Ventilation units with heat recovery shall be provided with summer bypass facility and external temperature sensor to allow potential for free cooling
- Energy efficient cooling plant shall be specified having energy efficiency (EER) that exceeds current Building Regulation standards
- Thermostatic zone control and time control to be provided throughout
- Low energy light fittings to be widely specified with suitable manual or automatic switching and suitable lighting zone control
- PIR sensors on light controls where appropriate to reduce unnecessary electricity usage
- Dawn/Dusk lighting control on external lighting
- Appropriate commissioning of all building systems to allow for efficient operation
- Energy efficient white goods to be provided where installed or recommended to future tenants
- Part L compliant energy metering and energy display devices

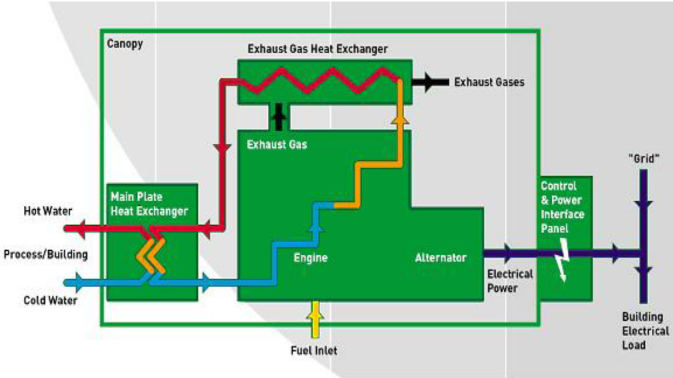
4.3 Energy Efficiency Carbon Savings

Following the inclusion of Be Lean measures the percentage reduction in carbon emissions from the building will be 42% when compared with the baseline building.

5.0 Combined Heat and Power (Be Clean) Assessment

A gas-fired Combined Heat and Power (CHP) unit is proposed to act as the lead heat source serving a decentralized heat and power network serving all areas of the building. The proposed development has been assessed as being well suited to a CHP-led community heating system. The heating system shall be supplemented by high efficiency, low NOX, gas-fired condensing boilers.

CHP uses a gas-fired reciprocating engine, connected to a generator to simultaneously generate both heat and power (electricity). Useable heat is generated by recovering the heat from the engine that in a conventional generator is rejected to atmosphere. This is illustrated schematically in the figure below.



In order to optimize the performance of the CHP engine it is important to provide consistent heating and electrical loads. For this reason, such a system would be supplemented by a gas fired boiler system and public electrical supply.

In order to analyze the performance and suitability of CHP and other potential low or zero carbon energy systems (described in Section 6), Hoare Lea have developed monthly load profiles from the total estimated energy consumption figures. These monthly load profiles have been applied to the Euston Road scheme to assess the suitability of CHP and other LZC technologies.

5.1 Feasibility Analysis

A detailed feasibility analysis has been carried out to determine the most appropriate size of CHP plant that is matched with the heating, hot water and power requirements across the development.

Initial stage calculations demonstrate that the following size of CHP unit would be suitable for the development, with the final size to be refined during detail design:

- 4 kWe Electrical Output
- 8 kWth Thermal Output

The electricity generated by the CHP plant will be fed into the building's electrical network. The use of this co-generation technology improves the overall efficiency of the primary energy delivered to the site with a corresponding reduction in the development's CO_2 emissions by means of low carbon technology.

The unit shall be provided with a catalytic converter on the flue exhaust to provide a significant reduction in NOX emissions, while regular planned preventative maintenance will ensure correct and efficient operation of the unit thus minimizing impact on the surrounding air quality.

Appropriate acoustic treatment shall be provided to the CHP unit (as shall be the case for all on-site mechanical and electrical equipment) to ensure that plant noise levels are in line with Planning requirements.

Calculations have been carried out using energy benchmark data to determine the daily, monthly and annual energy profiles for the development. From this data, the appropriate size of CHP plant and matched thermal storage has been established.

The analysis has been carried out to maximize the size of CHP plant that can feasibly be installed within the correct operating parameters of the equipment. An oversized CHP unit or one which is not provided with adequate thermal storage will frequently turn on and off, thus diminishing the performance and reliability of the equipment.

The size of the CHP plant has been calculated based on the thermal base load (primarily domestic hot water) that is available all year round to enable its operation for approximately 3102 hours per year. This equates to an average daily operation of 8.5 hours per day. These operating hours shall incorporate an availability factor to allow for planned and unplanned maintenance periods.

To enable the CHP plant to run continuously when it is operating, thermal storage vessels shall be used so that excess CHP capacity can be used to generate hot water for use at a later time, when there is a demand for heat in the building.

It is estimated that CHP combined with suitably sized thermal storage (circa. 10,500L with a delta T of 35 degK) will provide heat for approximately 60% of the building's thermal energy requirements, with gas fired boilers being used to meet peak demands and provide top up heat in winter months.

5.2 CHP Carbon Savings

The CO_2 emissions resulting from the introduction of a CHP engine are calculated in 3 stages. The CO2 emitted by the CHP due to gas consumption is calculated, the CO_2 emitted by the remaining gas fired boiler plant is calculated and the CO2 offset by the generation of electricity is calculated. These figures are then combined to produce the overall CO_2 emission reduction due to the CHP engine as summarized below. From the use of CHP equipment as the lead heat generating component of the community heating network and in conjunction with appropriately sized thermal storage it is estimated that this will result in a further reduction in CO_2 emissions of 31% of site carbon emissions over the Be Lean performance.

6.0 Renewable Technology (Be Green) Assessment

A number of technologies have been appraised in terms of technical, physical and financial feasibility, as potential low or zero carbon (LZC) systems for use on the project.

The nature and location of the building has a key consideration in this appraisal and has rendered a number of the more visible technologies such as wind turbines as unsuitable
Each technology has also been assessed for compatibility with a CHP-led community heating scheme and for suitability with the proposed building services systems.

6.1 Photovoltaic Panels (PV)

Solar Photovoltaic modules (PVs) convert solar radiation into electrical energy, which can be used on site or distributed to other electricity users via the national grid when there is excess electricity produced. Photovoltaic panels are typically roof mounted but curtain walling systems and louvered external shading applications exist. Solid PV cells (Mono or Poly-crystalline) can be either roof or façade mounted (although solar modules fitted on a south facing façade have only 75% the output of roof mounted modules). Thin film PV types are more flexible; they can be curved or flat and can be integrated into a roof or cladding system. PV cells can also be integrated into glazing as the gaps around the PV cells allow some daylight penetration. This can be used for partial shading in a glazed roof.

PV systems require only daylight, (not direct sunlight) to generate electricity (although more electricity is produced with more sunlight), so energy can still be produced in overcast or cloudy conditions.

The ideal orientation is south facing at an angle of 30° to the horizontal, though they may also be laid flat, with a slightly lower efficiency being achieved.

Switchgear/inverters are required to convert DC electricity to AC electricity and make to it compatible with Grid electricity (in terms of voltage, phase, power factor, frequency etc.).

The various PV options have been reviewed for suitability and discrete integration at Cambridge House, Euston Road. Facade mounted PV panels and building integrated amorphous thin films have been dismissed at this stage due to their visual impact, which would likely not be acceptable in terms of Planning.

There is only a limited area at roof level that could be considered for the installation of PV panels. The limited reduction in site carbon emissions that these would generate and the associated extensive payback period, this technology is not considered viable.

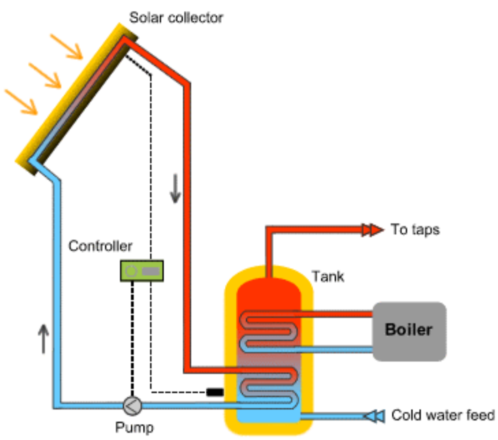
6.2 Wind Turbines

Wind turbines (both large-scale and roof-mounted) are one of the most effective ways of producing electricity without generating carbon emissions. Conversion of kinetic energy in the wind to mechanical energy is utilised to power generators, which are typically roof mounted or freestanding.

Wind turbines are not considered suitable for 1 Queen Anne's Gate due to visual and acoustic implications that would be detrimental to the nature of the building and the surrounding environment.

6.3 Solar Thermal Systems

Solar hot water heating systems use radiation from the sun to heat domestic hot water. In a solar hot water system, solar collectors normally positioned on building roofs are connected to a hot water storage cylinder(s) from which solar heated water is distributed to the buildings hot water outlets.

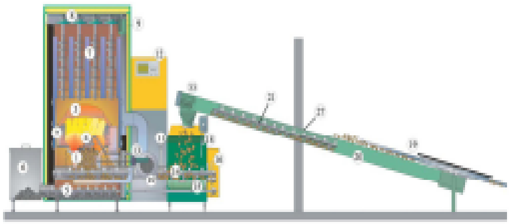


Two forms of panel are common: evacuated tubes, which have better performance but are more costly are typical for commercial applications, and flat plates are more typical for domestic installations.

Solar hot water systems are not considered to be suitable for this project due to the technical incompatibility with the proposed building systems.

It is proposed that hot water will be generated instantaneously in each apartment via a Heat Interface Unit, which shall be served by the CHP-led community heating scheme. Solar hot water systems are not considered to be technically suited to working in conjunction with CHP and an instantaneous hot water generation system. This technology is therefore not proposed for this development.

6.4 Biomass Heating



Biomass heating systems combust biomass material in a biomass boiler in order to heat water in the same way that gas boilers combust gas.

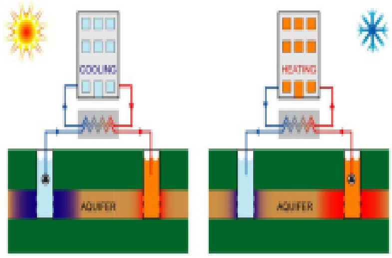
Biomass materials include all land and water based vegetation, e.g. wood chips, wood pellets, wood waste, fast growing coppice trees such as willow. The carbon dioxide emitted from burning biomass is balanced by that absorbed during the fuel's production. Biomass heating therefore approaches a carbon neutral process.

The implementation of biomass requires significant storage space and regular deliveries of large quantities of fuel. There are logistical complications associated with the requirement for large delivery vehicles to have regular access to the storage facilities along with concerns regarding future security of supply of sustainable biomass fuels. Establishing a suitable and dust-free method of fuel delivery would be challenging to incorporate on this site.

The use of biomass heating is not considered a suitable renewable energy technology for 1 Queen Anne's Gate. It is believed that the building is a in a Smoke Control Area, to which wood-burning technologies are not generally suited. There are also physical constraints and a conflict with the proposed CHP led strategy that renders this option technically and practically unsuitable.

6.5 Ground source heat pumps

Ground source heat pumps are used to extract heat from the ground during the heating season and to reject heat to the ground during the cooling season.



Heat is transferred to and from the ground by circulating a fluid through a system of pipes to a heat exchanger, which transfers the energy to the distribution network via a heat pump.

Ground source heat pumps utilise either water extracted from an aquifer (open loop) or water circulated within underground pipework (closed loop) as the heat source in a refrigeration process enabling them to produce hot water for circulating within the building, typically at around 30-35°C with efficiencies dropping off for every degree rise in temperature. This heat can used as a heating medium in buildings, which are adapted to low grade heating systems. In summer months heat is rejected to the ground and cooled water is extracted.

Open loop systems are not considered to be suitable for the site at 1 Queen Anne's Gate. Open loop systems require suitable geology and an aquifer or borehole, typically no less than 100m deep. Suitable separation needs to be provided between the extract and discharge wells. It is not possible to provide adequate separation, which is typically in excess of 150m and would exceed the footprint of the site.

Horizontal closed loop systems have also been considered for suitability. Such systems utilise horizontal pipework in trenches approximately 1.2 metres deep and rely on exposure of the surrounding ground to direct sunlight and penetrating rain to facilitate the process of heat exchange. As there is no scope to lay horizontal closed looped pipework on open ground, this option is not considered to be viable.

Finally, in the case of vertical loop systems, pipework is typically encased in concrete structural piles or inserted into purpose-drilled boreholes.

A vertical closed loop system would not be feasible as a majority of the building is existing including the basement areas.

Further to physical constraints possibly limiting the installation of piles and boreholes, this solution is deemed to be incompatible with the proposed building's community heating operating temperature. The maximum temperature likely to be available in winter is circa 30-35°C (35-40°C on primary side of heat pump) which is not be suitably hot enough to pre-heat the district heating system, which shall have a typical average operating temperature of 75°C flow/35°C return, subject to detail design.

Ground source heat pumps in all its forms have therefore been assessed to be unsuitable.

7.0 Conclusions

This Energy Strategy has been developed to support the planning application to for the proposed redevelopment at Cambridge House on Euston Road, London.

The energy assessments and review of "Be Lean", "Be Clean", and "Be Green" technologies have been carried out to demonstrate compliance with anticipated Core Strategy Policies and the London Plan Cooling Hierarchy.

Overall the development will result in a 60% reduction in carbon emissions over the benchmark performance.

Appendix A – SAP Calculation Results Summary Sheets

Euston Road - Post-Refurbishment Be Clean

Flat Reference	Dwelling Category	TER	DER	Apt (m^2)	No. of Apts	Total Floor Area	Total TER	Total DER	Criterion 1 (DER / TER Variance)	Criterion 1 (Pass / Fail)	ACR to Pass Criterion 3
1-1	Existing Build	21.88	17.47	79.80	1	79.8	1746.02	1394.11	-20.2%	Pass	4.20
1-2	Existing Build	21.42	15.29	57.27	1	57.27	1226.72	875.66	-28.6%	Pass	2.00
1-3	Existing Build	23.57	16.99	49.85	1	49.85	1174.96	846.95	-27.9%	Pass	3.00
1-4	Existing Build	25.09	17	49.78	1	49.78	1248.98	846.26	-32.2%	Pass	3.00
2-1	Existing Build	18.74	15.16	79.80	1	79.8	1495.45	1209.77	-19.1%	Pass	4.60
2-2	Existing Build	18.15	12.64	57.27	1	57.27	1039.45	723.89	-30.4%	Pass	2.40
2-3	Existing Build	20.34	14.56	49.85	1	49.85	1013.95	725.82	-28.4%	Pass	3.40
2-4	Existing Build	22.13	14.72	49.78	1	49.78	1101.63	732.76	-33.5%	Pass	3.40
3-1	Existing Build	17.4	13.57	79.90	1	79.9	1390.26	1084.24	-22.0%	Pass	5.40
3-2	Existing Build	15.99	11.36	69.97	1	69.97	1118.82	794.86	-29.0%	Pass	3.80
3-3	Existing Build	20.17	14.05	85.60	1	85.6	1726.55	1202.68	-30.3%	Pass	2.50
4-1	New Build	17.4	13.57	79.90	1	79.9	1390.26	1084.24	-22.0%	Pass	5.40
4-2	New Build	15.99	11.36	69.97	1	69.97	1118.82	794.86	-29.0%	Pass	3.80
4-3	New Build	20.17	14.05	85.60	1	85.6	1726.55	1202.68	-30.3%	Pass	2.50
5-1 Duplex	New Build	15.81	12.15	146.23	1	146.23	2311.90	1776.69	-23.1%	Pass	4.20
5-2 Duplex	New Build	16.71	11.17	102.78	1	102.78	1717.45	1148.05	-33.2%	Pass	3.60
Area Weighted Results:		**18.89**	**13.78**		**16**	**1193.35**	**22547.79**	**16443.53**	**-27.1%**	**Pass**	

Existing Builds:		**19.87**	**14.61**		**11**	**788.77**	**15673.07**	**11521.24**	**-26.5%**	**Pass**
New Builds:		**16.99**	**12.17**		**5**	**404.58**	**6874.72**	**4922.29**	**-28.4%**	**Pass**

Euston Road - Design Parameters - Be Clean

	Existing	New
U-values (W/m2K)		
External walls	0.3	0.18
Party wall between apartments	0	0
Party wall between corridors/stairs/lifts/risers	0.3	0.18
Glazing	1.4 (Double)	1.4 (Double)
Heat loss floors	0.25	0.25
Heat loss roofs	0.2	0.2
Additional Glazing Data		
Glazing G-Value	0.85	0.85
Fraction Glazed	0.8	0.8
Design Air Permeability Rate	10 m^3/hm^2 (@50Pa)	3 m^3/hm^2 (@50Pa)
Mechanical Ventilation	Balanced (With Heat Recovery) Vent Axia Sentinel Kinetic 2 Additional Wet Rooms - SFP 0.74 W/l/s - 91% Heat Exchange Efficiency	Balanced (With Heat Recovery) Vent Axia Sentinel Kinetic 2 Additional Wet Rooms - SFP 0.74 W/l/s - 91% Heat Exchange Efficiency
Space and Water Heating	Community Boilers providing 40% of space heating and hot water, 90% efficient Providing 60% of heat load, 80% efficient Controls: Charging System Linked to Use, Programmer and TRVs Emitter: Underfloor (Screed)	Community Boilers providing 40% of space heating and hot water, 90% efficient Providing 60% of heat load, 80% efficient Controls: Charging System Linked to Use, Programmer and TRVs Emitter: Underfloor (Screed)
Thermal bridging	0.15 (Default)	0.15 (Default)
Light fittings	100% Low Energy Fittings 0% Standard Fittings	100% Low Energy Fittings 0% Standard Fittings
Summer Overheating	Air change rate defined	Air change rate defined
Cooling	EER: 2 Living area, kitchen and all bedrooms.	EER: 2 Living area, kitchen and all bedrooms.