BUROHAPPOLD ENGINEERING

UCL Kathleen Lonsdale Building

Energy Strategy and Sustainability Statement

031084

5 April 2016

Revision 04

Revision	Description	Issued by	Date	Checked
01	Energy Strategy and Sustainability Statement	MD	20.10.2014	NW
02	Energy Strategy and Sustainability Statement	MD	04.11.2014	NW
03	Energy Strategy and Sustainability Statement	MD	23.03.2016	NW
04	Energy Strategy and Sustainability Statement	MD	05.04.2016	NW

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1 Introduction

1.1 Overview

This Sustainability Statement has been prepared to support the planning and listed building application for the refurbishment of the Kathleen Lonsdale Building. The study has been prepared by Buro Happold, who are the energy and BREEAM consultants on the project.

Planning and Listed Building Consent (2014/7223/P & 2014/7310/L) was granted in January 2015 for a number of works to the KLB including general internal and external refurbishment. In October 2015, permission was granted for two planning and listed building consents associated with minor revisions to the scheme. The two key revisions included the reconfiguration of flues on the rear façade of the building and a minor extension to accommodate the GMP lab, also to the rear of the building.

This sustainability statement accompanies a new planning application, which is seeking full planning and listed building consent for "Changes to the internal layout and amendments to the external façade". The new application encompasses a number of minor design changes which have arisen following the detailed design stages of the refurbishment scheme. Since the previous application, the main changes to this statement include the addition of new more efficient boilers and amendments to the floors being served by district heating. The text and pre-assessment score relating to the BREEAM submission has also been updated.

1.2 Aspirations and challenges

UCL aspire to be leaders of sustainability in the built environment, carrying out world class research and pioneering projects across many fields. This aspiration is supported by a long term vision to reduce the operational running costs and increase the overall sustainability of its estate, with an overarching objective to achieve a 20% reduction in operational CO_2 emissions by 2020, over a 2005 baseline.

The Kathleen Lonsdale Building is one of many campus buildings that will be transformed in the effort to achieve this goal. Key aspirations for the project are to:

- Achieve an absolute reduction in operational carbon emissions by 20% by 2020 (over a 2005 baseline);
- Achieve a BREEAM 'Very Good' level of points under the BREEAM 2008 Education fit out scheme, retaining as high a points buffer as practically possible.

All aspirations will be balanced against a number of constraints, such as the building's Grade II listing status, the diverse range of stakeholders, departments and building users and the spatial and budgetary constraints. As such, the project aims to be as 'green' as possible whilst bearing in mind that the final solution will have to achieve balance between these conflicting requirements.

1.3 Energy strategy

The energy strategy for the Kathleen Lonsdale Building (KLB) has been developed following a 'lean, clean, green' philosophy, working within the constraints of the existing building. Key interventions have included:

- Secondary glazing to the front and double glazing to the rear to improve thermal and solar performance;

- Window opening provisions for natural ventilation of office spaces;
- Compliance with the 'Building Services Compliance Guide' for new system efficiencies;
- Improvements to cooling and ventilation plant and distribution at roof level and the rear of the building;
- Basement, ground, 1st and 2nd floors connected to the UCL district heating network. 3rd and 4th floors fed by 96% efficient boilers (compared to previous boilers that were 80%).

As the KLB submitted a notice to apply for Building Regulations consent prior to 6 April 2014, the project will be demonstrating compliance against the 2010 Building Regulations. The approach agreed with Building Control was to follow the Part L2B 'elemental compliance' option due to the refurbishment works only being undertaken for a portion of the building and due to the limited extent of the fabric upgrade works.

Although no energy modelling is required for Building Control compliance, it should be noted that the design team have undertaken an energy audit of the existing building together with modelling of key interventions impacting on operational carbon emissions. The key finding from this study was that a 23% reduction in operational carbon emissions may be possible largely due to improvements to heating, cooling and lighting controls.

A renewable energy feasibility study was conducted, however due to heritage restrictions much of the technologies were deemed unviable. It should be noted however, that the basement, ground, 1st and 2nd floors will be fed by the UCL district heating network (previously only the basement to 1st floor was served). Following an analysis of carbon factors, this is understood to be of lesser carbon impact than conventional gas boilers.

For BREEAM compliance it is intended that energy modelling will be carried out for the BRE design stage submission based on frozen Stage E information. This modelling will also be completed post-construction by the Contractor for the final BRE assessment.

1.4 Wider sustainability

During the concept design stage, a BREEAM pre-assessment under the BREEAM 2008 Education scheme 'refurbishment' criteria was conducted. The assessment was carried out twice; firstly to give a 'Base' score to represent what was easily achievable on the project, and secondly to give a 'Stretch' score; setting an aspirational target for the design team bearing in mind the potential constraints of the project.

Following these pre-assessments it was agreed that the proposed target of BREEAM Excellent was not achievable due to the limitations on energy performance (specifically under credit 'Ene-1 – Reduction of CO_2 emissions'), due to the building fabric upgrade being limited and a large majority of the building services not being upgraded (as up to 40% of the building area will be occupied throughout building works). In light of this the route forward was agreed: to pursue BREEAM at a Very Good level targeting as high a points buffer as practically possible.

The current pre-assessment demonstrates that the project is on track to achieve BREEAM 'Very Good' certification with 65.5% of points targeted, giving a 10% buffer over Very Good. Categories scoring particularly well include Management, Transport, Health & Well-being, Waste and Water.

Looking beyond BREEAM, it should be noted that a series of bespoke targets have been identified, building upon the measures enacted through the BREEAM assessment mechanism and the sustainable aspirations of UCL for KLB. The proposed measures require engagement and buy-in from the future building tenants to ensure a robust deployment. It is proposed that further detailing of these measures will continue leading into operation and handover.

2 Energy strategy

2.1 Summary

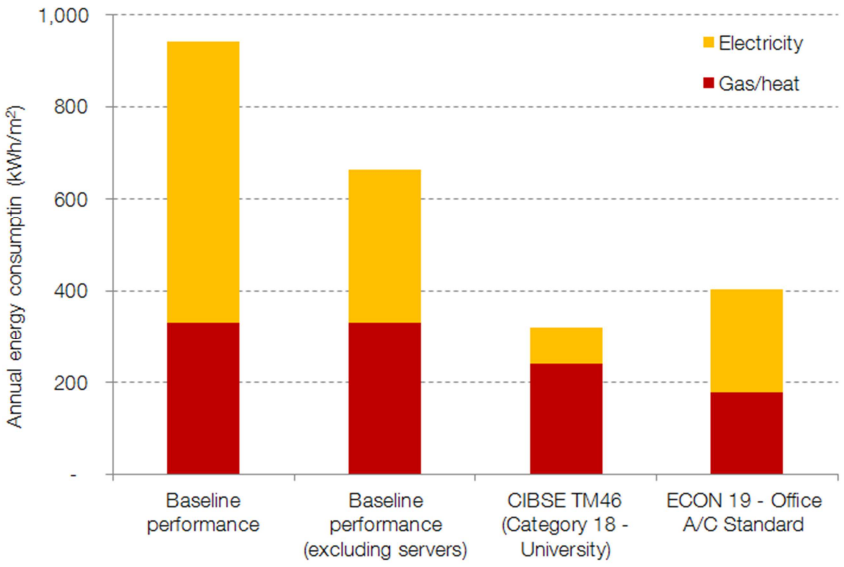
This section contains the energy strategy for the KLB covering (i) a summary the baseline energy performance data obtained through an energy audit (ii) the key outputs of the Part L2B compliance study, (iii) an operational carbon reduction analysis, and (iv) the findings of a renewable energy study.

2.2 Baseline energy performance

To understand the operational running performance of the KLB prior to refurbishment works, an energy audit was conducted through an assessment of utility bills, half hourly sub-meter data and a site inspection study.

The audit identified that KLB consumes far more energy than similar buildings, with annual energy costs of approximately £400,000 and operational carbon emissions of 2,500 tCO_2/year. This high level of consumption is largely due to the presence of two major servers, the high ventilation requirements of fully serviced chemistry laboratories and the large power consumption of earth science equipment.

Figure 2.1 compares the baseline energy use per m^2 compared to industry benchmarks for a typical university and office building. As shown, excluding server consumption, KLB consumes an average of 332 kWh/m^2/year for heating and 613 kWh/m^2/year for electricity, which is up to twice as intensive as benchmarks for typical university building.



Baseline heating and electricity usage at KLB (kWh/year):

Energy use for district heating (basement to 1st floor)	943,486
Energy use for gas boilers (2nd floor and above)	1,361,542
Small power equipment (including lab equipment)	1,083,758
Lighting	350,824
Local cooling	70,181
Mechanical plant	805,627
Server energy consumption	1,948,018

Figure 2.1 KLB energy consumption compared to benchmarks for a typical university and office building

Heating for the basement to 1st floor of KLB is currently served by the UCL district energy scheme. Heating to the 2nd floor and above is served by gas boilers located in the 4th floor plant room. The seasonal heating demand for the district heating supply is shown in Figure 2.2 below.

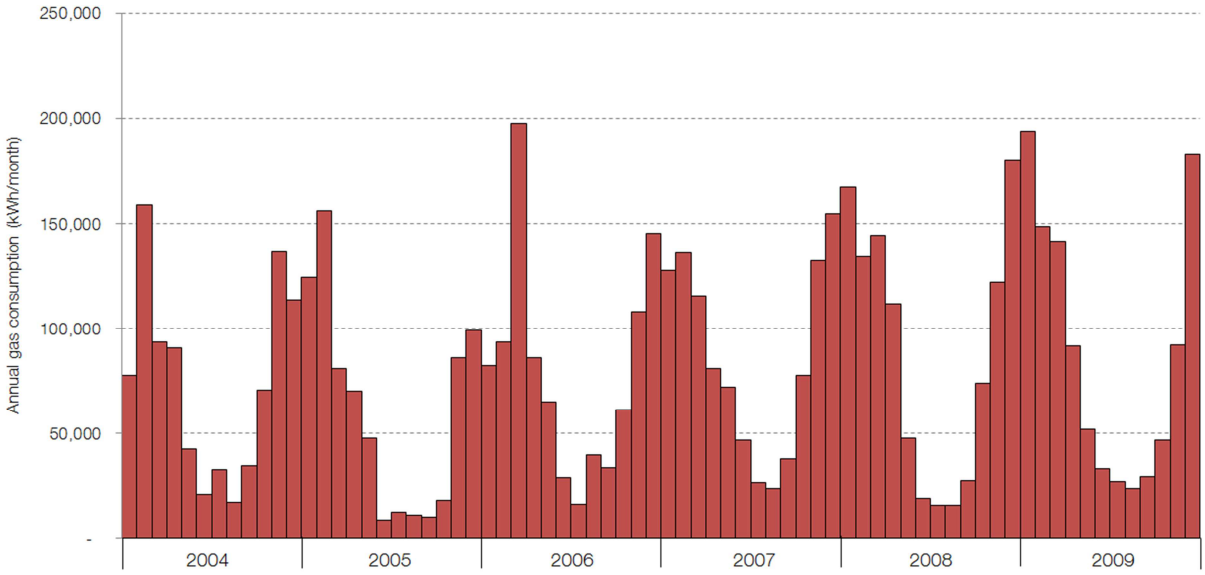


Figure 2.2 KLB district heating energy consumption

Regarding electricity usage, an average annual half hourly electricity use profile is given in Figure 2.3. As shown, during the week there is a high electrical base load of 200 kW, which only drops to 175 kW at weekends. Server energy use accounts for 46% of total electricity use for the building. Excluding servers, small power (including lab equipment accounts for 47%, lighting 15%, mechanical plant 35% and local cooling 3% of electricity usage.

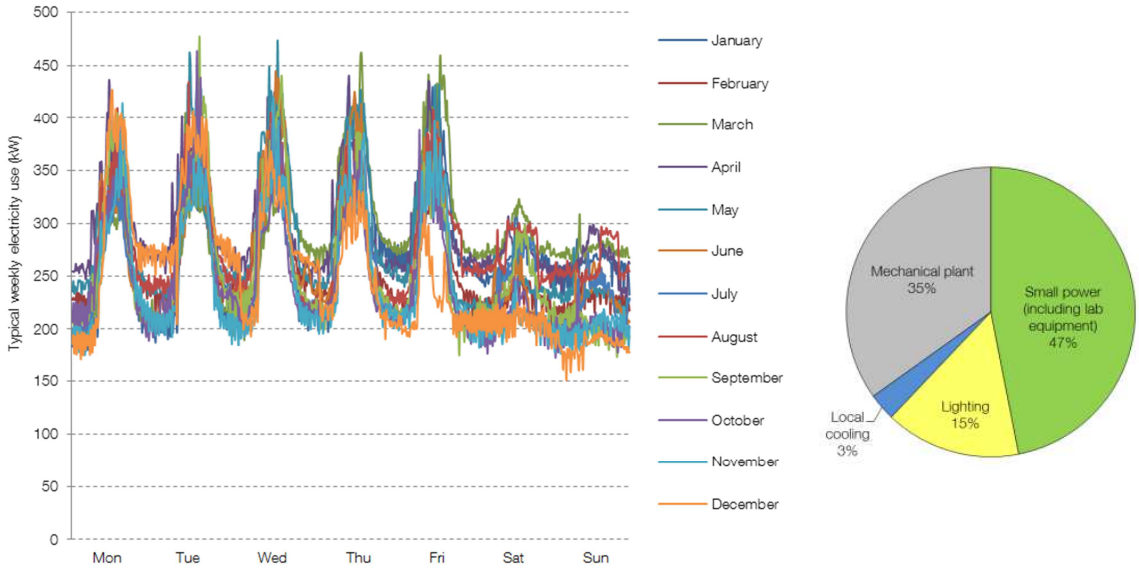


Figure 2.3 KLB electricity usage (excluding servers)

2.3 Part L compliance

The energy strategy for the Kathleen Lonsdale Building has been developed following a 'lean, clean, green' philosophy, working within the constraints of the existing building. Two key challenges have included:

- The Grade II listed status of the building, for which any proposals (particularly those impacting on the highly significant front façade), have had to retain with original character and appearance of the building whilst taking into account the impact on other listed buildings and the conservation area.
- The overall energy and carbon savings possible, when a large majority of the systems are not being upgraded (as up to 40% of the building area will be occupied throughout building works).

In order to overcome these challenges, the design team have proposed a series of interventions including:

- Secondary glazing to the front and double glazing to the rear to improve thermal and solar performance;
- Window opening provisions for natural ventilation of office spaces;
- Compliance with the 'Building Services Compliance Guide' for new system efficiencies
- Improvements to cooling and ventilation plant and distribution at roof level and the rear of the building
- Basement, ground, 1st and 2nd floors connected to the UCL district heating network. 3rd and 4th floors fed by 96% efficient boilers (compared to previous boilers that were 80%).

Compliance route

The proposed refurbishment work is primarily a fit out including some replacement of mechanical, electrical and public health services and façade upgrade work where feasible and acceptable for heritage purposes. These proposed works will trigger the requirement to demonstrate compliance with Part L2B.

As the KLB submitted a notice to apply for Building Regulations consent prior to 6 April 2014, the project will be demonstrating compliance against the 2010 Building Regulations. The two main approaches to comply with the requirements of Building Regulations Part L2B 2010 are:

- **Elemental Compliance:** all replacement and refurbishment measures should comply with minimum performance standards relating to fabric, glazing, mechanical and electrical services;
- **Emissions Approach**: demonstrate that Building Emissions Rate (annual carbon dioxide emissions) of the Actual building is less than a Notional Building with the limiting elemental Part L2B 2010 values.

Buro Happold previously met with Building Control (minutes available) to discuss the proposed works and to agree the strategy by which compliance will be demonstrated. The agreed approach was to follow the **elemental compliance** option due to the refurbishment works only being undertaken for a portion of the building and due to the limited extent of the fabric upgrade works.

By following the proposed route, compliance with Part L2B 2010 can be demonstrated by ensuring the following:

- All replacement equipment, plant and services installed comply with the performance requirements detailed in the Non-Domestic Building Services Compliance Guide 2010 edition;
- Should elements of the façade be replaced they will need to comply with Part L2B (2010) requirements for Thermal Elements and/or Controlled Fittings as relevant, or equivalent improvements be made elsewhere;

This is acceptable for all situations where services are being replaced, not provided for the first time or increased in capacity. The current services design will provide natural ventilation and radiators to the majority of building spaces, in line with the existing strategy. Given the performance improvements proposed for the glazing and (where applicable) walls and roof the heating requirements should be no greater than the existing provision and in most cases will be somewhat lower.

Due to the change in tenant within certain areas of the building there is a significant increase in cooling and ventilation provision. This specifically relates to the laboratory areas and their associated process requirements. Whilst these provisions specifically relate to process loads they do ultimately introduce cooling to a floor and/or increase capacity in other floors and as such Consequential Improvements will apply.

2.3.1 Consequential Improvements

Consequential Improvements are compulsory work required as part of Regulation 17D. They are considered in addition to the proposed (principal) works triggered when it is proposed to install fixed building services or increase to installed capacity per unit area of an existing fixed building service. They break down into two main requirements:

- Improve the fabric in those parts of the building served by the service, where economically feasible in line with the requirements detailed in AD L2B (2010) paragraph 6.10 (heating) and 6.11 (cooling);
- Make improvements in line with guidance in AD L2B (2010) paragraph 6.6 to adopt measures such as those in Table 6 such that their value is not less than 10% of the value of the principal works.

The principal works are defined as those works necessary to achieve the client's purposes. The current proposed approach for the KLB refurbishment works to general office/work spaces does not include any provision of heating or cooling where there was none previously, nor is it intended to increase capacity of any installation compared to previous performance. However, the works proposed in order to service the laboratories will result in both first time provision and increased capacity of provision of cooling. As such the requirement to consider Consequential Improvements do apply.

In the first instance this will trigger the requirement to improve fabric in any areas impacted (i.e. laboratories on the perimeter of the building). The proposed works to improve glazing aims to satisfy these requirement, with consideration given to ensure the performance is in line with the requirements of the standard.

The second aspect of the Consequential Improvements is likely to trigger a requirement to upgrade lighting and HVAC systems. Given the extent of the works proposed for the areas in question, coupled with the replacement of the chiller plant, glazing improvements and retention of the legacy district heating provision, it has been calculated that the 10% of principal works value requirement has been attained and exceeded.

2.3.2 Building fabric upgrades

There are some exemptions stated in Part L which can have an implication on the compliance approach. A key exemption is given below, which implies that the fabric and glazing construction may not need to be upgraded to the minimum Part L2B 2010 insulation levels:

> *Paragraph 3.5: The following classes of buildings have an exemption from the energy efficiency requirements where compliance would unacceptably alter the character or appearance of the buildings:*
>
> *a. listed buildings;*
> *b. buildings in conservation areas*

This implies that the U-values detailed in Table 2.1 are not applicable to the existing building elements:

Table 2.1 U-values not applicable to the existing building elements

Element	Threshold Part L2B 2010 Value of Retained Element W/m^{2}K	Threshold Part L2B 2010 Value of Replacement Element W/m^{2}K
Wall – internal insulation	0.7	0.30
Floor	0.7	0.25
Roof – insulation at ceiling level	0.35	0.16
Roof – insulation at rafter level	0.35	0.18
Windows, rooflights and doors > 50% glazing (including framing)	-	1.8
High usage entrance doors	-	3.5
Vehicle access and similar large doors	-	1.5

However the following requirement should be considered:

> *Paragraph 4.24: Where the replacement windows are unable to meet the requirements due to the need to maintain the external appearance of the façade or the character of the building, replacement windows should meet a centre pane U-value of 1.2 W/m2K, or single glazing should be supplemented with low-e secondary glazing. In this latter case, weather stripping should be on the secondary glazing to minimise condensation risk between the primary and secondary glazing.*

Proposed façade upgrades

The façade upgrades proposed primarily involve the windows. The works to the existing timber windows has changed from full replacement to refurbish and re-glazing secondary glazing to the front and double glazing to the rear to improve thermal and solar performance. The windows within the central portico facing Gower Place differ from elsewhere and it is proposed that these will remain unaltered albeit with secondary glazing. This is accordance with Camden's advice.

The windows in the mansard and Gower Place façade second floor are not original timber and currently double-glazed – it is not proposed to replace these. Windows to the Chemistry accommodation, ISD machine room, Radio Chemistry suite and retained basement Earth Sciences labs will not be modified as part of these works.

Key benefits of the glazing upgrades include improved thermal performance through improved U-values and air-tightness; improved passive solar protection through improved solar g-values and natural ventilation facilitation; improved longevity through architecturally sensitive integration, in accordance with heritage advice; improved sound insulation and noise buffering, from increased glazed layers and cavity size; and improved window security.

2.3.3 MEP systems

The 2010 edition of the 'Non-Domestic Building Services Compliance Guide' has been followed for the introduction of all new systems in the building. Some example values are detailed below:

Heating:

- Minimum controls: zone control, demand control and time control

Cooling:

- Split and multi-split air conditioners: EER 2.5
- Variable refrigerant flow systems: EER 2.5
- Chiller (water-cooled < 750 kW): EER 3.85
- Chiller (air-cooled < 750 kW): EER 2.5

Ventilation:

- Zonal toilet extract fan systems: 0.4 W/l/s
- Local fan coil unit systems: 0.6 W/l/s
- Heat recovery – thermal wheel: 65%

Lighting systems

The 2010 edition of the 'Non-Domestic Building Services Compliance Guide' states lighting efficacy and control requirements for existing buildings required to comply with Part L. Key parameters are given below:

Lighting efficacy (%)

- General lighting in office, industrial and storage areas: not less than 55 luminaire lumens per circuit-watt.
- General lighting in other types of space: not less than 55 luminaire lumens per circuit-watt

Luminaire control factors

- Luminaire in a daylit space with output controlled by photoelectric switching or dimming: Control factor 0.9
- Luminaire in space likely to be unoccupied for a significant number of operating hours: Control factor 0.9
- Circumstances a. and b. combined. Control factor 0.85

Recommended minimum controls:

- Owned space: Manual by door
- Shared space: Flexible manual switching, e.g. local pull cords or wireless transmitter
- Occasionally visited: Local manual switching
- Unowned: Time switching
- Managed: Time switching or centralised manual

Infiltration

For Part L2B compliance, there is no air tightness target. However where secondary glazing will be added, the recommended air permeability target is 10 $m^3/m^2.h$ @ 50 Pa and that an air permeability test is undertaken on completion in order to verify that this target is achieved.

Display Energy Certificate Recommendations

A copy of the Advisory Report[1] associated with 'The Energy Performance of Buildings (Certificates and Inspections) (England and Wales) Regulations 2007' has been obtained from the Non-domestic EPC Register. Within this report the following recommendations are made:

Table 2.2 AR Recommendations with a short payback for KLB

Recommendation	Potential impact
It is recommended that energy management techniques are be introduced. These could include efforts to gain building users commitment to save energy, allocating responsibility for energy to a specific person (champion), setting targets and monitoring.	HIGH
Engage experts to review the HVAC control systems settings and propose alterations and/or upgrades and adjust to suit current occupancy patterns.	HIGH
Consider introducing a system of regular checks of Heating, Ventilation and Air Conditioning (HVAC) time and temperature settings and provisions to prevent unauthorised adjustment.	MEDIUM
Consider installing weather compensator controls on heating and cooling systems.	LOW
Ensure building occupants understand when the various cooling modes of the mixed mode ventilation system are in operation to avoid windows being opened when mechanical cooling is on.	HIGH
Consider implementing a programme of planned lighting systems maintenance to maintain effectiveness and energy efficiency.	MEDIUM
Clean windows and roof lights to maximise daylight entering building and reduce the need for artificial lighting.	HIGH
Consider engaging with building users to economise equipment energy consumption with targets, guidance on their achievement and incentives.	HIGH
Enable power save settings and power down management on computers and associated equipment.	HIGH
Consider installing automated controls and monitoring systems to electrical equipment and portable appliances to minimise electricity waste.	HIGH

Table 2.3 AR Recommendations with a medium payback for KLB

Consider implementing regular inspections of the building fabric to check on the condition of insulation and sealing measures and removal of accidental ventilation paths.	LOW
Engage experts to propose specific measures to reduce hot water wastage and plan to carry this out.	MEDIUM

[1] 0982-0328-0420-4392-4096, dated 05.12.2008

Table 2.4 AR Recommendations with a long payback for KLB

Recommendation	Potential impact
The current metering provisions do not enable production of a specific and reasonably accurate Operational Rating for this building. It is recommended that meters be installed and a regime of recording data be put in place. CIBSE TM 39 gives guidance on this.	HIGH
Consider replacing or improving glazing.	LOW
Consider installing building mounted solar water heating.	MEDIUM

The majority of the recommendations made are being incorporated into the KLB refurbishment to the extent possible, through upgrade and replacement of existing systems and controls. Furthermore a significant number of the recommendations relate to end-user behavioural factors and communication regarding systems design and operation. The management of these aspects through the rest of the design process and ultimately into the operational phase will need to be given specific consideration from the next stage onwards in order to ensure a robust implementation and delivery of long-term energy savings.

Energy Meters

As per Part L2B requirements, reasonable provision of energy meters in line with CIBSE TM39 guidance has already been made for effective monitoring of the performance of newly installed plant. The energy meters will allow the building occupiers to assign at least 90% of the estimated annual energy consumption of each fuel to the various end-use categories. the building is greater than 1000 m^2 floor area, the metering system will enable automatic meter readings and data collection.

Building Log Book

As per Part L2B requirements, the owner of the building will be provided with a building log book containing sufficient information about the building, to include but not limited to:

- Any newly provided, renovated or upgraded thermal elements or controlled fittings
- Any newly provided fixed building services, their method of operation and maintenance
- Any newly installed energy meters
- Any other details that collectively enable the energy consumption of the building and building services to be monitored and controlled

2.4 Operational carbon modelling

Whilst no modelling was undertaken for Building Regulation compliance, it should be noted that following on from the KLB energy audit, a simulation study was undertaken to assess the possible operational CO_2 emissions reduction from the KLB refurbishment. The key driver for this study was to assess performance against the UCL target to achieve an absolute reduction in operational carbon emissions by 20%.

The CO_2 reduction modelling was conducted using IES dynamic modelling software by developing an analysis zone (shown in Figure 2.4) of teaching spaces and offices to represent a typical floor arrangement throughout the building. Baseline assumptions for fabric, system efficiency and daily profiles were then based on figures observed from the audit. Respective carbon savings from the analysis zone were extrapolated to utility bills for the property.

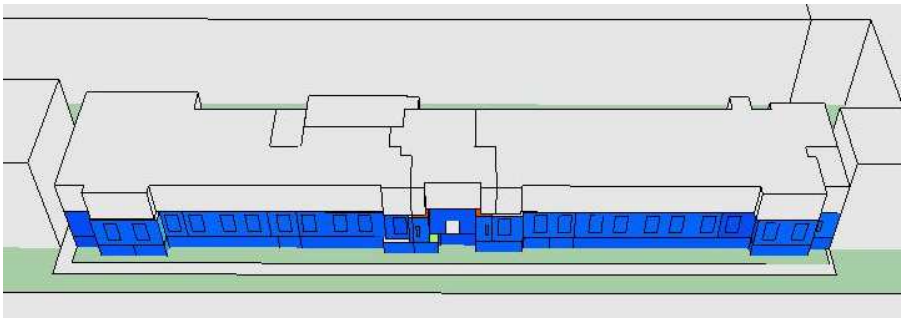


Figure 2.4 Analysis zone created to undertake operational energy modelling

A summary of the interventions modelled and their corresponding carbon savings is given below:

- **Reduce heating season:** Currently at KLB, the heating is operational from October to May. If this heating season was reduced from May to March, this simple intervention could reduce operational carbon emissions by 2.3%.

- **Heating off at night and weekends:** The audit identified that KLB is currently heated during night time and weekends, during periods of no/low occupancy. If set-points were adjusted so that the heating comes on at 6am and switches off at 7pm and the heating system was either partially off or set-back during weekends, this could reduce operational carbon emissions by 8.8%.

- **Reduce lighting intensity:** Currently, lighting energy use in KLB is 26% higher than typical benchmarks for similar building types. This is due to the presence of a large amount of inefficient T12 fluorescent tube lights, resulting in an average power density of 13.9 W/m^2 throughout the building with peak loads as high as 16.5 W/m^2. If this lighting load were reduced to 10 W/m^2, this could reduce operational carbon by 2.4%.

- **Lighting occupancy sensors:** In addition to inefficient light fittings, KLB also has no occupancy sensors of to reduce unnecessary lighting energy use. If incorporated, these interventions could reduce operational carbon by 0.6%.

- **Lower equipment loads:** In the lead up to the KLB refurbishment it is anticipated that there will be some degree of investment into new ICT equipment. If 60W desktop computers and 65W monitors were upgraded to lower wattage integrated 50W units or laptops, this could reduce operational carbon by 11.9%.

- **Cooling Controls:** Currently, the cooling set-points in air conditioned zones are 23°C. If this was increased to 26°C, this could reduce total carbon emissions by 0.7%.

Two further interventions considered, but not factored into the final results were as follows:

- **Improved U-values:** Internal wall insulation for the entire property is not included in the scheme, however it is calculated that 60mm of expanded polystyrene insulation could result in total carbon savings of 7.9%.

- **Glazing renovation:** Full glazing renovation is not included in the scheme, however it is calculated that the reduction in carbon emissions from secondary or double glazing all windows is 5.4%. It should be noted that new double glazing, compared to secondary glazing with a large cavity would provide similar / negligible difference in performance, depending on product specification.

Figure 2.5 illustrates the individual savings from each measure studied, together with the combined impact of selected measures. As shown, the when combined, these measures have the potential to achieve a 23% reduction in operational carbon emissions.

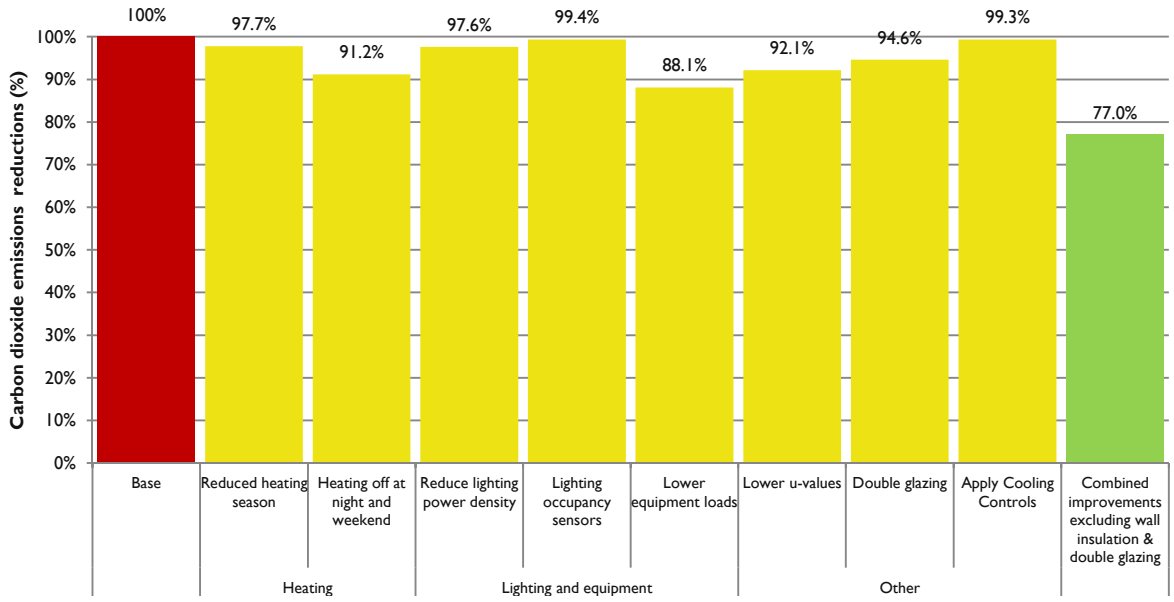


Figure 2.5 Operational carbon savings analysis

It should be noted that the projected carbon emissions from the above study cannot be used to reflect full Part L modelling results, as Part L will not take into account any benefit from reduced heating/cooling set points or daily operational profiles. Instead, key findings from the study are the importance of strict energy management and seasonal commissioning in operation.

For BREEAM compliance it is intended that energy modelling will be carried out for the BRE design stage submission based on frozen Stage E information. This modelling will also be completed post-construction by the Contractor for the final BRE assessment.

2.5 Renewable energy feasibility study

During the concept design stage a renewable energy feasibility study was carried out for KLB. The two main drivers for this study were that:

- BREEAM awards one credit under 'Ene-5 Low zero carbon technologies' where evidence demonstrates that a feasibility study considering local (on-site and/or near site) low or zero carbon (LZC) technologies has been carried out and the results implemented.
- The Camden Planning Guidance Sustainability report states that "All developments are to target at least a 20% reduction in carbon dioxide emissions through the installation of on-site renewable energy technologies. Special consideration will be given to heritage buildings and features to ensure that their historic and architectural features are preserved."

The results of this study (summarised in Table 2.5) indicate that photovoltaic panels and district heating would be the most viable technologies for further consideration.

Table 2.5 Renewable energy feasibility study*

Technology	Photovoltaic Panels	District Heating connection	Solar thermal collectors	Roof mounted wind turbine	Biomass boiler	Ground source heating/cooling	Stand-alone Wind Turbine
Viability based on site constraints	Unlikely. Large pitched roof. Dependant on UCL buy-in & planning.	Viable technology helped by presence of UCL DH network	Unlikely to be viable if district heating is used for hot water	Unlikely due to planning constraints and urban location	Unlikely due to lack of space for store & presence of existing DH network	Not viable due to lack of external space	Not viable due to lack of space and planning constraints
Energy savings (kWh/year)	21,143	194,503	12,218	1,961	740,815	Not calculated as not viable	Not calculated as not viable
Carbon savings ($kgCO_2$/year)	10,973	36,761	2,639	1,018	160,016	-	-
Carbon savings (over baseline)	0.55%	1.5%	0.13%	0.05%	8.0%	-	-
Payback (years)	14	1.3	10	102	4	-	-

**Carbon savings calculated from baseline fuel consumption identified in energy audit*

Photovoltaic panels were originally deemed to be viable due to the presence of a large south-easterly pitched roof. However, through the detailed design stage this strategy was not pursued due to the congested nature of the roof space on KLB, particularly given the complexity of installing new plant whilst legacy equipment is retained. This issue in conjunction with the limited output available from the proposed PV system suggests that such an approach would no longer be financially viable.

During the course of design, independent studies have been undertaken by UCL to ascertain the performance of the existing district heat network. As a result, it is calculated that the carbon emissions factor is 0.189 $kgCO_2$/kwh. By comparison, according to SAP 2013, gas is 12.5% more intensive at 0.216 $kgCO_2$/kWh. As a large part of the building is already served by district heating, the potential energy savings are limited. Currently, 1,361,542 kWh/year of heat is provided by gas boilers serving the 2nd floor and above in KLB. With this energy use now provided by district heating, the calculated carbon saving is 36,761 $kgCO_2$/year, equivalent to 1.5% of total carbon emissions for the building.

The district heating plant is offsite, thus noise from primary plant will not be contained in the building. In relation to grants, none are applicable to the selected technology. District heating is also not covered under Feed-in-Tariffs or Renewable Heat incentive. At the time of producing this study, the Renewables Obligation (RO) was the main support mechanism for renewable electricity projects in the UK. Alternatively, Enhanced Capital Allowances (ECAs) enabled a business to claim 100% first-year capital allowances on their spending on qualifying plant and machinery. Energy Efficiency Financing for Industry also provides unsecured interest-free Energy-Efficiency Loans has been replaced by a financing scheme run by the Carbon Trust in association with Siemens Financial Services to fund projects such as lighting, boilers or insulation.

3 Wider Sustainability

3.1 BREEAM

Due to the limitations on energy performance, it will not be possible to achieve BREEAM "Excellent" certification on this project as the minimum requirements for credit 'Ene-1 Reduction of CO_2 emissions' cannot be achieved. However, in light of this, it was agreed with UCL that the design team will achieve a BREEAM Very Good rating, retaining as high a points buffer as practically possible.

The Kathleen Lonsdale Building is currently on track to achieve 65.5% of the total available score, securing most of the credits under the following BREEAM categories: Management, Transport, Health & Well-being, Waste and Water. Table 3.1 summarise the target scores in each section.

Table 3.1 BREEAM progress table

Building Performance by Section					
	Environmental weighting	Credits available	Credits targeted	% Score	Weighted Score
Management	12.00%	21.00	18.00	85.71%	10.29%
Health & Wellbeing	15.00%	16.00	10.00	62.50%	9.38%
Energy	19.00%	27.00	8.00	29.63%	5.63%
Transport	8.00%	13.00	12.00	92.31%	7.38%
Water	6.00%	7.00	4.00	57.14%	3.43%
Materials	12.50%	15.00	15.00	100.00%	12.50%
Waste	7.50%	6.00	5.00	83.33%	6.25%
Land Use & Ecology	10.00%	10.00	4.00	40.00%	4.00%
Pollution	10.00%	11.00	4.00	36.36%	3.64%
Innovation	10.00%	10.00	3.00	30.00%	3.00%
				Total BREEAM Score	65.49%

Pass	30%
Good	45%
Very good	55%
Excellent	70%
Outstanding	85%

3.2 Key metrics relating to planning

Energy

In order to ensure that we are in line with Camden Borough's local policies and the UCL's campus wide sustainability aspirations, a Heritage Consultant undertook an assessment of the building and potential improvements to the building fabrics to reduce the operational energy demand of the building. For BREEAM compliance it is intended that energy modelling will be carried out for the BRE design stage submission based on frozen Stage E information. This modelling will also be completed post-construction by the Contractor for the final BRE assessment.

Water

The water consumption will be reduced to the largest possible extent by the installation of efficient fittings and low-volume toilets, therefore targeting a minimum 2 credits under Wat 1 – Water Consumption. This recognises the importance of reducing UCL's campus wide water demand without compromising the research and development in the building.

Materials

Due to the building being the refurbishment of a Grade II listed building, most of the material that makes up the external walls, roof, upper slabs, and internal walls will remain the same. Where these will change, the design team aspires to specify materials with a Green Guide rating of A/A+, therefore achieving a minimum of 5 credits under Mat 1. More than 80% of the existing façade (by mass) and building structure will be reused, achieving maximum credits under Mat 3 and Mat 4, far exceeding Camden's recommendation to ensure at least 10% of the total value of the materials used on site will be derived from recycled and reused sources.

Waste

A Site Waste Management Plan will exist that will ensure that the non-hazardous construction waste generated by the building's construction meets or exceeds the BREEAM resource efficiency benchmarks. In order to reduce the operational waste generation, the building will be equipped with facilities for the storage and collection of waste and recycling in line with Camden's Core Strategy – Sustainability Appraisal and the requirements stipulated in Wst 3 – Recyclable Waste Storage.

4 Beyond BREEAM

Looking beyond BREEAM, it should be noted that a series of bespoke targets have been identified, building upon the measures enacted through the BREEAM assessment mechanism and the sustainable aspirations of UCL for KLB. The proposed measures, summarised below require engagement and buy-in from the future building tenants to ensure a robust deployment.

Energy monitoring and feedback
Integrate a competitive energy metering strategy. Feedback results to users to continually drive down consumption.

Water monitoring and feedback
Integrate a competitive water metering strategy. Feedback results to users to continually drive down consumption.

Waste monitoring and feedback
Integrate a competitive waste monitoring strategy. Feedback results to users to continually drive down waste to landfill.

Travel monitoring and feedback
Undertake regular surveys of transport choices for building users and visitors. Calculate carbon footprint and communicate results/recommendations.

Well-being and productivity
Undertake regular user surveys to measure well-being and productivity in the working environment. Propose and measure impact of interventions.

Collaboration across all user groups
Hold regular networking events in hub areas to promote collaboration between building users. Use display areas to highlight collaborative projects.

Building research outreach
Communicate findings of the operational targets to the wider UCL community. Publish peer reviewed case study and submit for respected industry award.

It is proposed that further detailing of these measures will continue leading into operation and handover, with guidance provided regarding monitoring and evaluation strategies.

5 Conclusion

This report contained a summary of the energy and sustainability strategy for the Grade II listed UCL Kathleen Lonsdale Building.

The key measures being included to improve energy performance are double glazing to the rear and secondary glazing to the front of the building; increased connection to the UCL district heating network, new more efficient boilers to the top floors, full upgrade of lighting and HVAC equipment controls and new building services specification in line with the 'Building Services Compliance Guide' for new system efficiencies.

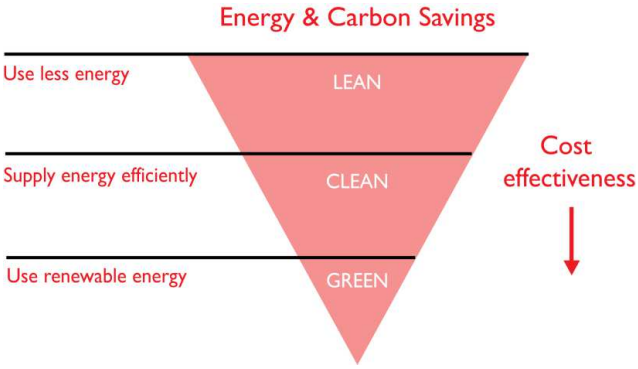
Operational carbon modelling has been conducted, predicting a 23% improvement over the baseline performance. Part L elemental compliance has been undertaken, with consequential improvement calculations demonstrating at least 10% of total construction costs has been spent on energy efficiency measures.

To improve the wider sustainability of the project, a BREEAM 'Very Good' certification level will be achieved, targeting a 10% points buffer. The current pre-assessment demonstrates that the project is on track to achieve BREEAM 'Very Good' certification with 65.5% of points targeted, giving a 10% buffer over Very Good. Categories scoring particularly well include Management, Transport, Health & Well-being, Waste and Water. Example measures to support this process include energy efficient laboratory specification, using the BRE Green Guide for material specification, selecting low flow water fixtures/fittings throughout, and adopting a site waste management plan.

Further to this work, a series of initiatives under the headings of energy, water, waste, transport, well-being, collaboration and research are being prepared, pushing beyond BREEAM to ensure the long-term operation of the building is sustainable.

Appendix 1: London Plan checklist

The London Plan acts as the overarching Spatial Development Strategy (SDS) of the city and framework for the development of London over the next 20–25 years. Key policies include:

Requirement	*Response*
Policy 5.2 - Minimising carbon dioxide emissions: Developments should minimise carbon dioxide emissions beyond Building Regulations Part L targets i.e. 35% improvement against the Part L Non-Residential notional building	The project will be complying with Part L2B of the Building Regulations following the 'elemental compliance' route to certification (i.e. no regulated energy modelling required), working within the heritage limitations. Key 'lean' energy efficient improvements include, secondary glazing to the front and double glazing to the rear to improve thermal and solar performance. 'Clean' measures include improved heating and lighting controls, new more efficient boilers serving the top floors and full compliance with the 'Building Services Compliance Guide' for new system efficiencies. 'Green' measures include full connection to the UCL district heating network.  Operational carbon modelling has shown that a 5.4% reduction in operational CO_2 is possible through glazing improvements. A further 23% is possible through system efficiency and controls improvements. An additional 1.5% reduction is then predicted for improvements brought by the district heating network connection.
Policy 5.3 - Sustainable design and construction: Major developments should meet the sustainable design standards set out in the Mayor's Supplementary Planning Guidance (SPG).	The main sustainability driver for this project is BREEAM. The project is currently registered with the BRE, and evidence is being collated against a number of themes. The current pre-assessment demonstrates that the project is on track to achieve both BREEAM 'Very Good' certification with a 10% points buffer.

Policy 5.5 - Decentralised energy networks. 25% of heat and power used in London to be generated through the use of localised decentralised energy systems by 2025.	Heating to the ground floor and basement is currently served by the UCL district heating network. For the refurbishment, the basement, ground, 1st and 2nd floors will be connected to the UCL district heating network. 3rd and 4th floors fed by 96% efficient boilers (compared to previous boilers that were 80%).
Policy 5.6 - Decentralised energy in development proposals. Developments should evaluate the feasibility of combined heat and power (CHP) systems. Where a new such system is appropriate this should include opportunities to extend the system beyond the site boundary to adjacent sites. Major development proposals should select energy systems in accordance with the following hierarchy: • Connection to existing heating or cooling networks • Site wide CHP network • Communal heating and cooling.	The viability of a combined heat and power system was not reviewed for this project, as all heating and hot water can be provided from the UCL district heating network.
Policy 5.7 – Renewable energy. Maximise renewable energy uptake, following the 'lean, clean, green' hierarchy	A renewable energy feasibility study was conducted (see section 2.5). Due to heritage and spatial restrictions, only district heating was deemed viable. As a significant proportion of the building is already connected to the network the estimated carbon saving of the additional benefit is only 1.5% against the buildings baseline operational CO_2 emissions.

Appendix 2: Camden planning guidance checklist

The following table has been prepared using CPG 1 Sustainability:

Requirement	*Response*
Energy efficiency: existing buildings • All buildings, whether being updated or refurbished, are expected to reduce their carbon emissions by making improvements to the existing building. Work involving a change of use or an extension to an existing property is included. As a guide, at least 10% of the project cost should be spent on the improvements. • Where retro-fitting measures are not identified at application stage we will most likely secure the implementation of environmental improvements by way of condition. • Development involving a change of use or a conversion of more than 500sq m of any floorspace, will be expected to achieve 60% of the un-weighted credits in the Energy category in their BREEAM assessment. • Special consideration will be given to buildings that are protected e.g. listed buildings	Full details of the energy strategy have been provided in chapter 2 if this report. As discussed, the project will be complying with Part L2B of the Building Regulations following the 'elemental compliance' route, working within the heritage limitations. Achieving a 60% score in the energy category of BREEAM will not be possible due to the building fabric upgrade being limited and a large majority of the building services not being upgraded (as up to 40% of the building area will be occupied throughout building works). The total cost of glazing improvements and services upgrades represents 46% of construction value.
Decentralised energy • Where feasible and viable your development will be required to connect to a decentralised energy network or include CHP.	Heating to the ground floor and basement is currently served by the UCL district heating network. For the refurbishment, the basement, ground, 1st and 2nd floors will be connected to the UCL district heating network. 3rd and 4th floors fed by 96% efficient boilers (compared to previous boilers that were 80%).
Renewable energy • All developments are to target at least a 20% reduction in carbon dioxide emissions through the installation of on-site renewable energy technologies. Special consideration will be given to heritage buildings and features to ensure that their historic and architectural features are preserved.	A renewable energy feasibility study was conducted (see section 2.5). Due to heritage and spatial restrictions, only district heating was deemed viable. As a significant proportion of the building is already connected to the network the estimated carbon saving of the additional benefit is only 1.5% against the buildings baseline operational CO_2 emissions.
Water efficiency • The Council expects all developments to be designed to be water efficient by minimising water use and maximising the re-use of water. This includes new and existing buildings. • The Council will require developments over 1000sq m to include a grey water harvesting	To ensure we are on track to achieve a minimum BREEAM rating of Very Good, the design team aspires to achieve a minimum of 2 credits under Wat 1 – Water Consumption. This implies reducing the water consumption to 1.4 - 4.4. m3 per person per year.

<table>
<tr><td>system, unless the applicant demonstrates to the Council's satisfaction that this is not feasible.</td><td>Water meters will also be installed throughout the building allowing the building users to monitor and manage the water consumption in the building and therefore encourage its reduction. A leak detection system will also be in place to reduce unnecessary water loss. Due to the nature of the refurbishment, grey water harvesting is not feasible for this project.</td></tr>
<tr><td>Sustainable use of materials
All developments should aim for at least 10% of the total value of materials used to be derived from recycled and reused sources. This should relate to the WRAP Quick Wins assessments or equivalent. Special consideration will be given to heritage buildings and features to ensure that their historic and architectural features are preserved.
Major developments are anticipated to be able to achieve 15-20% of the total value of materials used to be derived from recycled and reused sources.</td><td>Most of the material that makes up the external walls, roof, upper slabs, and internal walls will remain the same. Where these will change, the design team aspires to specify materials with a Green Guide rating of A/A+, therefore achieving a minimum of 5 credits under Mat 1.

More than 80% of the existing façade (by mass) and building structure will be reused, achieving maximum credits under Mat 3 and Mat 4 and far exceeding Camden's recommendation to ensure at least 10% of the total value of the materials used on site will be derived from recycled and reused sources.

Where building elements and architectural features have been identified of historical value, these will remain unaltered.</td></tr>
<tr><td>Sustainability assessment tools (BREEAM)
Submission of a pre-assessment report at the planning application stage. The report should summarise the design strategy for achieving your chosen level of BREEAM and/or Code for Sustainable Homes and include details of the credits proposed to be achieved.
Pre-assessment report is to be carried out by a licensed assessor. The name of the assessor and their licence number should be clearly stated on the report.
You are strongly encouraged to meet the following standards in accordance with Development Policy DP22 - Promoting sustainable design and construction:
<table><tr><th>Time period</th><th>Minimum rating</th><th>Minimum standard for categories (% of un-weighted credits)</th></tr><tr><td>2010-2012</td><td>'very good'</td><td rowspan="2">Energy 60%
Water 60%
Materials 40%</td></tr><tr><td>2013+</td><td>'excellent'</td></tr></table></td><td>Appendix 1 of the sustainability statement contains the BREEAM pre-assessment checklist. The pre-assessment is registered under Adonis Charalambous, licenced assessor. Mark Dowson is also leading the Sustainability elements and is a BREEAM AP (accredited professional).

The current pre-assessment demonstrates that the project is on track to achieve BREEAM 'Very Good' certification with 65.5% of points targeted, giving a 10% buffer over Very Good

An 'Excellent' level of certification will not be achievable due to the limitations on energy performance (specifically under credit 'Ene-1 – Reduction of CO2 emissions'), due to the building fabric upgrade being limited and a large majority of the building services not being upgraded (as up to 40% of the building area will be occupied throughout building works).</td></tr>
<tr><td>Brown roofs, green roofs and green walls
The Council will expect all developments to incorporate brown roofs, green roofs and green walls unless it is demonstrated this is not possible or appropriate. This includes new and existing buildings. Special consideration will be given to historic buildings to ensure historic and architectural features are preserved.</td><td>Due to the financial and heritage restrictions on this project, brown roofs, green roofs and/or green walls are not feasible.</td></tr>
</table>

Flooding • Developments must not increase the risk of flooding, and are required to put in place mitigation measures where there is known to be a risk of flooding. • Within the areas shown on Core Strategy Map 5 (Development Policies Map 2) we will expect water infrastructure to be designed to cope with a 1 in 100 year storm event in order to limit the flooding of, and damage to, property.	A flood risk assessment has been conducted for the project. This report is available upon request. The key finding of the report was that it can be reasonably concluded that the site has a low risk of flooding from the following sources; Fluvial, Tidal, Surface Water, Groundwater and Sewers
Adapting to climate change • All development is expected to consider the impact of climate change and be designed to cope with the anticipated conditions.	A ventilation options study and overheating assessment was conducted by Parsons Brinkerhoff, the MEP engineers for this project. In the study, all first floor rooms were assessed for overheating risk following the approach of CIBSE Guide A. Four office arrangements were studied to assess the optimal internal layout. Results show there will be some overheating, that cannot be fully mitigated. Passive protection measures such as solar control blinds, window openings, new double glazing at the rear and secondary glazing to improve thermal and solar performance are proposed working within the heritage constraints of the project.
Biodiversity • Proposals should demonstrate how biodiversity considerations have been incorporated into the development; if any mitigation measures will be included; and what positive measures for enhancing biodiversity are planned.	The design team aims to ensure that there will be no negative change in the site's existing ecological value as a result of the refurbishment.
External lighting • Lighting can have particular negative impacts on biodiversity. Unnecessary lighting should be avoided. Where lighting may harm biodiversity timers or specific coloured lighting will be required to minimise any disturbance.	The external lighting strategy will be designed in line with best practice guidelines. Maximum credits in Ene 4 - External Lighting and Pol 8 –Reduction of Night Time Light Pollution will be targeted. All external lighting will automatically be switched off between 2300hrs and 0700 hrs using timers. There will be no illuminated advertisements.
Local food growing • We encourage food to be grown wherever possible and suitable. Rooftops and shared spaces such as gardens and parks provide opportunities for food growing	Due to the spatial and heritage restrictions on this project, spaces for local food growing will not be feasible.

6 Appendix 1 – breeam checklist

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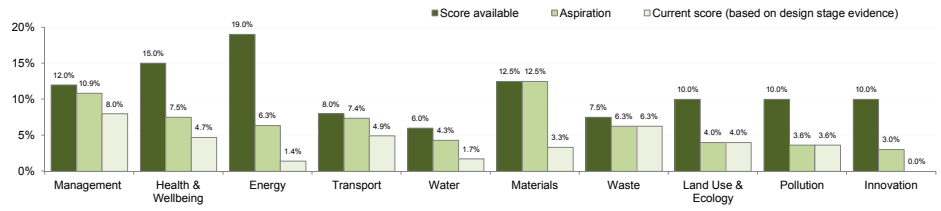
UCL Kathleen Lonsdale Building

BREEAM checklist - 4th March 2016

ASPIRATION (very good)	65.7%
CURRENT (pass)	38.0%



BREEAM Very Good minimum standards

Man 1 - Commissioning - 1 credit, **ON TRACK**

Hea 4 - High frequency lighting, 1 credit, **ON TRACK**

Hea 12 - Microbial contamination, 1 credit, **ON TRACK**

Ene 2 - Sub-metering of Substantial Energy Uses, **CONFIRMATION NEEDED**

Wat 1 - Water Consumption, 1 credit, **ON TRACK**

Wat 2 - Water meter, 1 credit, **EVIDENCE NEEDED**

Pass	30%	NOT POSSIBLE
Good	45%	HIGH RISK CREDIT
Very Good	55%	NO EVIDENCE. MEDIUM RISK
Excellent	70%	SOME EVIDENCE NEEDED. LOW RISK
Outstanding	85%	MINOR EVIDENCE NEEDED TO CLOSE
		ALL EVIDENCE IN PLACE

Ref	Title	Number of BREEAM credits available	Aspiration for BREEAM Very Good rating	Design stage evidence status (see key)	Outstanding evidence for DS submission	Responsibility
Management						
Man 1	Commissioning	2	2	1	Commissioning manager needed to close 1st credit - see RFI	PM/MEP/Grahams
Man 2	Considerate Constructors	2	2	2	-	-
Man 3	Construction Site Impacts	4	4	4	Completed A3 checklist needed to close credit - see RFI	Grahams
Man 4	Building user guide	2	2	2	-	-
Man 5	Site Investigation	1	1	1	-	-
Man 6	Consultation	2	1	1	-	-
Man 7	Shared Facilities	2	2	1	Re-design of security access needed for 2nd credit - see RFI	UCL / Reach Active
Man 8	Security	1	1		Design security compliance form needed - see RFI	Levit Bernstein / UCL
Man 9	Publication of building information	1	1	1	-	-
Man 10	Development as a learning resource	1	1		Confirmation of new screen needed - see RFI	MEP / UCL / Levitt Bernstein
Man 11	Ease of Maintenance	1	0	0		
Man 12	Life Cycle Costing	2	2	1	Further evidence needed for 2nd credit - see RFI	Sweett / MEP / Levitt Bernstein
Health & Wellbeing						
Hea 1	Daylighting	2	0	0		
Hea 2	View Out	1	0	0		
Hea 3	Glare Control	1	1	1	-	-
Hea 4	High frequency lighting	1	1	1	-	-
Hea 5	Internal and external lighting levels	1	1	1	MEP to confirm use of particular lighting standards - see RFI	MEP
Hea 6	Lighting zones & controls	1	1		TBC - e.g. lighting of no more than 4 spaces in office areas	MEP
Hea 7	Potential for natural ventilation	1	0	0		
Hea 8	Indoor air quality	1	0	0		
Hea 9	Volatile Organic Compounds	1	1		Further detail of standards needed to close - see RFI	Bond Bryan
Hea 10	Thermal comfort	1	0	0		
Hea 11	Thermal zoning	1	1		TBC - separate control 7m from perimeter areas	MEP
Hea 12	Microbial contamination	1	1	1	-	-
Hea 13	Acoustic Performance	2			Further evidence needed - see RFI. High risk	LB / UCL / Atkins / PM / Grahams
Hea 17	Specification of Laboratory Fume Cupboards	1	1	1	Evidence needed to confirm scope/standards - see RFI	MEP / UCL
Energy						
Ene 1	Reduction of CO2 Emissions	15	2		EPC needed - see RFI. Heritage is high risk	BH / LB / MEP / PM / heritage consultant
Ene 2	Sub-metering of Substantial Energy Uses	1	1		Formal confirmation from Fowler Martin needed - see RFI	MEP / Fowler Martin
Ene 3	Sub-metering of high energy load Areas and Tenancy	1	1		Formal confirmation from Fowler Martin needed - see RFI	MEP / Fowler Martin
Ene 4	External Lighting	1	1	1	Letter to confirm no external lighting - see RFI	PM
Ene 5	Low zero carbon technologies	3	1	1	-	-
Ene 10	Free Cooling	1	0	0		
Ene 19	Energy Efficient Laboratories	5	3		Further evidence needed (area & % saving calcs) - see RFI	MEP / Levitt Bernstein
Transport						
Tra 1	Provision of public transport	5	5	5	-	-
Tra 2	Proximity to amenities	1	1	1	-	-
Tra 3	Cyclist Facilities	2	2		Confirm users, spaces & compliance - see RFI	UCL / Levitt Bernstein
Tra 4	Pedestrian and cycle safety	1	0	0		
Tra 5	Travel plan	1	1		Site specific travel plan addendum needed - see RFI	PM / UCL
Tra 6	Maximum car parking capacity	2	2	2	-	-
Tra 7	Travel information point	1	1		Drawing & specification of information point - see RFI	Levitt Bernstein / UCL
Water						
Wat 1	Water Consumption	3	3	2	Further evidence needed for low flow WCs - see RFI	Levitt Bernstein
Wat 2	Water meter	1	1		Could not see this in MEP specs - see RFI	MEP
Wat 3	Major leak detection	1	0	0		
Wat 4	Sanitary supply shut off	1	1		Could not see this in MEP specs - see RFI	MEP
Wat5	Water recycling	1	0	0		
Materials						
Mat 1	Materials Specification (major building elements)	6	6		Evidence needed for Mat1 calculator - see RFI	Bond Bryan
Mat 2	Hard landscaping and boundary protection	1	1	1	-	-
Mat 3	Re-use of building façade	1	1	1	-	-
Mat 4	Re-use of building structure	1	1	1	-	-
Mat 5	Responsible sourcing of materials	3	3		Evidence needed for Mat5 calculator - see RFI	Bond Bryan
Mat 6	Insulation	2	2		Evidence needed for Mat6 calculator - see RFI	Bond Bryan
Mat 7	Designing For Robustness	1	1	1	Confirm protection in corridors from trolleys - see RFI	Levitt Bernstein
Waste						
Wst 1	Construction Site Waste Management	4	4	4	SWMP needed to close - see RFI	Grahams
Wst 2	Recycled aggregates	1	0		Can this credit be achieved / awarded by default?	Carter Clack
Wst 3	Recyclable waste storage	1	1	1	Further evidence needed re labelling/access - see RFI	UCL
Land Use & Ecology						
LE1	Re-use of land	1	1	1	-	-
LE2	Contaminated land	1	0	0		
LE3	Ecological value of site AND Protection of ecological features	1	1	1	-	-
LE4	Mitigating Ecological impact	2	2	2	-	-
LE5	Enhancing Site Ecology	3	0	0		
LE6	Long term impact on biodiversity	2	0	0		
Pollution						
Pol 1	Refrigerant GWP - Building services	1	0	0		
Pol 2	Preventing refrigerant leaks	1	0	0		
Pol 4	NOx emissions from heating source	3			NOx from DH and boilers to be calculated - see RFI	MEP
Pol 5	Flood risk	3	2	2	-	-
Pol 6	Minimising watercourse pollution	1	0	0		
Pol 7	Reduction of Night Time Light Pollution	1	1	1	As Ene4. Letter to confirm no external lighting - see RFI	PM
Pol 8	Noise Attenuation	1	1	1	-	-
Innovation - Exemplary Level Criteria						
Innovation	Man 2: Considerate Constructors	1	1		Is this achievable? Evidence needed	Grahams
Innovation	Wat 2: Water Meter	1	0		Is this achievable? Evidence needed	MEP
Innovation	Mat 1: Materials Specification	1	1		Is this achievable? Evidence needed	Bond Bryan
Innovation	Mat 5: Responsible Sourcing of Materials	1	0		Is this achievable? Evidence needed	Bond Bryan
Innovation	Wst 1 Construction Site Waste Management	1	1		Is this achievable? Evidence needed	Grahams