CAMDEN TOWN HALL

LENDLEASE CONSULTING (EUROPE) LTD ON BEHALF OF LONDON BOROUGH OF CAMDEN

ENERGY STATEMENT

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Camden

lendlease

Lendlease

Camden Town Hall

Energy Assessment

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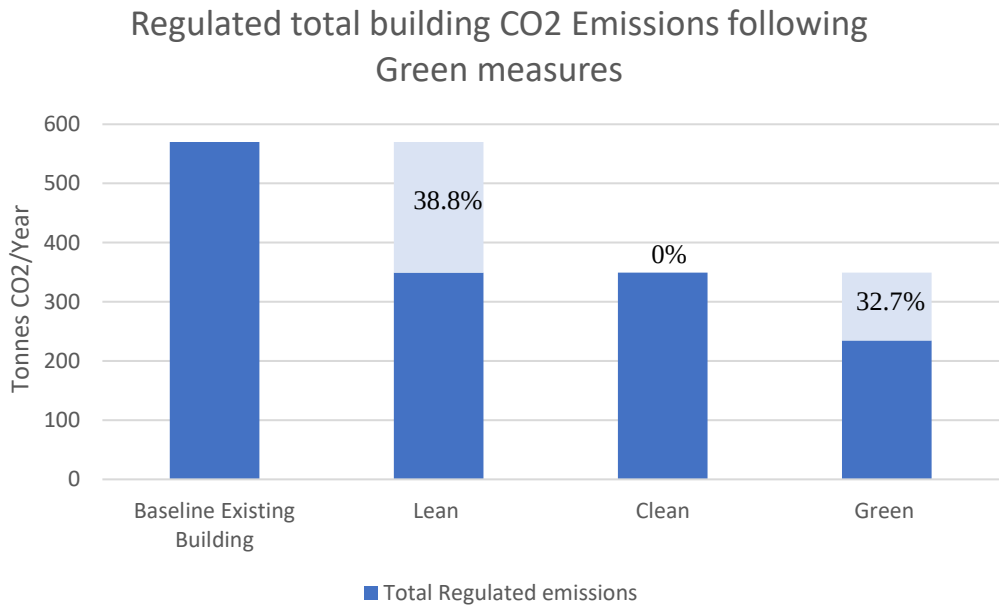
The energy assessment for Camden Town Hall has been developed in accordance with the 'Lean-Clean-Green' energy hierarchy model. This model considers first sensitively improving the building fabric of this listed building, then using efficient active systems before finally introducing low and zero carbon technologies.

Lean: As this is an existing building it falls under "Part L2B: Conservation of fuel and power in existing buildings other than dwellings". In particular, this requires that existing historic buildings are improved 'as far as is reasonably practicable'.

Passive and active lean measures adopted include the upgrading of windows across the site, covering over three of the four existing lightwells and installation of new, highly efficient building services. The Lean measures adopted for the proposed building maximise the opportunities to improve the thermal performance of the building elements in line with Part L2B recommendations considering the heritage constraints of the development. This "Lean" building result in a 38.7% reduction in CO_2 emissions over the existing baseline building.

Clean: Feasibility of adoption of "Clean" measures were assessed for the site. Due to the scale and the location of the site, neither CHP nor connection to a district heating network were found to be feasible at the present date. Therefore, Clean measures provide no further reductions in carbon emissions.

Green: A range of renewable technologies were assessed for the site. ASHPs were found to be the most appropriate for the site and have been adopted in the design resulting in a further 32.7% improvement over the "lean" building. The green measures adopted for the proposed site exceed the Camden Local Plan requirement for developments of 500sqm gross internal floorspace to achieve a 20% reduction in CO2 emissions from onsite renewables.



	Part L 2012 Carbon Factors			
	BER	**Total Regulated emissions**	**CO_2 Savings from hierarchy measures**	
	(kgCO_2/ m^2)	**(Tonnes CO_2/Year)**	**(Tonnes CO_2/Year)**	**(%)**
Baseline Existing Building	51.7	570		
Lean (Part L2B Compliant Baseline)	31.4	349	221	38.8%
Clean	31.4	349	0	0.0%
Green	21.1	235	114	32.7%

Note: this table and the associated graph have been developed in line with the GLA Energy Assessment Guidance 2018 (Para 6.5)

1 Introduction

This Energy Assessment report has been prepared for Lendlease, on behalf of the London Borough of Camden, in their role as project manager for the refurbishment of the Camden Town Hall. It has been prepared in support of the planning and listed building consent application for the part change of use and refurbishment of the Grade II listed building.

The Camden Town Hall (CTH), formerly St Pancras Town Hall, was built between 1934-37 to designs by AJ Thomas. It is a Grade II listed building, bounded by Judd Street, Euston Road, Tonbridge Walk and Bidborough Street. It is located within the King's Cross Conservation Area, and on the boundary of the Bloomsbury Conservation Area. It has been the primary public building and focus of the civic and democratic functions of the London Borough of Camden.

The building has 3 main storeys with a basement. The main entrance is from Judd Street. The former Sui Generis Town Hall, now known as the Camden Centre (Events Use), lies at the east end of the building with its foyer currently accessed from Bidborough Street.

New plant is proposed across the building and the project is targeting BREEAM Excellent. Full details of the proposals are found in the Design and Access Statement.

The proposed refurbishment project is aiming to significantly improve energy efficiency credentials through careful attention to thermal performance of the proposed façade system and HVAC systems. This report documents the methodology considered for reducing building energy consumption and carbon emissions associated with Camden Town Hall.

The energy assessment for the building has been developed in accordance with the 'Lean-Clean-Green' energy hierarchy model. This model considers improving the building fabric then using efficient active systems before introducing low and zero carbon technologies.

1. **Be Lean:** reduced energy demand
2. **Be Clean:** use energy more efficiently
3. **Be Green:** supply energy from renewable sources

1.1 Current and Expected Building Use

The site has been used as Camden's Town Hall, though many of the Council workers have moved to new offices at 5 Pancras Square. The Council's registry and civic and democratic services have remained in the building up until its closure in August 2018 for the refurbishment project. These council services have been temporarily relocated to alternative locations in Camden while the refurbishment project is carried out. The whole building has a Sui Generis Town Hall use.

The site has a PTAL rating of 6b (excellent) which is the highest level of public transport accessibility. The site is well located close to Kings Cross and St Pancras International railway stations, as well the underground and numerous bus routes.

The proposals seek to improve and upgrade the Grade II listed building, while finding new uses to operate alongside the remaining Town Hall functions. The application seeks a part change of use from Sui Generis Town Hall to B1 office space (Basement, Second and Third floor), retention of the civic and democratic uses at Ground and First floor and the change of use of the Sui Generis Town Hall to Events Use.

The proposals include works to improve the Judd Street entrance and reception, reorganisation of the registry and marriage suites, technological improvements to the Council Chamber alongside sensitive conservation repairs to the most historically significant spaces.

A new commercial office entrance is proposed on the Bidborough Street elevation to provide access to the Second and Third floors which will be converted to commercial office and the Basement which will be converted to a basement affordable SME workspace for small and medium sized companies. A new lift will be located in the south east lightwell to provide dedicated access to these floors.

The Camden Centre will be let commercially to a new events company who will continue to operate the space putting on a range of commercial events. Two new entrances are proposed on Tonbridge Walk, alongside a new lift and dumbwaiter. The preferred new tenant, Il Bottaccio, has proposed a package of measures to enable community groups to continue to use the space, further details are included in the Planning Statement.

1.2 Site Constraints

The building was built in 1937 and is listed Grade II under the planning Act 1990 as amended for its special architectural or historic interest.

The site is bounded to the north by Euston Road, a major road with fast flowing traffic. Directly to the north of the site is St Pancras Station and Chambers and the St Pancras Renaissance Hotel. Adjacent to this, on either side, are the Grade I listed British Library and Kings Cross Station. To the west of the site, on Judd Street, are office buildings and student accommodation, the offices of the Royal National Institute for the Blind are located to the south west of the site. Directly south of the site on Bidborough Street are the Queen Alexandra Manson Block, a 5-7 storey residential block. At the end of Bidborough Street is the Argyle Primary School. Directly to the east of the site, on Tonbridge Walk is the old Town Hall Annex, which is being converted into a hotel.

The structure is steel frame with Portland stone cladding.

2 Regulatory & Certification Context

2.1 London Borough of Camden

The Camden Local Plan sets out the Council's planning policies. Camden Council have prepared a Camden Planning Guidance (CPG) document to support the Camden Local Plan (CLP). The CPG covers a range of areas with sustainability being a key topic. The council is committed to reducing Camden's carbon emissions by improving energy performance of buildings and as such the Lean – Clean – Green principles have been applied.

Policy CC1 Climate change mitigation requires all developments to minimise the effects of climate change and encourage all developments to meet the highest feasible environmental standards that are financially viable during construction and occupation.

Paragraph 8.11 of the Local Plan requires developments of 500sqm gross internal floorspace to achieve a 20% reduction in CO_2 emissions from onsite renewables.

Policy CC2 Adapting to climate change requires developments to be resilient to climate change.

Policy D2 of the Camden Local Plan relates to Heritage. Paragraphs 7.56 to 7.60 and 7.62 describe approaches relating to improvements that may be undertaken in buildings of heritage significance. The Plan states that in assessing applications for retrofitting sustainability measures to historic buildings the Council will take into consideration the public benefits gained from the improved energy efficiency of the building (paragraph 7.57). It also explains that the council has a general presumption in favour of the preservation of listed buildings (paragraph 7.58). In order to protect listed buildings, the Council will control external and internal works that affect their special architectural or historic interest (paragraph 7.59). Paragraph 7.62 describes appropriate sustainability measures in listed buildings.

Camden Planning Guidance

Table 2b, Energy reduction targets sets out the energy and carbon reduction targets for major (>1,000m2) non-domestic refurbishments (assessed under L2B). Camden Town Hall falls under this classification . For overall carbon reduction targets, it asks for the "greatest possible reduction, meeting Part L2B for retained thermal elements."

It then asks for the reduction in CO_2 from onsite renewables (after all other energy efficiency measures have been incorporated) for this type of building to be 20% (in line with the above Local Plan Guidence).

Section 11 Sustainability Assessment Tool states that 'BREEAM Excellent is required for all non-residential development of 500m^2 or more floorspace'. As the project's refurbishment area is larger than 500m^2, this sets the minimum target rating for the project.

In addition to the overall score, CPG Energy Efficiency and Adaptation Section 11.3 references that the minimum standards for specific BREEAM categories (% of un-weighted credits) are the following:

- Energy 60%
- Water 60%
- Materials 40%

The above policies in relation to BREEAM are being addressed in the Sustainability Statement.

2.2 London Plan

The current London plan (Policy 5.2 Minimising Carbon emissions) sets the following requirements for non-domestic buildings asks for a 40% improvement on 2010 building regulations for buildings going to panning between 2013-2016 and for 2016-2019 an improvement "as per building regulations requirements"

This has been superseded by "Energy Assessment Guidance" issued by the GLA in October 2018. This guidance document asks that projects *"demonstrate at least a 35% on-site reduction beyond Part L 2013 for non-residential development".*

Section 7 of this document covers "Calculating regulated CO2 emissions for refurbishments" and describes how baselines for refurbished buildings should be calculated.

In addition, the below policies from the adopted London Plan area are addressed.

- 5.6 Decentralised Energy in Development Proposals
- 5.7 Renewable Energy
- 5.8 Innovative Energy Technologies
- 5.9 Overheating and Cooling Quality

2.3 Building Regulations Part L

In November 2013 amendments to Part L of the Building Regulations 2010, was implemented under the Approved Document L2B: Conservation of Fuel and Power in existing buildings other than dwellings.

2.4 European Energy Performance of Buildings Directive

The EU Energy Performance of Buildings Directive (EPBD) was introduced in the UK from January 2006 with a three year implementation period ending January 2009.

The EPBD introduced higher standards of energy conservation for new and refurbished buildings from April 2006 and requires energy performance certification for all buildings when sold or leased. In addition, it introduced regular inspections for larger air conditioning systems and advice on more efficient boiler operation for commercial properties.

Energy Performance Certificates (EPC) is required on construction, sale or lease of all buildings from October 2008 – both dwellings and non-dwellings. The certificate includes an energy rating, as well as advice on how to make cost effective improvements to the building to make it more energy efficient. The ratings are similar to those currently used for white goods, ranging from A to G, with A the best and G the worst.

From July 2015, a Display Energy Certificate (DEC) and advisory report are required for buildings with a total useful floor area over 250m^2 that are occupied in whole or part by public authorities and frequently visited by the public. Note that the total useful floor area is defined as the gross floor area, as measured in accordance with the Building Regulations.

Private organisations, including those that may share a building with a relevant institution, do not need to display a DEC, but may elect to do so, on a voluntary basis.

2.5 BREEAM

The BRE Environmental Assessment Method (BREEAM) is a voluntary tool to measure the sustainability of non-domestic buildings in the UK. It covers a broad range of sustainability indicators including energy and carbon dioxide emissions, water, materials, surface water run-off, waste, pollution, health and wellbeing, management, and ecology. Each category includes a number of environmental issues.

An assessment must be carried out by an authorised BREEAM assessor and is a two stage assessment process taking in both the design stage and post construction stage. Camden council are committed to achieving the highest possible BREEAM rating for the proposed scheme, whilst acknowledging the specific characteristics of the site and its surroundings.

Arup has been appointed to provide BREEAM advice for the Camden Town Hall project during Stage 2. The BREEAM AP held meetings with the design team and reviewed planning requirements in order to have an overall understanding of the project and the requirements. The BREEAM pre-assessment analysis confirms that BREEAM Excellent can be targeted for the project providing all of the measures identified in the pre-assessment are incorporated in the design. Refer to Sustainability Statement for more details.

3 Existing Building Performance

This section defines how the baseline energy demand and carbon dioxide emissions of the building are calculated.

All energy calculations were modelled using the Integrated Environmental Solutions (IES) Virtual Environment. The calculation engine version 7.0.6 BRUKL compliance module v5.2.g.3.

3.1 Existing Baseline Energy Demand

The baseline building has been developed including all the existing building fabric for both solid elements and windows. The building services minimum values have been based on Part L minimum requirements. Existing air permeability and plant performance assumptions are summarised below.

Key input parameters such as existing fabric U-Values, G-Values, air permeability and existing plant performance data used in the base case model have been summarised below.

Fabric Area	**U Value (W/m^{2}K)**
Stone Walls - LG, 2 & 3	1.8
Stone Walls - L1	1.2
Concrete Floor	0.62*
Pitched Roof (Insulated under)	0.2
Flat Roof	0.2
Single Glazing	6
Single Glazing w/ secondary glazing	2.0
Air Permeability	15 m^3/m^2/hour at 50 Pa**
Plant Performance	
Boiler seasonal efficiency	80%
Cooling plant SEER	2.2
AHU Specific Fan Power (W/l/s)	4

*A reduced value for the floor U-value has been used to account for limited heat loss from areas deep in the floor plate

** It is assumed that the air permeability of the existing building is 15 m^3/m^2/hour at 50 Pa – the contractor when appointed, will undertake an air tightness test to establish the baseline, at which point we will be able to establish the exact air permeability of the existing building.

The building currently has different uses which has been taken into consideration when assessing the primary and operational energy consumption. Building classifications used in the model are:

- Camden Centre – Events Use
- B1 – Office and workshop businesses – to represent office areas

4 Passive Design Approach (Lean)

This section describes measures taken to minimise the energy demand for the building by considering the building fabric and surrounding environment.

As this is an existing building it falls under "Part L2B: Conservation of fuel and power in existing buildings other than dwellings". In particular, this requires that existing historic buildings are improved 'as far as is reasonably practicable'. Details of what is "reasonably practicable" are set out in Part L2B.

The Lean measures adopted for the proposed building are what is considered to be the "reasonably practicable" improvements. Therefore, the "Lean" building would be equivalent to a Part L2B compliant building.

In addition, Policy 5.9 "Overheating and cooling" of the adopted London plan asks *"major development proposals to reduce the potential overheating and resilience on air conditioning systems and demonstrate this in accordance with the 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)."*

Camden Local Plan Policy CC2 "Adapting to climate change" also requires that this hierarchy is followed. The cooling hierarchy is addressed in the following sections.

4.1 Site Location

This is an existing building situated in an urban location in the London borough of Camden. Its adjacent streets are Euston Road to the North, Judd Street to the West and Bid Borough Street to the South.

4.2 Site Weather

A full dynamic thermal model was created to assess year-round thermal comfort conditions. The weather file used for this was the 2005 London test reference year. A further assessment was undertaken to simulate the impact of climate change by using future weather files for 2020, 2050 and 2080 (see section 7).

4.3 Microclimate

The site is surrounded by other buildings in relatively close proximity, so local wind canyons may be in effect. The original building features four full height light wells that extend from roof level to the basement which may currently also introduce irregular wind patterns. Three of these original light wells are proposed to be covered over at the top. The energy model considers the impact of surrounding buildings on the town hall.

The adjacent streets, in particular Euston Road, have poor air quality due to high levels of air pollution from passing traffic.

Internal environment can be influenced by additional passive measures such as internal blinds to minimise solar gains.

4.4 Building Layout and Orientation

There is potential for zoning some areas to improve system efficiency. For example, the basement back of house areas would have broadly similar servicing requirements and could be treated as one zone. Other areas could be operated based on occupancy; the toilets, bike stores and storage areas could be served continuously during normal occupied hours and then on a PIR at other times.

The council offices will be arranged around the perimeter of the ground and first floors and will hence have different façade orientations. It would therefore be sensible to control heating to these spaces on a room by room basis, as south facing offices will receive higher solar gains. Similarly, the open plan office space on the upper floors can be split into smaller perimeter and internal thermal zones to enable better control of the localised environments.

4.5 Building Form and Fabric

Opportunities to improve the building form and fabric has been found by covering three out of the four existing lightwells to reduce the external surface area of the building through which thermal losses currently occur. The new glazed roofs on top of the lightwells will meet Part L minimum requirements while still allowing natural light into the space.

It is proposed to also improve the insulation on the roof areas to Part L2B standards.

All existing external windows are proposed to be upgraded with secondary double glazing with improved U and G values to minimise heat losses in the winter, maintain daylight and minimise the air tightness of the building.

Upgrading the thermal performance of the walls of the building was assessed, however, due to the heritage nature of the internal spaces, particularly the wood panelled spaces at 1st floor, it was considered unfeasible to improve the performance of the external walls through the addition of insulation.

4.6 Thermal Mass or other Fabric Thermal Storage

Thermal mass has been considered and will be used where appropriate taking advantage of the thermal inertia of the existing masonry walls to stabilise the thermal comfort within the occupied spaces such as the commercial spaces at basement, level 2 and level 3.

4.7 Building Occupancy Type

The occupancy varies across the building's different room types. As discussed above there may be potential to control some areas based on their occupancy.

The Council Chamber's use is intermittent and its occupancy greatly variable. Similarly, the Camden Centre will potentially be a Events multi-use function room that would see a wide variety of occupancy patterns. Each will have a dedicated Air Handling equipment that may be turned off when the space is not occupied, thus reducing energy demands.

In addition, there will likely be a difference in occupancy types between the compartmentalised council offices and the open plan tenant offices. Different Air handling systems will also be used for each of these spaces to better align the energy demands with the occupancy of the spaces.

4.8 Ventilation Strategy

Due to the Town Hall's proximity to busy roadways, the opportunity for any provision of natural ventilation and cooling via natural ventilation is minimal due to the poor external air quality and high air and noise pollution. Highly efficient mechanical ventilation systems with heat recovery are therefore proposed to serve the buildings different areas.

4.9 Daylighting

The existing main facades have relatively low glazing ratios and the windows are inset into the stonework, so care will be taken when adding secondary glazing to maintain as much natural light as possible. Selection of glazing will be such to maximise natural daylight whilst minimise the solar gains. Secondary glazing with a G value between 0.35 and 0.4 are proposed for the development.

High level windows in the basement, adjacent to the Euston Road pavement will be opened up to allow some natural light into the basement affordable SME workspace space.

4.10 Contribution of Lean Design Measures

4.10.1 Passive

As mentioned previously, the listed status of the building prevents extensive upgrades to the fabric, however, the covering over of three of the four light wells

reduces the surface area of the existing fabric exposed to the elements and thus brings passive improvements to the building form.

The Base case shown below includes the proposed extension to the building and basic upgraded building services. In addition, secondary glazing is added to all refurbished windows which further improves the performance of the façade.

The improvements to the fabric are summarised below.

Fabric Area	**U Value (W/m^{2}K)**
Stone Walls - LG, 2 & 3*	1.8
Stone Walls - L1*	1.2
Concrete Floor*	0.6
Pitched Roof (Insulated under)	0.2
Flat Roof	0.2
Improved Single Glazing w/ secondary glazing	2.0
Skylight	1.8
Air Permeability	10 m^3/m^2/hour at 50 Pa**

*Due to the heritage nature of the existing building and particularly the heritage status of the internal wood panels in ground and first floor it is not proposed to improve the existing stone walls. However, these are considerably thick masonry elements and their thermal performance is expected to be adequate.

** It is assumed that the air permeability of the proposed building is 10 m^3/m^2/hour at 50 Pa – due to the heritage nature of the building it is not possible to know the exact air tightness of the building following upgrades to the fabric. The air tightness of the refurbished building will be tested on site following completion of the building.

4.10.2 Active

Active Lean measures relate to strategies to source and supply energy efficiently.

It is assumed that significant enhancements to plant efficiencies are made, which can be achieved by replacing current plant with modern units and upgrading existing systems. Installing high efficiency lighting and lighting controls also delivers a benefit. The perimeter offices will have lighting controls linked to daylight sensors to minimise unnecessary energy use and heating in brighter conditions.

Plant Performance	
Boiler seasonal efficiency	86%
Heat Recovery efficiency	65%
Cooling plant SEER	2.5
AHU Specific Fan Power (W/l/s)	1.9
FCU Specific Fan Power (W/l/s)	0.3

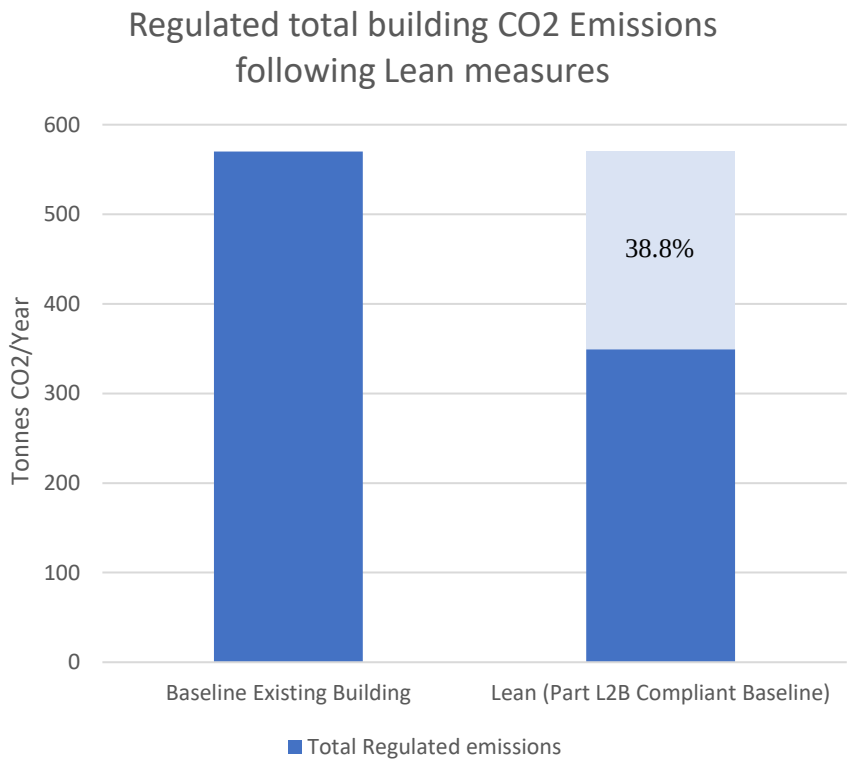
The improvements to the heating, cooling and ventilation system are summarised in the table below.

Metering of energy (electricity and heating/cooling) is to be provided for all main building uses and tenancies.

4.10.3 Results

The combination of passive and active lean measures result in a 38.8% improvement in carbon emissions over the existing building as shown in the graph below.

As discussed earlier, the Lean measures adopted for the proposed building are what is considered to be the “reasonably practicable” improvements. Therefore, the “Lean” building would be equivalent to a Part L2B compliant building.



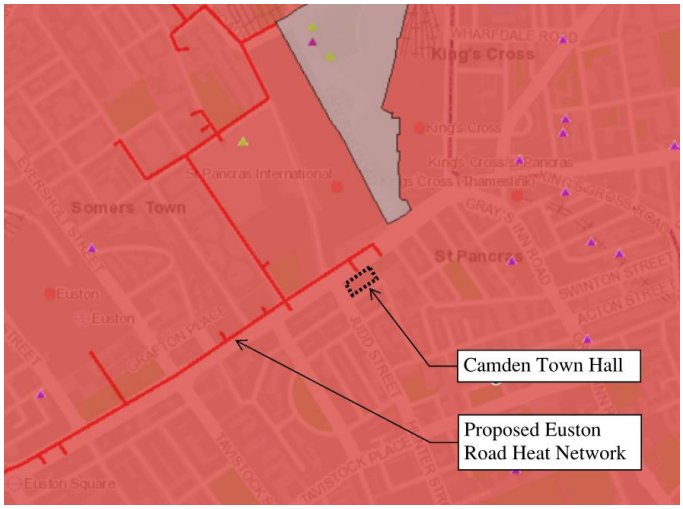
5 District Networks & CHP (Clean)

Policy 5.6 “Decentralised energy in development proposals” of the Adopted London Plan requires that: “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.”

5.1 District Heating Networks

District Heating (also known as District Network) is a distribution system of insulated pipes that takes heat from a central source and delivers it to a number of domestic or non-domestic buildings. The heat source might be a facility that provides a dedicated supply to the heat network, such as a combined heat and power plant; or heat recovered from industry and urban infrastructure, canals and rivers, or energy from waste plants.

There is not currently a district heating network in the area, however, the London Heat Map (see below) shows that the proposed Euston Road Heat Network is planed to run directly adjacent to the site. The only areas of this Heat Network to have begun construction are the area directly local to Somers Town and the Francis Crick Institute and it is not known when the network might extend to the area of Camden Town Hall, nor whether there would be capacity for the building to connect to it. Given the relatively low heating demand of the building and the fact that the use of Air Source Heat Pumps (described in the below section) is likely to result in a lower carbon heating solution, it is assumed that a connection to a district heating network would not be utilised in the near future. However, in order to provide the flexibility for connecting to the district network in the future and support Camden Borough heating hierarchy (which favours connecting to district networks), an allowance will be made for a set of pipework to terminate at basement level for connecting to district pipes in future.



Element of London Heat Map showing proposed Heat Network Provision around the site.

5.2 Combined Heat and Power (CHP)

A CHP system can use a variety of fuel sources, but the most common and reliable source is natural gas. The CHP engine uses the gas to drive an electrical generator and heat is a produced as a by-product from the engine cooling system and from the hot gases in the flue. In a conventional power station the heat is dumped to maximise the electricity production efficiency, but with a CHP system electricity generation efficiency is reduced to allow the heat to be utilised directly for hot water and space heating.

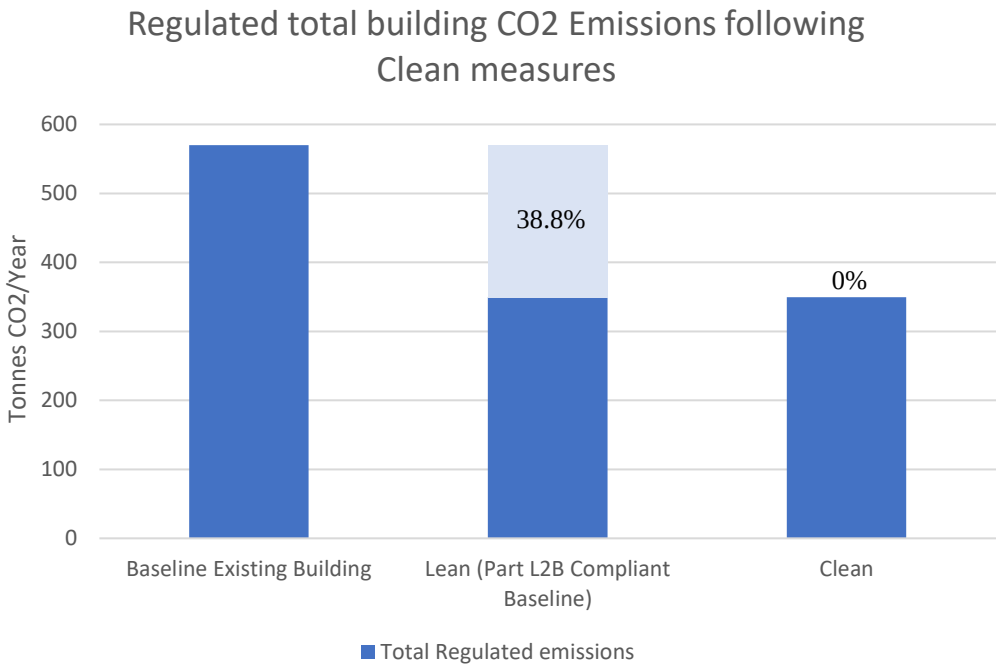
CHP systems operate most efficiently when there is a large base heating demand throughout the year. They have been found to be economic when they can be run for more than 6,000 hours per year. This means that an economic CHP system needs to run on an average 16.5 hours per day, 7 days per week. Ideally, it would run for longer hours to allow for downtime and maintenance. A variety of end users and a large hot water accumulator would allow for a larger CHP system to be economically feasible.

The usage profile of the building is expected to be that of a typical office; Monday to Friday, and approximately 8am to 6pm. During the summer period the electrical energy demand is expected to be high, however there is no need of heating. This usage profile equates to approximately 2600 hours of operation per annum. The base load heating demand is too low to justify a CHP system as a viable solution for this development.

Furthermore, the Greater London Authority planning guidance states that non-domestic developments with a simultaneous heat and power demand of less than 5000 hours per annum are exempt from on-site CHP systems.

5.3 Clean Measures Summary

As neither District Heating nor CHP are feasible to integrate into the building, no improvement to the buildings performance is seen over the Lean strategies described in section 4.


Regulated total building CO2 Emissions following Clean measures
600
500
400
300
200
100
0
Tonnes CO2/Year
38.8%
0%
Baseline Existing Building
Lean (Part L2B Compliant Baseline)
Clean
Total Regulated emissions

6 Low and Zero Carbon Assessment (Green)

To further reduce carbon dioxide emissions, the viability of various renewable sources of energy were considered and detailed in this section.

This is in line with Policy 5.7 "Renewable energy" of the Adopted London Plan asks that *"major development proposals should provide a reduction in expected carbon dioxide emissions through the use of on-site renewable energy generation, where feasible."*

6.1 Wind Turbines

Wind turbines harness the kinetic energy in the wind and convert this to electrical energy using a mechanical turbine. The efficacy of wind turbines depends heavily on the (i) wind speed and (ii) the swept area of the turbine's blades.

In an urban environment such as the town hall site, wind characteristics are generally turbulent owning to the surrounding buildings obstructing its path. This leads to low, 'gusty' wind speeds which are not ideal for turbines. Large scale wind turbines need a considerable and consistent wind speed to start operating, while smaller machines can cope with lower 'start up' speeds.

Constraints of the building being listed preclude the use of building integrated wind turbines. Studies with small scale wind turbine installations have a very poor performance unless they are sited well above the surrounding buildings. In the case of the town hall, the potential yield from small turbines is not deemed sufficient to warrant application.

It is deemed that wind turbines are therefore not feasible for this project.

6.1.1 Biomass Boilers

Biomass requires woodchip or wood pellets as a fuel source. These are then combusted at high efficiency to generate heat.

In order to realise high efficiencies the burners are better suited to constant loads which do not cycle on and off as it takes longer for the boilers to reach their optimum efficiencies. The heating loads for the proposed development are not expected to be sufficiently constant to make biomass heating a feasible option.

The procurement, delivery and storage of the biomass raw material also requires consideration. Added to this, combustion of biomass is also noted for leading to degradation in air quality. The air quality in the town hall site is particularly important noting the close proximity to Euston road that already experiences poor air quality.

Biomass heating is therefore not considered as a viable opportunity for the project.

6.1.2 Ground Source Heat Pumps

Soil temperature is mainly influenced by the temperature of the atmosphere at ground level and by solar radiation. Below around 2-3m depth, the temperature varies very little over the course of a year and is approximately constant at the mean annual air temperature. For Camden Town Hall, this is likely to be around 12-13°C.

Ground Source Heat Pumps only work efficiently if there is a relatively balanced annual heating and cooling load for the development.

There are a number of ways in which the ground can be used: horizontal pipes in the ground; vertical boreholes, and; putting the pipe work in piles. In all cases, the system is closed and the working fluid is pumped around. Open loop systems tend to use an aquifer deep underground to act as a heat sink;

As the project area is limited to the existing building footprint, Horizontal Arrays would not be feasible as it would not be feasible to install under the building. Boreholes would be challenging to construct due to the site constraints. Similarly, Energy Piles where ground loops are installed within the building piles would not be appropriate as the building currently has all the foundations it requires.

6.1.3 Air Source Heat pumps

An air source heat pump is a refrigerant based system which uses the outside air as a heat source. At peak design conditions, the emissions from air source heat pumps are comparable to those from a gas fired heating system. However, when they operate in ‘mid-season’ external conditions (external temperature in the region of 12°C) their efficiency improves, reducing carbon emissions. Optimum emissions reductions from air source heat pumps can be obtained if they generate hot water at a relatively low temperature (around 40°C to 55°C). .

Heat pumps can also be reversible to provide beneficial comfort cooling. The relatively small size of external units can be more easily accommodated within the constraints of an existing building compared to one or two large modules.

Air Source Heat Pumps need to be located externally. As roof space is available, Air Source Heat pumps are considered to be feasible for the project.

6.1.4 Photovoltaic (PV)

Photovoltaic panels are semi-conductors which convert incident sunlight into electricity. They work well in a semi-rural or urban context as long as unshaded space can be identified.

Key to the efficiency of PV is shading. If shading occurs on an individual module, the electrical output of the whole array is reduced. This means that the optimum siting of modules should be completely unshaded. The existing and new flat roofs of the building are at a lower level than the existing pitched roofs; therefore any

PVS on the flat roof will be shaded. In addition to that the flat roofs are being used to house the ASHPs and associated equipment (eg. pump sets).

The existing pitched roof facing south has a very small free area and part of it is being used as ventilation louvres for the exhaust air from the air handling units which are located within the eaves of the pitched roof. As such, there is not sufficient available area for a PV installation.

Photovoltaics is therefore not considered as a viable opportunity for the project.

6.1.5 Solar Thermal

Solar panels can be used to good effect to raise the temperature of water when the sun shines. A percentage of the hot water demand in summer for WC and shower areas can be supplied with solar thermal.

The existing pitched roof facing south has a very small free area and part of it is being used as ventilation louvres for the exhaust air from the air handling units which are located within the eaves of the pitched roof. As such, there is not sufficient available area for a solar thermal installation.

Solar thermal is therefore not considered as a viable opportunity for the project.

6.2 Innovative energy technologies

Policy 5.8 “innovative energy technologies” of the adopted London Plan *“encourages the more widespread use of innovative energy technologies to reduce use of fossil fuels and carbon dioxide emissions. In particular the Mayor will seek to work with boroughs and other partners in this respect, for example by stimulating:*

a) the uptake of electric and hydrogen fuel cell vehicles

b) hydrogen supply and distribution infrastructure

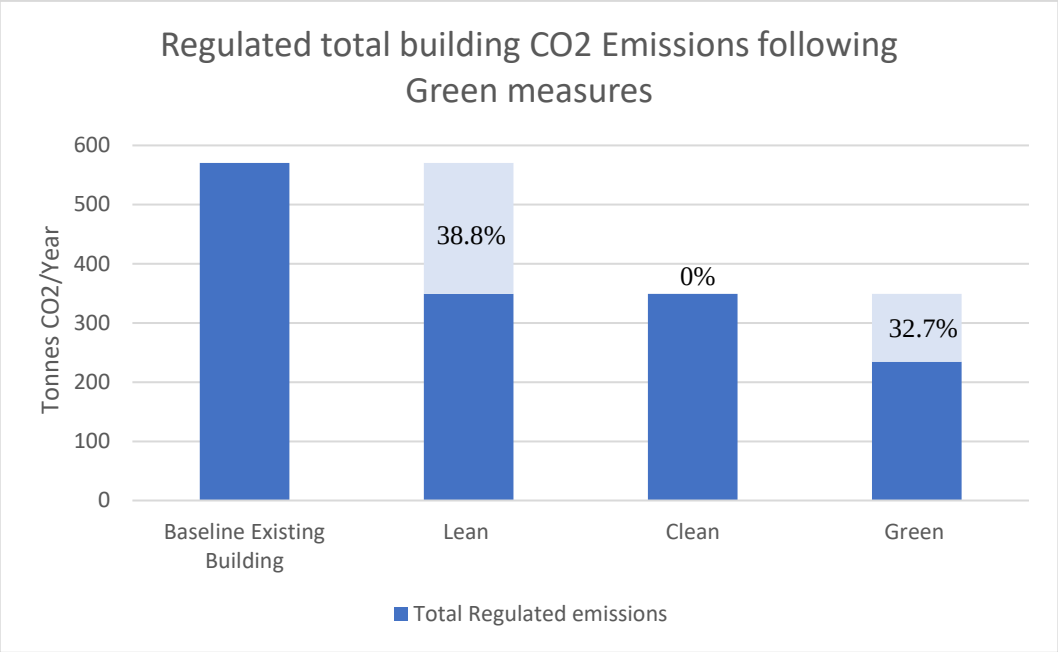
c) the uptake of advanced conversion technologies such as anaerobic digestion, gasification and pyrolysis for the treatment of waste.”

Due to the scale of the project and the current infrastructure available, these innovative energy technologies have been found to not be appropriate for the site at present. These may be reviewed should more suitable innovative technologies be developed.

6.3 Contribution of green design measures

The carbon savings associated with the integration of ASHPs in the building are illustrated in the graph below. These are based on the Part L 2012 Carbon factors as per current building regulations.

ASHP Plant Performance	
Heat Pump SCOP	3.42
Heat Pump SEER	3.62



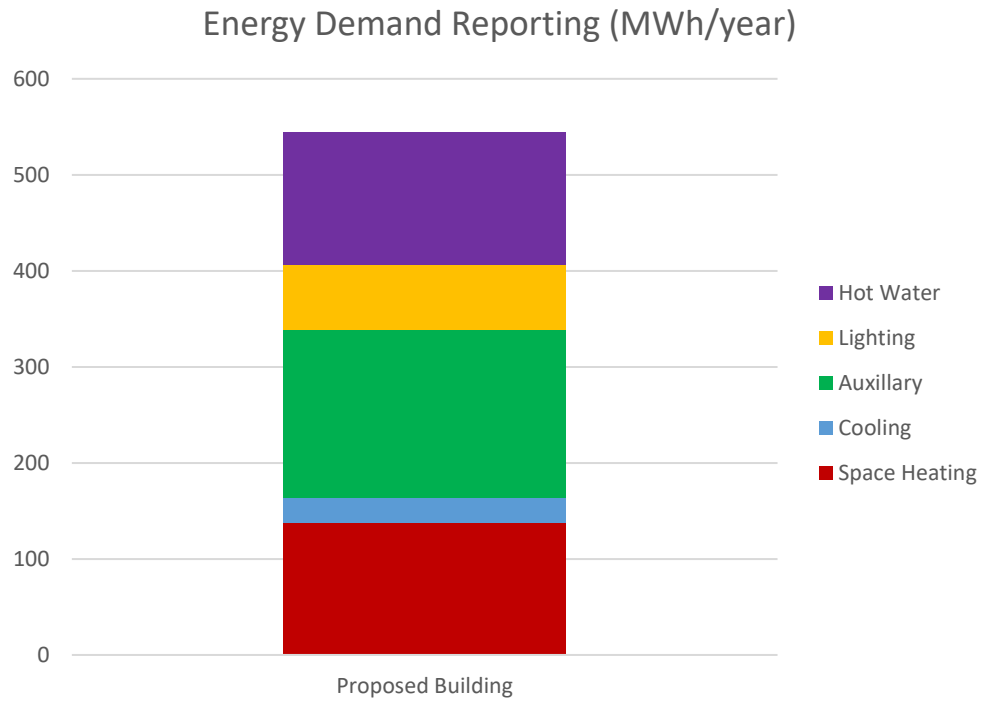
	Part L 2012 Carbon Factors			
	BER	**Total Regulated emissions**	**CO_2 Savings from hierarchy measures**	
	($kgCO_2/m^2$)	**(Tonnes CO_2/Year)**	**(Tonnes CO_2/Year)**	**(%)**
Baseline Existing Building	51.7	570		
Lean (Part L2B Compliant Baseline)	31.4	349	221	38.8%
Clean	31.4	349	0	0.0%
Green	21.1	235	114	32.7%

Note: this table and the associated graph have been developed in line with the GLA Energy Assessment Guidance 2018 (Para 6.5)

The adoption of ASHPs provides a further 32.7% improvement over the "lean" building. The green measures adopted for the proposed site exceed the Camden Local Plan requirement for developments of 500sqm gross internal floorspace to achieve a 20% reduction in CO2 emissions from onsite renewables.

Through the use of the energy hierarchy, the total reduction in building CO2 emissions over the existing baseline building has been calculated to be 58.8%. This exceeds the 35% requirement set out by the GLA Energy Assessment Guidance 2018 document.

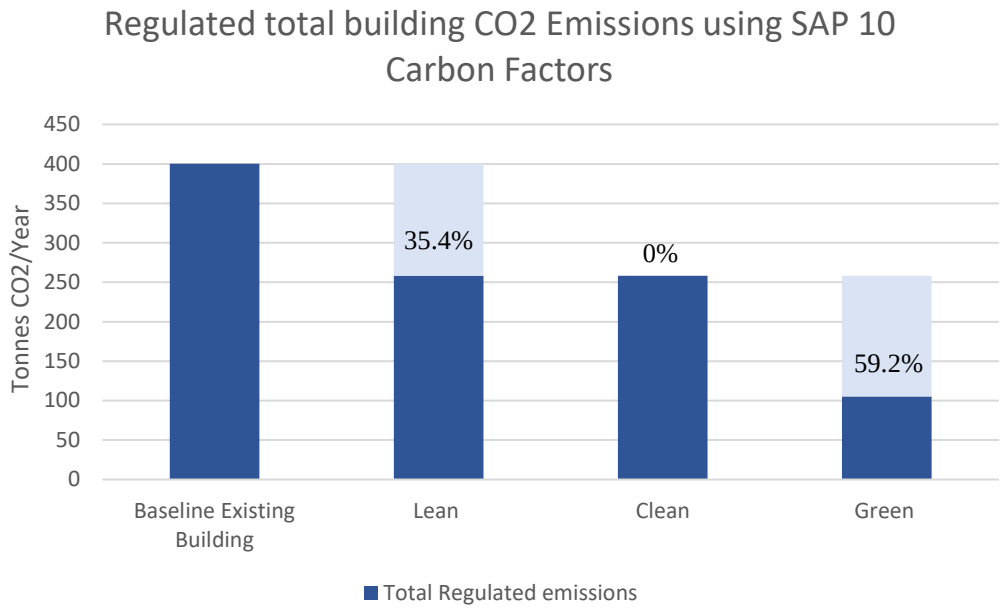
The below graph shows the annual energy demands of the proposed building split between the main energy uses in the building.



For information purposes we have also compared the above results using the SAP 10 carbon emissions figures (currently recommended by GLA).

Grid Carbon Factors		**kgCO2/kWh**
Part L 2012	Mains Gas	0.216
	Electricity	0.519
Draft Part L 2019	Mains Gas (Draft Part L 2019)	0.210
	Electricity (Draft Part L 2019)	0.233

The impact of the Lean, Clean and Green measures are shown in the Graph below:



The usage of the SAP 10 carbon factors show a further reduction on the building carbon emissions linked to the decarbonisation of the grid.

7 Adaptation to Climate Change

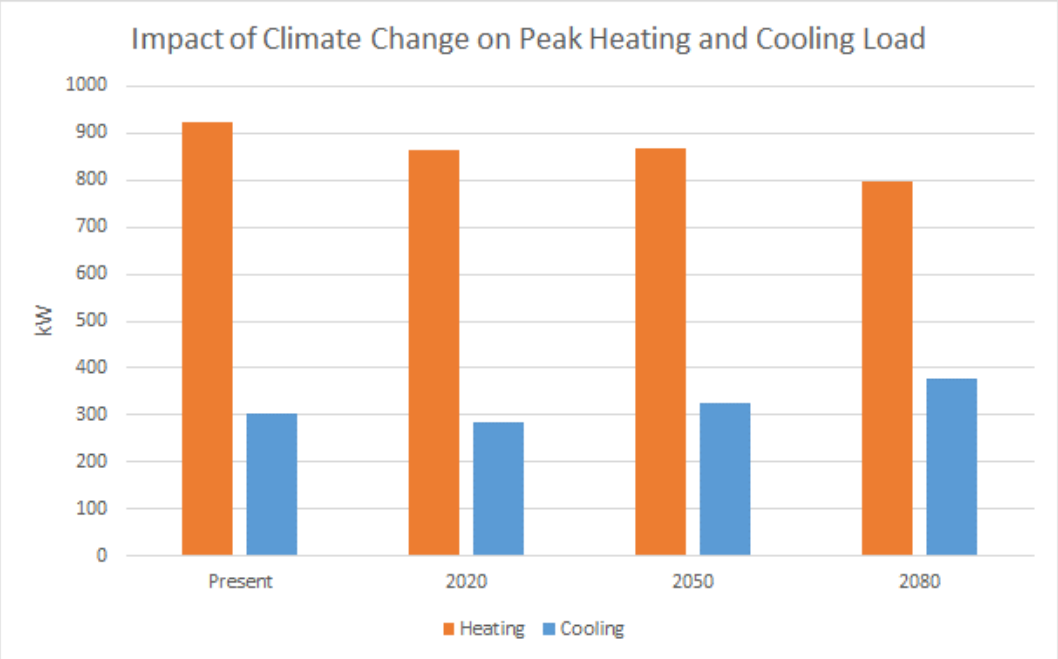
The 2014 report from the Intergovernmental Panel on Climate Change (IPCC), concluded that, “The global mean surface temperature change for the period 2016–2035 relative to 1986–2005 is similar for the four RCPs, and will likely be in the range 0.3˚C to 0.7˚C”

CIBSE have undertaken studies to predict the temperatures for the future taking into account Climate Change predictions for the future. The analysis is split into three 30 year analyses as follows:
Two ‘timescales’, each a thirty-year period
2020s (2011-2040)
2050s (2041-2070)

The building services plant has a design life of 20 years, and therefore it has been decided that the 2011 – 2040 prediction should be used to specify the building services plant.

The building services need to be designed for a changing weather environment, therefore the final energy model has been tested using future weather files.

A functional adaptability study has also been undertaken to evaluate how the building may be adapted in the alternative uses in the future. This file note may be found in the Appendix.



8 Conclusion

This energy statement has demonstrated how the proposed Camden Town Hall development meets planning policy relating to energy.

Policy CC1 Climate change mitigation of the Camden Local Plan has been met through the reductions in carbon emissions following the energy hierarchy (**CC1 point a**), sensitively incorporating energy efficiency improvements in this existing building (**CC1 point d**).

A Low and Zero Carbon Assessment has been carried out (section 6) to review the feasibility of a range of renewable technologies for the site, finding that ASHPs are the most appropriate for the building. This meets the requirements set out by the **London Plan policies 5.7 Renewable Energy and 5.8 Innovative Energy Technologies.**

The **Camden Planning Guidance** to target the greatest possible reduction, meeting Part L2B for retained thermal elements has been met.

The **GLA Energy Assessment Guidance** target of a 35% improvement over the baseline existing building has been met with an overall improvement of 58.8%.

The feasibility of connecting to a district heating network has been assessed and found not to be feasible or appropriate for the site (**CC1 point i**). This also addresses **London Plan policy 5.6 Decentralised Energy in Development Proposals.**

Paragraph 8.11 of the Local Plan requires developments of 500sqm gross internal floorspace to achieve a 20% reduction in CO2 emissions from onsite renewables. This has been met with a 32.7% of carbon emissions through the use of Air Source Heat Pumps on site.

Policy CC2 Adapting to Climate Change of the Camden Local Plan has been met through the application of the cooling hierarchy in the Lean measures adopted in the building (section 4). This also addresses **London Plan policy 5.9 Overheating and Cooling Quality.**

Energy reductions are demonstrated to be sufficient to exceed the minimum energy credits requirements for BREEAM “Excellent”.

Appendix A

Functional – Adaptability Note

A1 Functional Adaptability

This technical note summarises how the building services strategies in the building, specifically the commercial offices, may be adapted to alternative uses in the future, taking into account the new scheme proposed by Purcells. This note is in relation to BREEAM Credit Wst 06 Functional Adaptability and is associated to Purcell's latest architectural proposals, as part of the Stage 2+ updates.

Due to the listed nature of the building, there are significant constraints on what may be achieved in certain parts of the building. In order to minimise the impact on the listed nature of the building, a mixed use in a future scenario may be most achievable based on the proposed services capacities in the current scheme.

Building uses such as Hotels and Residential require lower volumes of fresh air than commercial office, however, the water and drainage requirements are significantly increased. Additional drainage from each residential/hotel unit would be exceedingly challenging to run down from Level 2 without impacting upon the heritage level 1 Council spaces, therefore it is not recommended that Hotel/ Residential units are only considered for Levels 3 and 4. The implementation of hotels or residential units must also be discussed at an early stage with Thames Water due to the high water consumption.

Exhibition spaces have a higher fresh air requirement than commercial offices due to the higher occupant density. However, this may be balanced with spaces of lower ventilation requirements (such as residential/hotel) which leads to the Level 2 office area being a potential location for a future gallery.

The following table summarises the services impacts of usage opportunities of the current commercial office space and is to be read in conjunction with the services sections in the original Stage 2 report.

	Exhibition Space	**Hotel**	**Residential**
Electrical Central Plant	A 1500kVA transformer will be installed which will provide sufficient capacity is spaces are to be adapted in the future.	A 1500kVA transformer will be installed which will provide sufficient capacity is spaces are to be adapted in the future.	A 1500kVA transformer will be installed which will provide sufficient capacity is spaces are to be adapted in the future.
Electrical Distribution	Primary electrical risers at each corner of the building will provide routes adaptions to mains cabling in the future.	Primary electrical risers at each corner of the building will provide routes adaptions to mains cabling in the future.	Primary electrical risers at each corner of the building will provide routes adaptions to mains cabling in the future.

Mechanical Central Plant	Central Heating and Cooling (if necessary) strategy maintained with ASHPs. Ventilation requirements to the space would double based on 10 l/s.person at 3m2/person.	Central Heating and Cooling (if necessary) strategy maintained with ASHPs. Ventilation rate decreases.	Central Heating and Cooling (if necessary) strategy maintained with ASHPs. Local ventilation units for each residential unit. Coordination with Intakes/exhausts would require development.
Mechanical Distribution	Considerable modifications to the ventilation system will be required as it will have to be reverted from a minimum fresh air system to an all air system.	Distribution of pipework to be modified to serve each unit. Ventilation strategy to be reviewed to enable each unit to be separately served.	Distribution of pipework to be modified to serve each unit. Each unit would require metering. Local ventilation unit to be installed for each residential unit. Coordination with Intakes/exhausts would require development.
PH Central Plant	Water tank capacities sufficient as although the population density is three times higher the water use per person for an exhibition is six times lower	The type and grade of hotel significantly impacts the water demand. Hot and cold water consumption per person is between 3 and 5 times higher compared to the existing office scheme. A significant amount of additional space will be required to accommodate a hotel on these levels.	Hot and cold water consumption per person a three times higher compared to existing office scheme. Additional space will be required to accommodate larger tanks. Utility meter cupboards located on Level 2, 3 and 4 will be required.
PH Distribution	Proposed distribution and sanitary facilities likely to be sufficient for Exhibitions	Water services distribution pipework will be larger to cater for higher demands but can be routed within existing risers. A significant upgrade of the drainage infrastructure is	Water services distribution pipework will be larger to cater for higher demands but can be routed within existing risers. A significant upgrade of the drainage infrastructure is required

		required to incorporate ensuite drainage and higher flowrates. High discharge flowrates require early dialogue with Thames Water. Offsets of drainage pipework will require an acoustic review.	to incorporate flat drainage and higher flowrates generated compared to the office scheme. High discharge flowrates require early dialogue & approval with Thames Water.

Appendix B

BRUKL Report