Energy and Sustainability Statement

21 Bloomsbury Street
Commercial "Office" Development

SWECO

Change list

Ver:	Date:	Description of the change	Prepared		Reviewed		Approved	
00	08.04.22	Draft for comments	LB	08.04.22	MP	08.04.22	KA	08.04.22
01	25.07.22	Draft with numbers for comments	LB	25.07.22	MP	29.07.22	KA	29.07.22
02	05.08.22	Final issue for planning	LB	05.08.22	MP	05.08.22	KA	05.08.22

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Appendices:

1 Executive Summary

This report has been prepared on behalf of Capital 38 Limited (the "Applicant") to support a full, detailed planning application of **21 Bloomsbury Street** (the "Proposed Development") a commercial office scheme in London, within London Borough of Camden (LBC). The Proposed Development of the site consists of circa 11,181 m^2 of total gross internal area (GIA).

The proposed scheme will comply with the London Plan 2021, Approved Document Part L Volume 2 (Conservation of Fuel, and Power) of the Building Regulations 2021, and the latest guidelines set out by the Camden Council. The methodology of carrying out, and reporting predicted energy consumption, and associated carbon emissions are outlined in the Mayor's Energy Hierarchy as detailed in the Energy Assessment Guidance (June - 2022), section 6.15 to 6.25 for Major Refurbishment. Although Sweco acknowledges that the proposed scheme is not GLA referrable, GLA's methodology is being followed as means of best practice.

Following the energy and carbon evaluation, it is proposed that extensive energy efficiency measures along with low, and zero carbon (LZC) strategies are incorporated into the design for the Proposed Development. Section 11 of this Sustainability Statement provides details of the strategy for the Proposed Development. As demonstrated in detail in this assessment, energy, and carbon emissions calculations have confirmed that the proposed energy efficiency design, and LZC applications will achieve:

- **Regulated carbon dioxide savings of 2% relative to a New-Build Part L 2021 at Be Green stage and 36% at Be Lean stage;**
- **BREEAM UK Refurbishment and Fit-out 2014 targeting "Excellent" for office areas with aspiration for "Outstanding";**
- **WELL Standard v2 'Core' targeting "Gold" with an approach to pre-certificate and certify the building at a later stage;**
- **All-electrical development by removing the gas-fired boilers and CHP onsite to eliminate the NOx emissions and improve the air quality, which aims towards the development being true net zero carbon;**
- **The Energy Unit Intensity and space heating demand, calculated used the CIBSE TM54 methodology, are 75.99 kWh/m^2/year and 10.58 kWh/m^2/year respectively;**
- **Assessment of Life Cycle Analysis (LCA) using the RICS published standards to analyse the embodied carbon impact and inform the early stage building design.**

The energy assessment has been carried out using "The London Plan (2021)" energy hierarchy. The London Plan energy hierarchy is as follows:

1. Be Lean: Use less energy;
2. Be Clean: Supply energy efficiently;
3. Be Green: Use renewable energy;
4. Be Seen: Energy monitoring.

The GLA has released a cover note (15th June 2022) regarding the recent update to Part L, in which they have acknowledged the increased difficulty with achieving the improvement targets. Due to this, they will continue to monitor the progress and update benchmarks if required.

"Initially, non-residential developments may find it more challenging to achieve significant on-site carbon reductions beyond Part L 2021 to meet both the energy efficiency target and the minimum 35% improvement. This is because the new Part L baseline now includes low carbon heating for non-residential developments but not for residential developments."

The concept of applying the Energy Hierarchy in relation to Part L 2021 of the Building Regulations is illustrated in Figure 1. Where the dark blue bars drop below the black dotted line, this demonstrates savings in regulated CO2 emissions compared to a development that complies with Part L 2021 of the Building Regulations.

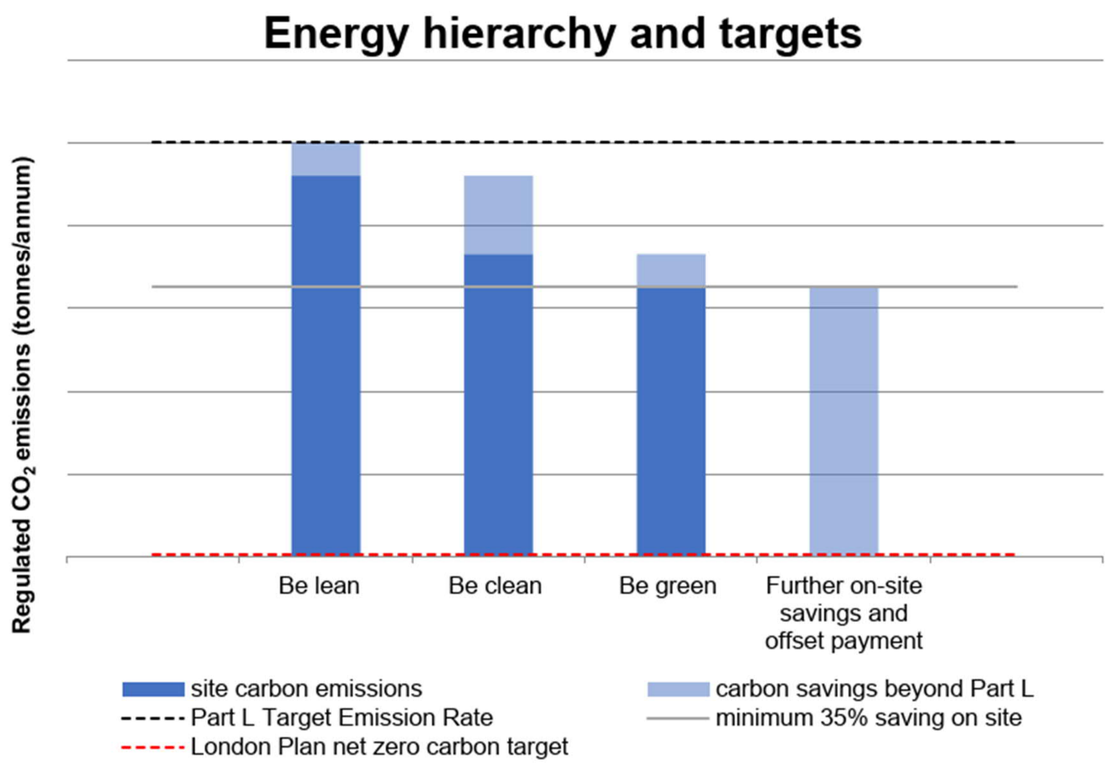

Figure 1 GLA's Non-Domestic Energy Hierarchy – Example

The combination of the optimised passive design measures, energy-efficient plant selection, and the innovative heat pump design result in an overall annual carbon reduction of **38%** relative to the current 2021 Part L target emission rate (TER) for the building, using SAP 10.2 carbon numbers.

1.1 Non-domestic Operational Carbon Dioxide Emissions

The following tables demonstrate compliance with the energy hierarchy, and the carbon targets proposed by the GLA. The commercial areas within the Proposed Development, namely office, amenity, are classified as 'non-domestic areas' as per Building Regulations terminology and will be referred as such throughout the report.

1.1.1 Part L 2021 (SAP 10.2)

Table 1-1 Carbon Dioxide Emissions After Each Stage of The Energy Hierarchy for Non-Domestic Buildings

Energy Planning – Greater London Authority guidance on preparing energy assessment	Carbon Dioxide Emissions (Tonnes CO2 per Annum)				
	Regulated Energy	Unregulated Energy	Total CO2 Reductions	Regulated Energy % Reduction	Unregulated Energy % Reduction
Building Regulations 2021 Part L Compliant Development	68.5	63.0	-	-	-
LEAN - After energy demand reduction	43.8	50.4	94.2	36%	20%
CLEAN - After Clean Technology	43.8	50.4	0.0	0.0%	-
GREEN - After Renewable Energy	42.7	50.4	1.1	2.5%	-

Table 1-2 Regulated Carbon Dioxide Savings from Each Stage of The Energy Hierarchy for Non-Domestic Buildings

Non-domestic areas	Regulated Carbon Dioxide Savings	
	(Tonnes CO_2 per annum)	(%)
Savings from reduced energy demand	24.7	36%
Savings from Clean Technology	0.0	0%
Savings from renewable energy	1.1	2%
Total Cumulative Savings	25.8	38%
Total Target Savings - GLA's Target	68.5	100%

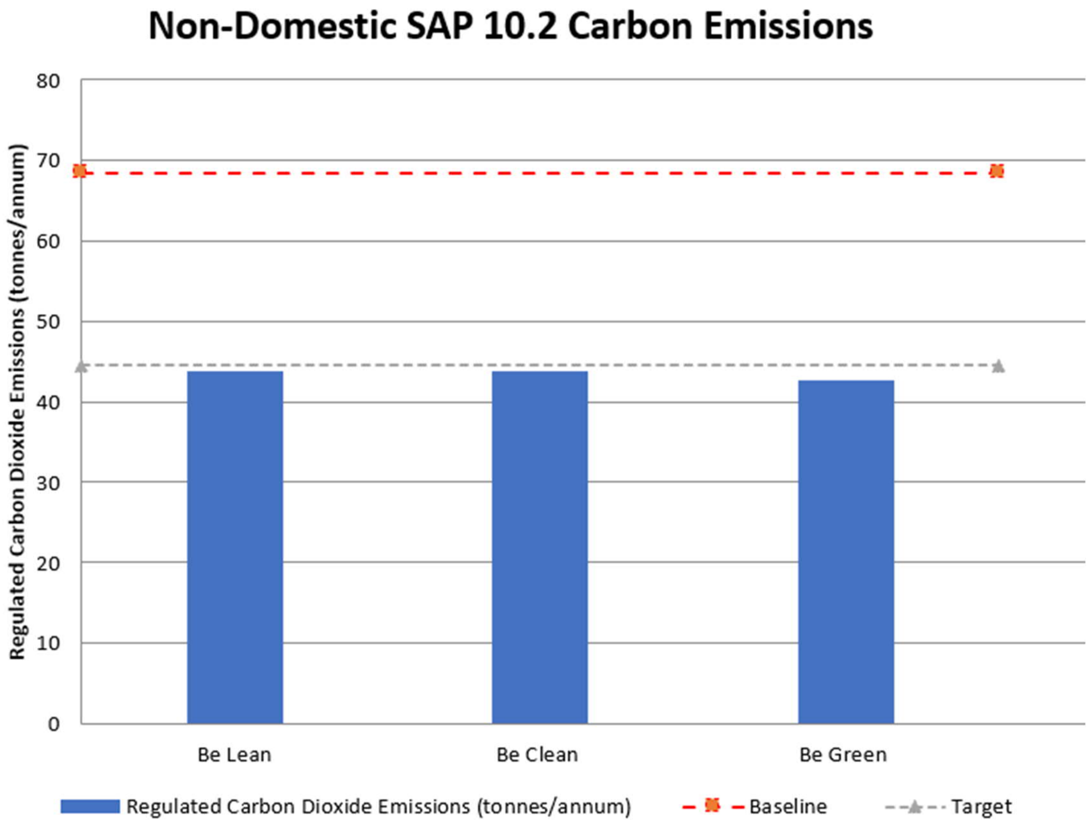

Figure 1-1 GLA's Energy Hierarchy for the Proposed Development as per SAP 10.2 Carbon Factors

The chart above reflects the changes in the overall CO_2 emissions after using the SAP 10.2 carbon factors, as the applicable carbon factor for the Proposed Development.

The carbon dioxide emissions savings shown in the tables above are matching the BRUKL outputs enclosed in **Appendix A.**

1.2 Carbon Offsetting

In summary, the Proposed Development will be net zero carbon for operational energy and embodied by the following:

- Only purchasing electricity from green energy providers with recognized supply coming from renewable sources from day 1;
- Encouraging tenant's to be adopt "Green Fit-out" and monitor and review landlord performance via Post Occupancy Evaluation;
- Significantly reducing embodied carbon and mapping performance against a whole life carbon approach using the RICS methodology; and
- Voluntarily offsetting embodied carbon emissions from construction using recognized standards such as the Gold Standard, or similar.

Carbon offsetting is therefore not applicable for the refurbishment and net zero carbon type proposed project.

![SWECO logo]

2 Introduction

2.1 Purpose of the Report

This report describes the various options for energy, and carbon reduction, and contains a sustainability strategy for the 21 Bloomsbury Street. As part of this document the energy and carbon performance of the Proposed Development is assessed against local and national planning policy requirements as described in Section 3 of this report.

The energy and carbon figures presented in this report are calculated for the purpose of initial estimates only, using the preliminary information currently available. Hence whilst they can be used to gain an understanding of the benefits of each technology, they must not be taken out of context; establishing the best economic, and energy-efficient operation will require more complex analysis of building projected load profiles when these are developed.

2.2 Development Description

The Site is in a Conservation Area. The existing building is not listed but is in the vicinity of several Statutory Listed Buildings.

Extension and alterations to 21 Bloomsbury Street to provide office floorspace [Class E] and gym/office floorspace [Class E], comprising

(i) strip-out of existing landlord's Cat A fit-out and any remaining tenants Cat B fit-out;
(ii) remodelling of ground floor reception and office entrance;
(iii) replace all central and on-floor plant;
(iv) retain any existing central plant where possible; sprinkler tanks & equipment, subject to validations;
(v) add new office space on 6th floor;
(vi) rear extension on 2nd to 5th floor;
(vii) new amenity space on 7th floor;
(viii) new terraces on upper floors where possible; and
(ix) partially infill existing atrium[1].

Notes:

1. This assessment is based on the assumption that both the atrium infill, confirmed to be permitted development under Certificate of Lawfulness ref. 2022/0189/P, and the development proposed by this application for planning permission are both implemented in order to fully assess the construction and future operational requirements of the building.

Table 2-1 Area Schedule by planning use

Use	GIA, m^2	GEA, m^2
Office, Reception / Amenity - Class E(g)(i)	11,181	12,103

Figure 2-1 The Proposed Development's aerial front view (Stiff + Trevillion)

Figure 2-2 The Proposed Development's aerial rear view (Stiff + Trevillion)

2.3 Planning Application Boundary

The site is in the London Borough of Camden. The building comprises of circa 11,181 sqm GIA of office accommodation across Lower Ground, Ground, Levels 01 to 06 with new amenity space on Level 07. The site is bounded by Bedford Avenue and Bloomsbury Street.

The Proposed Development benefits by being in proximity to Tottenham Court Road, Goodge Street and Holborn underground stations.

Figure 2-3 Indicative development red line boundary

2.4 Methodology

Sweco UK uses Integrated Environmental Systems' (IES) VE Compliance software to demonstrate Part L compliance for the non-domestic areas.

The IES VE Compliance software has been approved by The Department for Levelling Up, Housing and Communities (DLUHC) for use as a Dynamic Simulation Model (DSM) software package. As part of its approval process, the IES software had to demonstrate that it satisfies all the tests, and other requirements defined in accordance with ISO 90003:2004 – 'Guidelines for the application of ISO 9001:2000 to computer software.

The methodology used by the IES accredited software is summarised below:

- A three-dimensional software model of the proposed non-domestic areas of the building is generated using the software's Model IT component. This model is based on the architectural drawings and is an accurate geometric representation of the building.
- The building usage is defined for the building in line with the National Calculation Method's (NCM) various definitions for building uses.
- The building systems are defined and allocated to each of the rooms within the building.
- The software calculates a Building Emissions Rate (BER) based on the geometry of the building, its use, and the efficiency of the building systems defined.
- The software automatically generates a notional building using the geometry for the proposed building, but allocating glazing coverage, U-values, and plant efficiency in accordance with the Elemental Method as defined in NCM modelling guide 2021 Edition (July 2022).
- The software calculates an Emissions Rate for the Notional building, which is the Target Emission Rate (TER) for the actual building.

2.5 Architectural Information

The energy model of the building uses the architectural design drawings issued by ***Stiff+Trevillion*** dated 18th March 2022.

Any subsequent changes made to the drawings within the analysis period have been reviewed by the team and no significant deviations were found that would affect the results.

2.6 Energy Assessors

The energy assessment has been carried out and approved by CIBSE Energy Registered Low Carbon Energy Assessors based at Sweco UK – 1 Bath Road, Maidenhead, SL6 4AQ.

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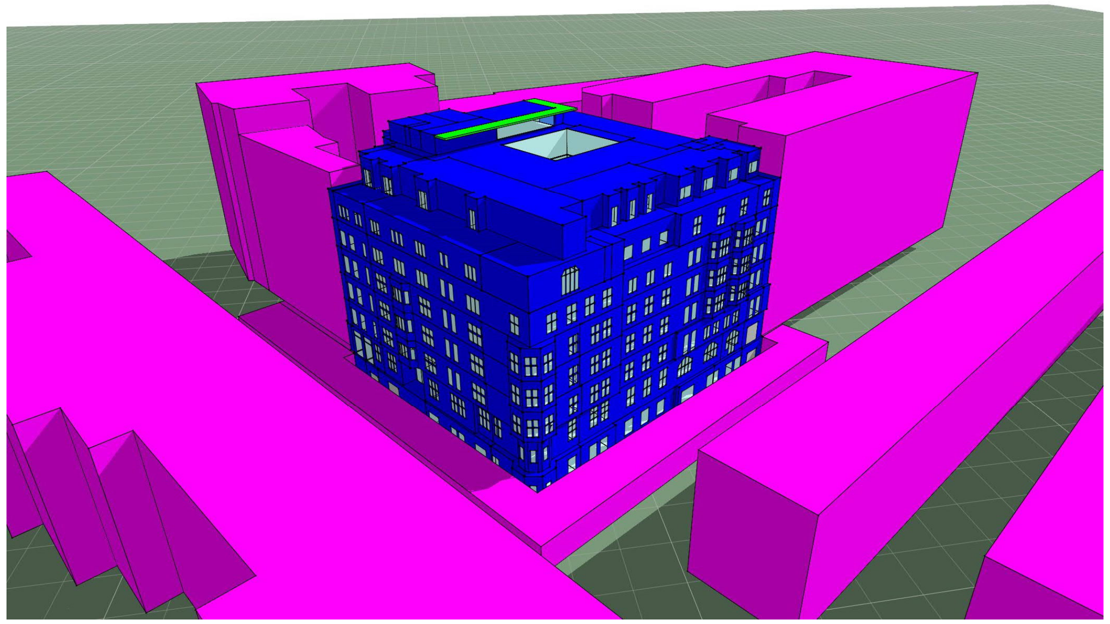


Figure 2-4 3D view of 21 Bloomsbury Street development extracted from IES-VE, note that not all shading elements were modelled physically due to software limitation therefore might not be visualised in the image above.

3 Legislation, and Planning Policies

3.1 Legislation

3.1.1 Climate Change Act 2008 (2050 Target Amendment)

The Climate Change Act sets legally binding greenhouse gas emission reductions targets of 100% by 2050 (with an interim target of 26% by 2020) against a 1990 baseline, which are to be achieved through action taken in the UK, and abroad. It contains provisions to enable the Government to require public bodies, and statutory undertakers to carry out their own risk assessment and make plans to address the risk of climate change.

In May 2019, the Climate Change Committee recommended a new emissions target for the UK: net-zero greenhouse gases by 2050 to respond to the Paris Agreement commitments. The recommendation has been adopted by the government, and the targets were amended accordingly in June 2019.

3.1.2 Energy Act 2011

The Act includes provisions for the establishment of the Green Deal, which is a new financing framework to fund improvements to the energy efficiency of domestic, and non-domestic properties. This will be paid back through a charge on the energy bill so that there is no upfront cost for consumers. The scheme was cancelled in July 2015.

The Act provided powers to ensure that from April 2018, it became unlawful to rent out a residential or business property that does not reach a minimum energy efficiency standard, currently set at EPC rating 'E'.

3.1.3 Building Regulations Part L 2021

Approved Documents are issued by the Secretary of State to provide guidance on compliance with specific aspects of building regulations in some of the more common building situations. They set out what, in ordinary circumstances, may be accepted as a reasonable provision for compliance with the relevant requirement(s) of the Building Regulations to which they refer.

Approved Document Part L of the Building Regulations covers the carbon emissions that are attributable to buildings in use, resulting from lighting, heating, cooling, and ventilation, excluding small power.

At the time of writing this report, the new Part L has been issued (December 2021) and proposes further options to increase the energy efficiency requirements.

In January 2021 the government has clarified the implementation of the new Part L. The timescale is as below:

- For transitional arrangements to apply to an individual building, developers will need to both:
  - Submit a building / initial notice or deposited plans by June 2022;
  - and commence work on each individual building by June 2023.
- Where notices or plans are submitted after June 2022, transitional arrangements will not apply, and homes must be built in line with 2021 Part L standards.
- Where notices or plans are submitted before June 2022 but work on any individual building does not commence by June 2023; the non-commenced buildings must build in line with 2021 Part L standards.
- No individual building will need to change once building work has commenced, in line with the definition on commencement below, if work commences within the reasonable period. However, developers will need to plan their sites appropriately, and if work on a building commences outside of the reasonable period, they will need to ensure that it is compliant with new standards.
- For the purposes of transition, commencement will not change from the existing 2013 definitions:
  - Excavation for strip or trench foundations or for pad footings.
  - Digging out and preparation of ground for raft foundations.
  - Vibrofloatation (stone columns) piling, boring for piles or pile driving.
  - Drainage work specific to the building(s) concerned.

Part L 2021 takes a fabric first approach, which is closely followed by low carbon heating systems. Emphasis has especially been placed on the inclusion of photovoltaic panels and heat pumps to provide space conditioning.

The Proposed Development will need to conform to the requirements set out in Approved Document L of the Building Regulations 2021. In summary:

- Non-domestic developments come under Part L, Volume 2 of the Building Regulations 2021 for new buildings.
- A rigid calculation methodology is set out to show compliance. This is the National Calculation Method (NCM) for non-domestic buildings.
- The required maximum carbon dioxide emissions can be achieved by any mixture of passive design features (i.e., reducing energy demand), and energy efficiency measures, but minimum standards of thermal performance apply.

In all cases, the carbon dioxide emissions achieved are calculated by comparing the proposed design against a target which complies with Building Regulations values.

3.1.4 Building Regulations Part L 2021 application to the Proposed Development

The Proposed Development will be assessed under:

- Part L 2021 for the new non-domestic buildings.

It is a requirement that such buildings meet the minimum building regulations in terms of the maximum façade U-values, minimum values for energy efficiencies, and minimum values for CO_2 reductions as listed within the Part L requirements, as shown section 4: Baseline Carbon Emissions (TER).

Fuel CO2 emission factors are based on SAP 2021, and the NCM document for Part L 2021 compliance, considered within the energy model to calculate the CO2 emissions that will be produced because of the running of the systems, as outlined within the report. Fuel CO2 emission factors in terms of SAP 10.2 carbon factors are used to calculate the equivalent carbon dioxide emissions associated with different fuels. For example, 1 kWh of power from grid electricity will have a different environmental impact than 1 kWh of power from natural gas as presented in the Table 3-1.

Grid electricity has significantly decarbonised since the issue of Part L2A 2013, hence SAP 10.2 carbon factors have been released with Part L 2021.

This will ensure that the assessment of new developments better reflects the actual carbon emissions associated with their expected operation. The impact of these new emission factors is significant in that technology generating on-site electricity (such as gas-engine CHP) will not achieve the carbon savings they have to date.

The Proposed Development's energy strategy is based on an all-electric HVRF system with thermal storage, and free cooling from summer by-pass from the mechanical ventilation heat recovery units, and openings on the facades for natural ventilation.

Table 3-1 Fuel Factors 2013 Part L (SAP10) and PartL2021 (SAP10.2)

System	Fuel Source	Emission Factor (KgCO2/kWh)	
		SAP 10	SAP 10.2 (new)
LTHW Heating Energy	Natural Gas	0.210	0.210
Chiller Energy	Grid Electricity	0.233	0.136
Lighting Energy	Grid Electricity	0.233	0.136
Pump / Fan Energy	Grid Electricity	0.233	0.136
DHW Energy	Natural Gas	0.210	0.210

3.2 Planning Policies

3.2.1 National Planning Policy Framework (NPPF) England

In July 2021, the Ministry of Housing, Communities, and Local Government revised the issue of National Planning Policy Framework (NPPF), which sets out the Government's planning policies for England, and how development should happen in the country.

Chapter 14: "Meeting the challenge of climate change, flooding, and coastal change" is NPPF's relevant section to this energy, and sustainability statement. That chapter provides a framework for local authorities to address the following issues as regards planning applications: (Key paragraphs extracted)

The planning system should support the transition to a low carbon future in a changing climate, taking full account of flood risk and coastal change. It should help to shape places in ways that contribute to radical reductions in greenhouse gas emissions, minimise vulnerability and improve resilience; encourage the reuse of existing resources, including the conversion of existing buildings; and support renewable and low carbon energy and associated infrastructure.

- New development should be planned for in ways that:

a) Avoid increased vulnerability to the range of impacts arising from climate change. When a new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through the planning of green infrastructure; and

b) Can help to reduce greenhouse gas emissions, such as through its location, orientation, and design. Any local requirements for the sustainability of buildings should reflect the Government's policy for national technical standards.

- To help increase the use, and supply of renewable, and low carbon energy, and heat, plans should:

a) Provide a positive strategy for energy from these sources, that maximises the potential for a suitable development, while ensuring that adverse impacts are addressed satisfactorily (including cumulative landscape, and visual impacts);

b) Consider identifying suitable areas for renewable, and low carbon energy sources, and supporting infrastructure, where this would help secure their development;

c) Identify opportunities for development to draw its energy supply from decentralised, renewable, or low carbon energy supply systems, and for co-locating potential heat customers, and suppliers.

Local planning authorities should support community-led initiatives for renewable, and low carbon energy, including developments outside areas identified in local plans or other strategic policies that are being taken forward through neighbourhood planning.

- In determining planning applications, local planning authorities should expect new development to:

a) Comply with any development plan policies on local requirements for decentralised energy supply unless it can be demonstrated by the applicant, having regard to the type of development involved, and its design, that this is not feasible or viable; and

b) Take account of landform, layout, building orientation, massing, and landscaping to minimise energy consumption.

- In determining planning applications, local planning authorities should expect new development to:

a) not require applicants to demonstrate the overall need for renewable or low carbon energy, and recognise that even small-scale projects provide a valuable contribution to cutting greenhouse gas emissions; and

b) approve the application if its impacts are (or can be made) acceptable. Once suitable areas for renewable and low carbon energy have been identified in plans, local planning authorities should expect subsequent applications for commercial scale projects outside these areas to demonstrate that the proposed location meets the criteria used in identifying suitable areas.

3.3 Regional Policies

3.3.1 The London Plan (2021)

The Mayor of London published the current "London Plan" in March 2021. This is the Spatial Development Strategy for Greater London. The Development Plan for each London Borough must ultimately comply with the general requirements of the London Plan (2021).

To support borough planners, the Mayor has previously published the following guidance documents through London Renewables: "Integrating Renewable Energy into New Developments: A Toolkit for Planners, Developers and Consultants", and more recently the Supplementary Planning Guidance, "Sustainable Design and Construction", 2014.

The London Plan includes planning policies both for reducing energy consumption within buildings and, more significantly, for promoting the use of decentralised electricity generation and renewable energy technologies. These policies cover the requirements of each borough with respect to Energy strategies and planning applications.

The Energy Planning – 'GLA Guidance on preparing energy assessments as part of planning applications' (June 2022) states the requirements and guidance for energy strategies to ultimately reduce carbon dioxide emissions.

These emissions should include those covered by the Building Regulations and those that are not covered by the Building Regulations.

The Mayor of London has declared a climate emergency and has set an ambition for London to be net zero-carbon. This means all new buildings must be net zero carbon. The Mayor's London Plan sets the targets and policies required to achieve this. It includes:

- A net zero-carbon target for all major developments, which has applied to major residential developments since 2016.
- A requirement for all major development to 'be seen' i.e., to monitor and report its energy performance post-construction to ensure that the actual carbon performance of the development is aligned with the Mayor's net zero carbon target.
- A requirement for all referable planning applications to calculate and reduce whole life-cycle carbon emissions to fully capture a development's carbon impact.

Therefore, the target reduction on CO_2 emissions of the development according to the GLA's requirements is:

- Zero Carbon for Domestic Areas as compared to a Part L, Volume 1 Compliant Build.
- Zero Carbon for Non-Domestic Areas as compared to a Part L, Volume 2 Compliant Build

The London Plan recognises that energy efficiency should come before energy supply considerations and has suggested a simple strategy known as the Energy Hierarchy (Policy SI 2). The process follows good practice in the design of low carbon buildings and comprises four distinct stages and order of application:

1. Use Less Energy (Be Lean).
2. Supply Energy Efficiently (Be Clean).
3. Use Renewable Energy (Be Green).
4. Monitor, verify and report on energy performance (Be Seen).

This strategy puts energy efficiency/conservation measures first to reduce the demand for energy, 'Be Lean'. Following this, consideration must be given to supplying the resultant reduced energy demand as efficiently as possible, including to exploit local energy resources (such as secondary heat) and supply energy efficiently, 'Be Clean'. Sources of low or zero carbon and renewable energy technologies should then be examined for incorporation, 'Be Green'. Lastly, it is a requirement for developments to monitor and report energy performance post-construction to ensure that the actual carbon performance of the development is aligned with the Mayor's net zero carbon target, 'Be Seen'.

London Plan (2021) requires a minimum on-site reduction of:

- at least 35 per cent beyond Building Regulations: residential development should achieve 10 per cent, and non-residential development should achieve 15 per cent through energy efficiency measures. Where it is clearly demonstrated that the zero-carbon target cannot be fully achieved on-site, any shortfall should be provided, in agreement with the borough, either:

1. through a cash in lieu contribution to the borough's carbon offset fund, or
2. off-site provided that an alternative proposal is identified, and delivery is certain

As Per London Plan Policy SI 3, developments in Heat Network Priority Areas (HNPAs) (i.e., areas in London where the heat density is sufficient for heat networks to provide a competitive solution for supplying heat to buildings and consumers) should have a communal low-temperature heating system and should select a heat source in accordance with the following heating hierarchy:

a) connect to local existing or planned heat networks

b) use zero-emission or local secondary heat sources (in conjunction with heat pump, if required)

c) use low-emission combined heat and power (only where there is a case for CHP to enable the delivery of an area-wide heat network, meet the development's electricity demand and provide demand response to the local electricity network)

The table below outlines compliance with the London Plan (2021).

Table 3-2 Compliance with London Plan (2021)

London Plan (2021)	Applied measure at the Proposed Development
Policy SI1 Improving Air Quality	Fossil-fuel free development with all-electric energy strategy primarily served by an HVRF system with on-floor air handling units (AHUs) to satisfy comfort heating and cooling needs. Refer to Section 5.2
Policy SI2 Minimising greenhouse gas emissions	38% carbon reduction via passive, and energy-efficient design. Completion of a Whole Life Carbon (WLC) assessment in accordance with the RICS Professional Statement on WLCA. Refer to Sections 1.2 and 11.6.
Policy SI3 Energy Infrastructure	No potential for future connection to district energy networks. Refer to Sections 7, and 11.
Policy S14 Managing Heat Risk	Extensive passive measures adopted to reduce building cooling demand and mitigate overheating. The development team is looking to maximise the urban greening where possible and aims to achieve as close as possible to UGF of 0.3. Refer to Sections 6, and 11.
Policy SI5 Water Infrastructure	Extensive water-saving measures to exceed BREEAM UK Refurbishment and Fit-out 2014 targets, and attenuate surface water run-off. Refer to Section 11 and accompanying appendices with BREEAM pre-assessment.
Policy SI7 Reducing waste, and supporting the circular economy	Relevant BREEAM UK Refurbishment and Fit-out 2014 credits targeted, life cycle assessment, and early considerations of applying the waste hierarchy through the design. Refer to Section 11, and accompanying appendices with BREEAM pre-assessment.
Policy SI8 Waste capacity, and net waste self-sufficiency	Relevant BREEAM UK Refurbishment and Fit-out 2014 credits targeted. Refer to Section 11 and accompanying appendices with BREEAM pre-assessment.
Policy SI10 Aggregates	Relevant BREEAM UK Refurbishment and Fit-out 2014 credits targeted, life cycle assessment, and early considerations of applying the waste hierarchy through the design. Refer to Section 11 and accompanying appendices with BREEAM pre-assessment.
Policy SI12 Flood risk management	Relevant BREEAM UK Refurbishment and Fit-out 2014 credits targeted. Refer to Section 11 and accompanying Appendix C with BREEAM pre-assessment.

3.3.2 London Environment Strategy – May 2018

The Mayor of London published the London Environment Strategy setting out London's plans to tackle environmental challenges by 2050. The aims are:

- For London to have the best air quality of any major world city by 2050, going beyond the legal requirements to protect human health, and minimise inequalities.
- For London to be the world's first National Park City, where more than half of its area is green, where the natural environment is protected, and where the network of green infrastructure is managed to benefit all Londoners.
- For London to be a zero-carbon city by 2050, with energy-efficient buildings, clean transport, and clean energy.
- To make London a zero-waste city. By 2026, no biodegradable or recyclable waste will be sent to landfill, and by 2030, 65 per cent of London's municipal waste will be recycled.
- For London, and Londoners to be resilient to severe weather, and longer-term climate change impacts. This will include flooding, heat risk, and drought.
- For Londoners' quality of life to be improved by reducing the number of people adversely affected by noise, and promoting quieter, and tranquil spaces.
- For London to transition to a low carbon circular economy.

As summarised in Table 3-2, and within Section 11 of this report, the Proposed Development will positively contribute to achieving the objectives set out by the London Environment Strategy.

3.4 Local Policies – Camden Council

The Camden Local Plan sets out the Council's planning policies and replaces the Core Strategy and Development Policies planning documents (adopted in 2010). The Local Plan covers the period from 2016-2031.

The Council has prepared a number of other documents that provide advice and guidance on how their planning policies will be applied for certain topics, areas or sites known as Supplementary Planning Guidance (SPG). These documents do not have the same weight in decision making as Camden development plan documents but they are important supporting documents. One of these documents which is of importance for this report is CPG3: Sustainability.

There are five key strategic Policies which Camden aims to implement to address sustainability within built environment:

- Policy CC1: Climate change mitigation
- Policy CC2: Adapting to climate change
- Policy CC3: Water and flooding
- Policy CC4: Air quality
- Policy CC5: Waste

Detailed information of these Policies is illustrated below.

3.4.1 Sustainability and climate change

The Council aims to tackle the causes of climate change in the borough by ensuring developments use less energy and assess the feasibility of decentralised energy and renewable energy technologies.

Climate change adaptation involves changing our behaviours and processes to prepare for the potential effects of climate change. It needs to be clear that buildings and people can adapt to changes already evident within the climatic system.

Improving local air quality, mitigating the impact of development on air quality and reducing exposure to poor air quality in the borough is vital in safeguarding public health and the environment. The focus of Policy CC4 is to mitigate the impact of development on air quality and to ensure exposure to poor air quality is reduced in the borough.

The Sustainability and Climate Change Policies related to the Local Plan are as illustrated.

- Policy CC1: Climate change mitigation

Policy CC1 Climate change mitigation

The Council will require all development 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.

We will:

a. promote zero carbon development and require all development to reduce carbon dioxide emissions through following the steps in the energy hierarchy;
b. require all major development to demonstrate how London Plan targets for carbon dioxide emissions have been met;
c. ensure that the location of development and mix of land uses minimise the need to travel by car and help to support decentralised energy networks;
d. support and encourage sensitive energy efficiency improvements to existing buildings;
e. require all proposals that involve substantial demolition to demonstrate that it is not possible to retain and improve the existing building; and
f. expect all developments to optimise resource efficiency.

For decentralised energy networks, we will promote decentralised energy by:

g. working with local organisations and developers to implement decentralised energy networks in the parts of Camden most likely to support them;
h. protecting existing decentralised energy networks (e.g. at Gower Street, Bloomsbury, King's Cross, Gospel Oak and Somers Town) and safeguarding potential network routes; and
i. requiring all major developments to assess the feasibility of connecting to an existing decentralised energy network, or where this is not possible establishing a new network.

To ensure that the Council can monitor the effectiveness of renewable and low carbon technologies, major developments will be required to install appropriate monitoring equipment.

- Policy CC2: Adapting to climate change

Policy CC2 Adapting to climate change

The Council will require development to be resilient to climate change.

All development should adopt appropriate climate change adaptation measures such as:

a. the protection of existing green spaces and promoting new appropriate green infrastructure;
b. not increasing, and wherever possible reducing, surface water run-off through increasing permeable surfaces and use of Sustainable Drainage Systems;
c. incorporating bio-diverse roofs, combination green and blue roofs and green walls where appropriate; and
d. measures to reduce the impact of urban and dwelling overheating, including application of the cooling hierarchy.

Any development involving 5 or more residential units or 500 sqm or more of any additional floorspace is required to demonstrate the above in a Sustainability Statement.

Sustainable design and construction measures

The Council will promote and measure sustainable design and construction by:

e. ensuring development schemes demonstrate how adaptation measures and sustainable development principles have been incorporated into the design and proposed implementation;
f. encourage new build residential development to use the Home Quality Mark and Passivhaus design standards;
g. encouraging conversions and extensions of 500 sqm of residential floorspace or above or five or more dwellings to achieve "excellent" in BREEAM domestic refurbishment; and
h. expecting non-domestic developments of 500 sqm of floorspace or above to achieve "excellent" in BREEAM assessments and encouraging zero carbon in new development from 2019.

- Policy CC3: Water and flooding

Policy CC3 Water and flooding

The Council will seek to ensure that development does not increase flood risk and reduces the risk of flooding where possible.

We will require development to:

a. incorporate water efficiency measures;
b. avoid harm to the water environment and improve water quality;
c. consider the impact of development in areas at risk of flooding (including drainage);
d. incorporate flood resilient measures in areas prone to flooding;
e. utilise Sustainable Drainage Systems (SuDS) in line with the drainage hierarchy to achieve a greenfield run-off rate where feasible; and
f. not locate vulnerable development in flood-prone areas.

Where an assessment of flood risk is required, developments should consider surface water flooding in detail and groundwater flooding where applicable.

The Council will protect the borough's existing drinking water and foul water infrastructure, including the reservoirs at Barrow Hill, Hampstead Heath, Highgate and Kidderpore.

- Policy CC4: Air quality

Policy CC4 Air quality

The Council will ensure that the impact of development on air quality is mitigated and ensure that exposure to poor air quality is reduced in the borough.

The Council will take into account the impact of air quality when assessing development proposals, through the consideration of both the exposure of occupants to air pollution and the effect of the development on air quality. Consideration must be taken to the actions identified in the Council's Air Quality Action Plan.

Air Quality Assessments (AQAs) are required where development is likely to expose residents to high levels of air pollution. Where the AQA shows that a development would cause harm to air quality, the Council will not grant planning permission unless measures are adopted to mitigate the impact. Similarly, developments that introduce sensitive receptors (i.e. housing, schools) in locations of poor air quality will not be acceptable unless designed to mitigate the impact.

Development that involves significant demolition, construction or earthworks will also be required to assess the risk of dust and emissions impacts in an AQA and include appropriate mitigation measures to be secured in a Construction Management Plan.

- Policy CC5: Waste

Policy CC5 Waste

The Council will seek to make Camden a low waste borough.

We will:

a. aim to reduce the amount of waste produced in the borough and increase recycling and the reuse of materials to meet the London Plan targets of 50% of household waste recycled/composted by 2020 and aspiring to achieve 60% by 2031;
b. deal with North London's waste by working with our partner boroughs in North London to produce a Waste Plan, which will ensure that sufficient land is allocated to manage the amount of waste apportioned to the area in the London Plan;
c. safeguard Camden's existing waste site at Regis Road unless a suitable compensatory waste site is provided that replaces the maximum throughput achievable at the existing site; and
d. make sure that developments include facilities for the storage and collection of waste and recycling.

The following table outlines the compliance of the Proposed Development against the Camden Council policy.

Table 3-3 Camden Council Policies, and References within the Report

Policy ref.	Policy key requirements	Sections within this report
Policy CC1(a): Climate change mitigation	Promote zero carbon development and require all development to reduce carbon dioxide emissions through following steps in the energy hierarchy	Refer to **Sections 8&10** for the 'Net Zero Carbon strategy', and **Section 11** for the Sustainability Statement
Policy CC1(b): Climate change mitigation	Require all major development to demonstrate how London Plan targets for carbon dioxide emissions have been met	Refer to **Section 8.2** for the 'Be Green' measures applied to the building – the development achieved 2% of the regulated carbon dioxide emissions savings at the 'Be Green' stage.
Policy CC1(c): Climate change mitigation	Ensure that the location of development and mix of land uses minimise the need to travel by car and help to support decentralised energy networks	Car-free development, and enhanced cycle parking provision Refer to **Section 11** for further details

Policy ref.	Policy key requirements	Sections within this report
Policy CC1(d): Climate change mitigation	Support and encourage sensitive energy efficiency improvements to existing buildings	Replacing all the existing plant to increase energy efficiency Refer to **Section 5.2&10** for further details
Policy CC1(e): Climate change mitigation	Require all proposals that involve substantial demolition to demonstrate that it is not possible to retain and improve the existing building	Demolition is minimised as this is a refurbishment of existing building. Refer to **Section 11.7** for further details
Policy CC1(f): Climate change mitigation	Expect all developments to optimise resource efficiency	Refer to **Sections 5.2**, **10&11.4** for description of resources like energy and water being managed within the Proposed Development.
Policy CC1(i): Climate change mitigation	Requiring all major developments to assess the feasibility of connecting to an existing decentralised energy network, or where this is not possible establishing a new network.	No potential for future connection to an existing decentralised energy network. Refer to **Section 10** for 'Energy Strategy'
Policy CC2(a): Adapting to Climate Change	The protection of existing green spaces and promoting new appropriate green infrastructure	Increased biodiversity on roof and facades with green roof and planting on south facing terraces Refer to **Section 11** for the Sustainability Statement, and **Appendix C** for the BREEAM pre-assessment
Policy CC2(b): Adapting to Climate Change	Not increasing, and wherever possible reducing, surface water run-off through increasing permeable surfaces and use of Sustainable Drainage Systems	Refer to **Section 11.5** for 'Flood Risk, Water Management & Drainage'

Policy ref.	Policy key requirements	Sections within this report
Policy CC2(c): Adapting to Climate Change	Incorporating bio-diverse roofs, combination green and blue roofs and green walls where appropriate	Proposed green roof and rainwater attenuation tank at ground floor. Refer to **Section 11.5** for 'Flood Risk, Water Management & Drainage', and **Section 5**
Policy CC2(d): Adapting to Climate Change	Measures to reduce the impact of urban and dwelling overheating, including application of the cooling hierarchy	Refer to **Section 5** for 'Cooling, and Overheating'
Policy CC2(h): Adapting to Climate Change	Expecting non-domestic developments of 500 sqm of floorspace or above to achieve "Excellent" in BREEAM assessments and encouraging zero carbon in new development from 2019	Targeting BREEAM 'Outstanding' with a minimum accreditation of 'Excellent' Refer to **Section 11** for the Sustainability Statement, and **Appendix C** for the BREEAM pre-assessment
Policy CC4: Air Quality	The Council will ensure that the impact of development on air quality is mitigated and ensure that exposure to poor air quality is reduced in the borough.	Refer to **Section 11.9** for 'Air Quality & Pollution'
Policy CC5: Waste	Make sure that developments include facilities for the storage and collection of waste and recycling.	Refer to **Section 11.7** for 'Waste Management'

4 'Baseline' Carbon Emissions (TER)

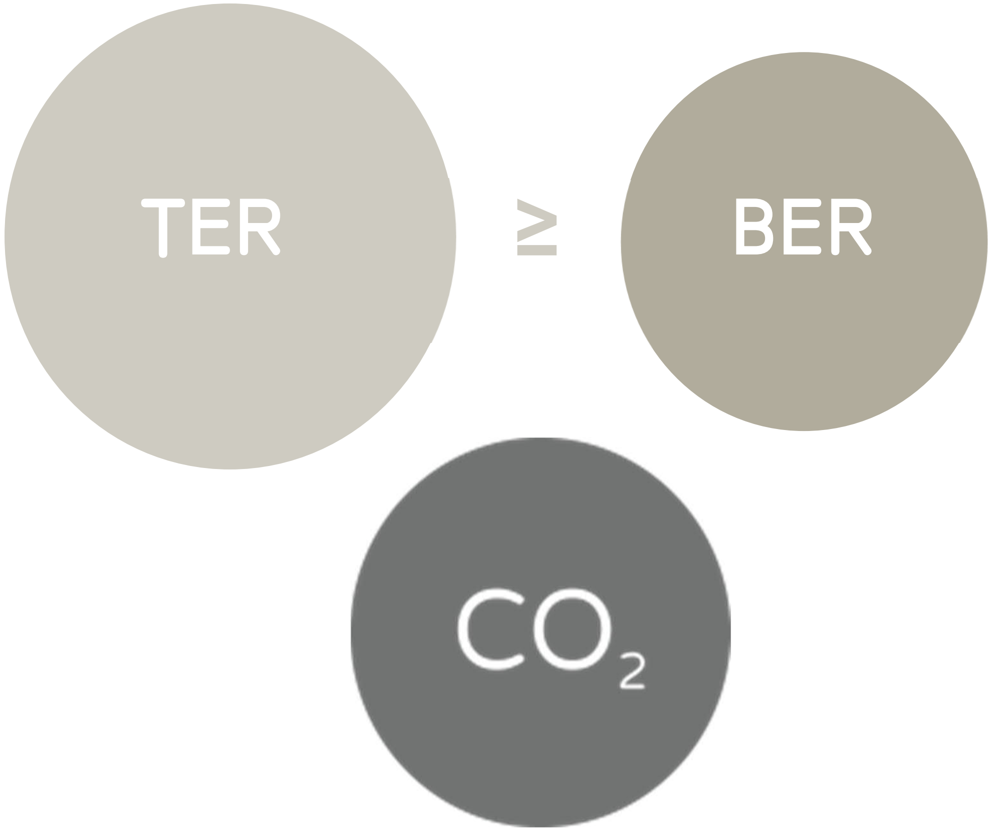
4.1 Baseline TER

The 'baseline' building represents a development which just meets the minimum standards of CO_2 emissions reduction (i.e., the Building Emissions Rate (BER) is equal to the Target Emissions Rate (TER), as defined by Part L of the Building Regulations 2021).

Allowances for energy consumption not included under Part L have been made by reference to published material or by calculation. These include small power (energy use for electrical appliances). The energy breakdown, and carbon dioxide emissions by end-use, and area are shown in Section 1.1, Table 1-1 to Table 1-2.

As part of the study for the commercial areas of the building, a thermal model of the building was developed, and analysed using the approved IES Virtual Environment (VE) Software (Version 2022 1.0.0). This software models the carbon dioxide emission rates produced by a building in accordance with Part L of the Building Regulations (2021). The software is approved for use by The Department for Levelling Up, Housing and Communities (DLUHC) as a Dynamic Building Simulation Modelling Package (DSM).

Unregulated energy use, and the associated carbon dioxide emissions for the non-domestic buildings has been calculated using the BRUKL document (typical output document), and Chartered Institution of Building Services Engineers' (CIBSE) publications for guidance, as well as evidence established through previous development work.



5 'Be Lean' – Reducing Energy Demand

This section of the report details the applied measures at the Proposed Development to reduce energy demand as part of the 'Be Lean' stage of the Energy Hierarchy, and is based on the following strategies:

- "Fabric First approach" – designing of a high thermal performing building envelope (for new elements), with optimised glazing ratio in the new south-facing facade for daylighting, and solar gains management during summer, and winter.
- Central ventilation strategy for the offices' areas flexibility, and lower energy use due to improved energy efficiency of mechanical ventilation equipment.
- Promoting energy savings and wellness initiatives through robust metering, and control strategy.
- Energy-efficient equipment will be used throughout the development to reduce energy consumption; and
- Setting an ambitious energy use intensity target (EUI) for operational energy using the NABERS UK design for performance system.

5.1 Passive Design Features: Regulated Energy Use and response to Climate Resiliance

The chapter identifies the Proposed Development strategies and their effectiveness at adaptability and building resilience to climate variability and change.

Passive features take advantage of the climate, location, and site context to reduce energy demand for regulated energy uses (e.g., heating, cooling, ventilation, lighting, and pump energy). Examples of design features include maximising the use of natural resources, such as passive solar heating, daylighting, and designing out unwanted gains through glazing ratio optimisation, including greenery for stabilising temperature conditions, wherever possible.

5.1.1 Site location, and microclimate

The Proposed Development is in the London Borough of Camden a highly urban area in the vicinity of Tottenham Court Road, Goodge Street and Holborn underground station.

Camden's microclimate is fundamentally different from other parts of London where higher temperatures can be experienced due to urban heat island impact, and within a densely urban environment with potential issues of sunlight availability at ground level during winter months. The design positively responds to the local environmental conditions by:

- Developing a massing for the new built areas that optimises the site potential, whilst striving to safeguard daylight, and sunlight to existing nearby properties.
- Proposing light coloured materials to new and most exposed elevations to contribute to reducing urban heat island effect.
- Locating intakes of air supply as far as possible from pollution sources.
- Improving local air quality by prioritising electricity-based rather than fossil fuel-based heating systems such as AHUs or HVRF systems.
- Where fossil fuels will only be used for life safety, and backup electrical supply rather than day-to-day use; and
- Providing more greenery to terraces across several floors with green roof.

The height of the neighbouring buildings can aid in mitigating direct solar radiation by providing an appropriate amount of shading which has been recognised and accounted for in the energy model.

5.1.2 Building orientation, layout, and form

The building footprint responds to the existing buildings geometry, maximising the available floor space, while reducing the size of atrium, with cut-ins across south elevation to articulate the massing and provide terraces for its occupants.

The architectural intent is to have a unique building identity, and language which maximises passive design solution such as the proposed ratio of glazing to solid in new elements. The east and south elevations on the upper levels are more exposed where the existing deep window recess as well as greenery helps with mitigating excess solar gains. The lower levels of the office floors extent across the whole boundary floor plate. They benefit from overshadowing from the surrounding buildings.

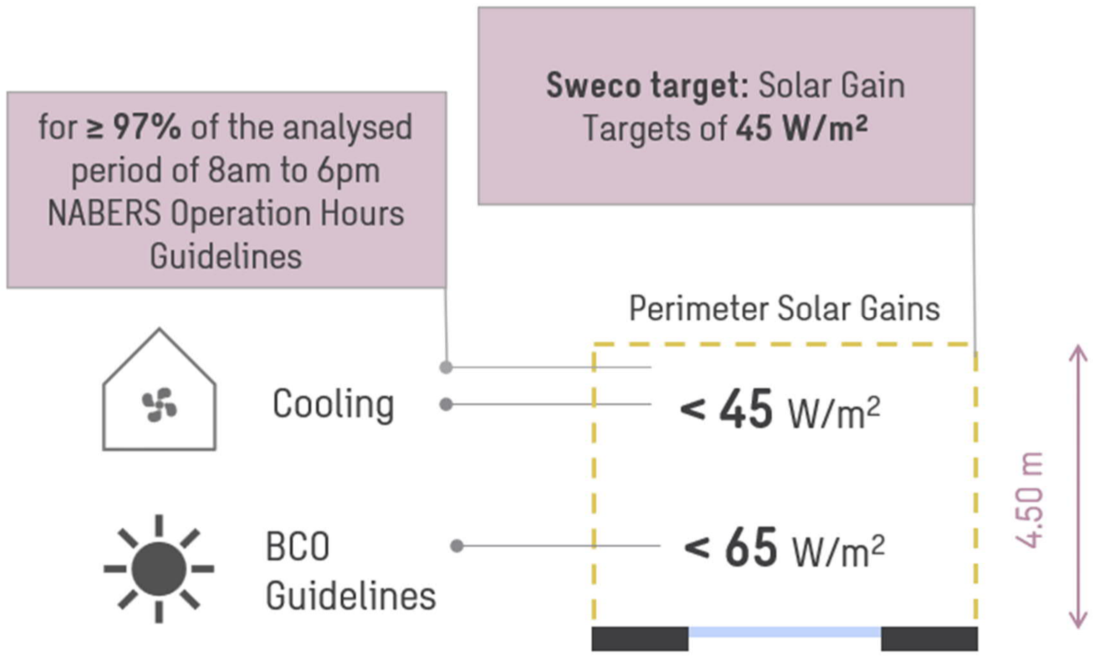
5.1.3 Façade Optimisation

For the new façade elements, solid areas are going to be derived from detailed thermal modelling analysis during the design process to optimise solar heat gains through the glazing with daylighting, and thus ensure good levels of natural daylight penetration whilst limiting unwanted solar gain, and heat loss.

Sweco undertook a detail exercise to ensure a low g-value and appropriate shading measures are executed, this included testing various glazing options and coating.

The aim is to drive down the solar gains within the perimeter aimed at achieving solar gains of less than 45W/m^2 for not more than 3% of the percentage hours in occupancy period (NABERS occupancy profile: 8:00 to 18:00) following Sweco's best practice. BCO guidance of no more than 65W/m^2 is to be considered for the corner zones and where the retained structure results in design constraint. The target was set based on a two-fold ambition:

- Energy demand reduction: Improve the energy performance
- Health and well-being: Improve thermal comfort



This methodology allows to design (and upgrade) facades to control excess gains in the summer but at the same time benefit from the solar presence in winter and maximise daylighting where possible. Sweco worked with Stiff+Trevillion to ensure passive design strategies are being considered to reach ambitious solar gain targets, this includes:

- Replacing the glazing allowing for a lower g-value 0.40 on North and East facades; and 0.28 on South and West.
- Proposed new South elevation: stepped terraces with planters and greening
- Glazing to solid ratio revised to control solar gain (in new elements)
- Building benefits from dense surrounding context providing shading

Typical office floor plans were tested (Levels 2, 6 and 7) where upper levels are most exposed in the critical South and East facing orientations, as they receive the most solar gains.

The output of the study concluded a need to reduce the g-values (as glazing is being replaced) to value 0.40 on North and East facades; and 0.28 on South and West to ensure that majority of the zones are within the 45-65 W/m² solar gains range for no more than 3% of occupied hours between April to September.

5.1.4 Building Envelope

The external envelope of a building acts as an important climatic modifier, with a well-designed façade significantly reducing the buildings energy demand and contributing to a comfortable internal environment by minimising cold draughts, and excessive solar heat gains in summer.

For these very reasons, Sweco recommends a “Fabric First” approach as a first step to a high performing building. The following table details improvements made to the proposed building’s construction elements as a “Fabric First” approach to reduce heating and cooling loads and increase comfort level within the spaces by even heat distribution within the occupied spaces at the Proposed Development.

The outlined U-values in Table 5-1 are critical to reducing carbon emissions, and coordination on the practice of achieving these U-values has been discussed with the architectural team, the next stages of design will provide more detailed calculations to confirm those.

The following values are indicative of the design stage and are subject to confirmation and further analysis.

Table 5-1 Building Fabric Thermal Performance Non-Domestic Areas New Elements

Parameter		Part L2A 2013 Limiting Value	Part L 2021 Limiting Value	Sweco Target Values
Building Airtightness (@ 50Pa)		10 m³/h/m²	8 m³/h/m²	3 m³/h/m²
U-values	New Wall	0.35 W/m²K	0.26 W/m²K	0.22 W/m²K
	Retained Wall	0.55 W/m²K		0.26 W/m²K
	Roof	0.25 W/m²K	0.18 W/m²K	0.15 W/m²K (proposed) 0.35 W/m²K (existing)
	Floor	0.25 W/m²K	0.18 W/m²K	0.20 W/m²K
Glazing U-value		2.2 W/m²K	1.6 W/m²K	1.4 W/m²K
Rooflight U-value		2.2 W/m²K	2.2 W/m²K	1.8 W/m²K
Glazing g-value (BS EN 410)		South and West		0.28
		North and East		0.40
		Rooflight		0.30
Glazing Visible Light Transmittance		-		≥ 60%

Notes:

1. The "Proposed Values" are the construction parameters applied to the actual building simulation model and should be reflective of the average of the actual building element U-value.
2. U-values outlined within the Energy Assessment Guidance (2020) for major refurbishment have been applied to the Baseline Existing Building

3. The U-values include repeating cold thermal bridges. A margin of 10% of the U-value has been added to the target U-values to make provision for non-repeating thermal bridging. The thermal bridging coefficient should not exceed 10% of the target U-values listed above.
4. Glazing g-value to vary based upon exposure to sunlight, to balance daylighting against the cooling loads.
5. The g-value specified to shopfronts or active frontages of the building considers that façade set-backs or additional shading is proposed. The design must be able to manage the solar gains entering the space to allow for a transparent façade whilst considering passive solar gain control measures.

Renovated thermal elements within refurbished buildings would have to comply with the requirements of paragraphs 4.7 to 4.8 in ADL2 2021.

Where a thermal element is subject to a renovation through undertaking an activity listed in paragraph 11.2, the performance of the whole element should be improved to achieve or better the relevant U-value set out in column (b) of Table 2, provided the area to be renovated is greater than 50 per cent of the surface of the individual element or 25 per cent of the total building envelope.

The existing fabric u-values are to be confirmed following the façade survey results.

Table 5-2 Upgrading retained thermal elements

Element	U-value W/m²K	
	(a) Threshold	(b) Threshold
Wall - cavity insulation(2)(5)	0.70	0.55
Wall - external or internal insulation(2)(6)	0.70	0.30
Floors(7)(8)	0.70	0.25
Pitched roof - insulation at ceiling level(2)	0.35	0.16
Pitched roof - insulation at rafter level(2)(3)	0.35	0.18
Flat roof or roof with integral insulation(2)(4)	0.35	0.18

Notes:

1. Area-weighted average values.
2. For dormer windows, 'roof' includes the roof parts of the window and 'wall' includes the wall parts (cheeks).
3. If meeting such a standard would limit head room, a lesser standard may be appropriate. In such cases, both of the following should be achieved.
   a. The depth of the insulation plus any required air gap should be at least to the depth of the rafters.
   b. The insulant should be chosen to achieve the lowest practicable U-value.
4. If there are problems with the load-bearing capacity of the frame or height of the upstand, for a flat roof or roof with integral insulation, a lesser standard may be appropriate.
5. This applies only to a wall suitable for cavity insulation. Where this is not the case, it should be treated as 'wall – external or internal insulation'.
6. If meeting such a standard would reduce the internal floor area of the room bounded by the wall by more than 5%, a lesser standard may be appropriate.
7. The U-value of the floor of an extension may be calculated using the exposed perimeter and floor area of either the whole enlarged building or the extension alone.
8. If meeting such a standard would create significant problems in relation to adjoining floor levels, a lesser standard may be appropriate.

5.1.5 Cooling, and Overheating

Policy SI 4 of the London Plan (2021) requires that major development proposals should reduce the potential of overheating and the reliance on air conditioning systems.

The design principles of the scheme were analysed with the use of dynamic overheating modelling. Thermal comfort was assessed against CIBSE criteria and BREEAM Hea 04 criteria for commercial developments and includes the latest weather sets from CIBSE TM49: Design Summer Years for London (2014). A full assessment can be found in Appendix B and a summary of results is provided in Section 6 of this report.

5.1.6 Daylighting Strategy

Daylighting takes two approaches: the impact of the building on the daylight receipt of surrounding buildings and enhancing the daylight provision of the Proposed Development. Both have been considered here.

As previously described, façade performance has been optimised to enhance daylighting provision to the commercial spaces at the Proposed Development. This considered solar performance of glass, window-to-wall ratios in new elements, the existing building context, and passive solar shading measures/window reveal depths to ensure that daylight provision to the spaces was not provided at the expense of another key performance indicator. For example, a balanced approach was taken to ensure that the specified g-value did not negate the ability of the glass to provide good visual light transmittance. These considerations for a key part of the project approach and will be reflected in specification.

5.1.7 Low Water Consumption

Reduced water usage using low flow water outlets and appliances can also lead to a reduction in the energy required to heat domestic hot water. The development sets very high targets for reducing potable water consumption and integrating water reuse technologies. More details can be found in Section 11.4.

5.2 Active Design Features: Regulated Energy Use

Active features include the power-driven systems used to operate the building accounting for energy efficiency considerations as presented in this section.

5.2.1 Heating, Cooling, and Ventilation Strategy

Will be primarily served by a Hybrid Variable Refrigerant Flow (HVRF) system. From the HBC unit heating or cooling will be then provided to fan coil units located at high level within the office space via a water system (LTHW or CHW), serving the internal and perimeter zones.

Ventilation fresh air is provided by on-floor air handling units each equipped with thermal wheels to maximise heat recovery and thus minimise the energy requirements associated with tempering the air.

5.2.2 Building Management System, and Metering

The development will be provided with a microprocessor-based digital Building Management System (BMS).

The BMS will automate the building services systems, helping building managers understand how the building is operating, and allow them to control, and adjust systems to optimise performance, in a simple, efficient manner.

BMS control of landlord plant and equipment will be designed with energy efficiency as the key driver. Some examples of the energy-efficient controls include:

- Demand led control strategies - The BMS shall use demand-led strategies where appropriate, demands for heating, and cooling shall be monitored by the BMS, evaluated, and processed, prior to commanding systems operational.
- Time program control - The BMS shall provide time schedules that can be programmed to define when an operation signal is to be sent to the controlled plant. The time schedules shall allow different on/off times for building/plant control strategies to be defined throughout the year.
- Optimisation Control - The BMS shall provide individual optimisation programmes for the time schedules associated with temperature control of space/zone, to enable the operation of the related heating and/or cooling systems prior to normal operating periods, to bring the zones within comfortable temperatures at the start of normal occupancy times. The optimisation programme shall be self-adaptive using an iterative process after each period of operation to improve its performance.
- Seasonal Operation - Plant controls shall be pre-programmed for seasonal operation, allowing plant start-up routines, and temperature control set points to be determined and automatically adjusted based on the season of operation.

5.2.3 Energy Metering, and Billing

All landlord meters shall be connected and interfaced with the building management system (BMS) to enable energy consumption data to be collated, analysed, and distributed as required by the metering, and billing strategy.

Metering of energy usage on all floors, per tenancy and per dwelling will allow building owners / occupiers to view and interrogate where potential energy savings can be made throughout their buildings.

The energy metering, and sub metering strategy will be in line with best practice as outlined in CIBSE TM31, 39, and 46 to ensure compliance with current legislation, together with Part L of the Building Regulations and BREEAM Ene-02.

The strategy will be compliant with The Heat Network (Metering, and Billing) Regulations 2014, and the EU Energy Efficiency Directive. All notifications, and assessments as required by the regulations shall be made by the Contractor.

5.2.4 EC/DC Motors for Fan Coil Units

The current Part L Building Regulations set stringent efficiencies for the fans used in all air conditioning and mechanical ventilation systems. Recent advances in fan motor technology have resulted in substantial reductions in energy consumption, and otherwise a significant proportion of building energy use. EC/DC (electronically commutated direct current) motors will be used in place of conventional AC motors.

5.2.5 High-Efficiency Variable Speed Drives

By varying the fan, and pump speeds for the water, and air distribution systems to match the building load profiles, fan, and pump energy consumption will be considerably reduced. This functionality will be afforded and managed via the intelligent Building Management System (BMS).

5.2.6 Ventilation Heat Recovery

The energy required to heat or cool the incoming fresh air supply to the buildings will be significantly reduced by using an efficient heat recovery system. The heat recovery systems will utilise the thermal properties of the return air to transfer 'free' heat/cooling to the incoming fresh air supply. These will be controlled to minimise the demand for any heating, and cooling of the fresh air supply.

5.2.7 Low Energy Lighting

A full lighting installation will be provided throughout the landlord, and common areas of the buildings, generally comprising LED luminaires, with functional lighting. All luminaires will be provided with dimmable control gear (addressable) to suit its type and application. All landlord lighting will be controlled through the addressable lighting control system.

Lighting will be provided to the external areas, including main entrance on the ground floor, the external terraces and on the roof garden. External luminaires will generally comprise suitably IP-rated LED luminaires to suit the architectural design. Luminaires will be provided with DALI-addressable dimmable control gear. Where proposed, external lighting will be controlled through the building lighting control, and management system, and minimised wherever possible to avoid light pollution. Lighting levels are listed in the next table.

Table 5-3 Applied Lighting Specifications

System	Parameter	Applied Value
Lighting Efficiency: Non-domestic Areas	Café Areas / Reception Areas	8 W/m^2 400-500 Lux Display lighting 35 lm/crit watt
	Office Areas	5 W/m^2 Based on 400 Lux
	Storage Areas	200 Lux & 100 lm/W
	Toilet Areas	200 Lux & 100 lm/W
	Shower Areas	200 Lux & 100 lm/W
	Circulation Areas	250 Lux & 100 lm/W

System	Parameter	Applied Value
	Plant Areas	200 Lux mechanical & PH plantroom 300 Lux electrical plantroom 100 lm/W
	Cycle Store	200 Lux & 100 lm/W
	Stairs	250 Lux & 100 lm/W
Lighting Controls	Transient Spaces	Presence Detection On/Off
	Occupied Spaces	Presence Detection On/Off Daylight Dimming Control

Note 1: All installed Lighting will be LED, and all-day lighting areas to have daylight dimming controls with local sensors with presence detectors. All transient areas will have presence detectors.

5.2.8 Automatic Monitoring, and Targeting

The Building Regulations Approved Document L identifies that the provision of automatic monitoring and targeting with alarms for out-of-range values, can provide significant savings in energy consumption of the building services systems. A saving in energy consumption of 5% is awarded for complete installations that measures, records, transmits, analyses, reports, and communicates meaningful energy management information to enable the operator to interrogate and manage the energy it uses.

5.2.9 Power Factor Correction

The Building Regulations Approved Document L identifies that the provision of power factor correction to the building's electrical supply can provide significant savings in electrical consumption. A saving in electrical energy consumption of 1% is awarded for power factor correction to 0.9, and a saving of 2.5% awarded for power factor correction to 0.95 power factor. This Proposed Development intends to have a power factor correction of 0.95 as a minimum.

5.2.10 Efficient HVAC Parameters

The following design parameters were assigned to the base building heating, ventilation, and air conditioning (HVAC) systems to establish its annual CO2 emission rate.

Table 5-4 Applied HVAC Parameters for Main Central Plant, Non-Domestic Areas

System	Parameter	Applied Value
Cooling System Office/Reception – VRF System	Seasonal Efficiency (SEER)3	7.63
	Nominal Efficiency (EER)5	2.78
Cooling System	Seasonal Efficiency (SEER)3	7.63
	Nominal Efficiency (EER)5	2.78

System	Parameter	Applied Value
Café/Gym – VRF System		
Heating System Office/Reception – VRF System	Seasonal Efficiency (SCOP)3	3.2
Heating System Café/Gym – VRF System	Seasonal Efficiency (SCOP)3	3.2
Heating System WC Electric heating	Efficiency3	100%
Air Handling units (AHUs) Office L00-L05 Space	SFP	1.65 W/l/sec (average value)
	Ventilation Heat Recovery Efficiency	83.5% (Plate heat exchanger)
	Demand Control Ventilation	Yes
Air Handling units (AHUs) Office L0G & L06	SFP	2.08 W/l/sec (average value)
	Ventilation Heat Recovery Efficiency	82.5% (Plate heat exchanger)
	Demand Control Ventilation	Yes
Heat recovery unit (HRU) WC	SFP	1.60 W/l/sec (average value)
	Ventilation Heat Recovery Efficiency	84.8% (Plate heat exchanger)
	Demand Control Ventilation	No
Heat recovery unit (HRU) Café/Gym	SFP	1.60 W/l/sec (average value)
	Ventilation Heat Recovery Efficiency	83.5% (Plate heat exchanger)
	Demand Control Ventilation	No
Heat recovery unit (HRU) Showers	SFP	1.60 W/l/sec (average value)
	Ventilation Heat Recovery Efficiency	85.0 % (Plate heat exchanger)
	Demand Control Ventilation	No
Electric Water Heater - DHW Toilets	Delivery Efficiency	100%
Electric Water Heater - DHW Shower	Delivery Efficiency	100%
Pumps	Pump Type	Variable Speed with multiple pressure sensors
Domestic Hot Water	Storage Volume	12,000 L

System	Parameter	Applied Value
	(for Showers)	
	Storage Losses	0.0047 (kWh/(l.day)
	Circulation Losses	10 W/m
	DHW Controls	Timed Control
Electrical / Metering	Power Factor	Greater Than 0.95
	Lighting systems have provision for metering	Yes
	Automatic Monitoring of energy Data?	Yes
	Controls	Central Start & Stop Optimum Start & Stop Local time & temperature Control Weather Compensation Control

Note 1: Values based on equipment's technical specification to allow for flexibility in design going forward.

5.3 Active Design Features: Unregulated Energy Use

Unregulated energy refers to 'plug loads' such as:

- Lifts, escalators.
- Refrigeration systems.
- Computers, laptops, printers, photocopiers, audio-visual equipment.
- Server rooms, and other electrical loads.

Unregulated energy use can account for a large portion of the total energy consumption within office buildings according to CIBSE TM54 – prediction of operational energy use (Figure 5-1). Therefore, to bridge the performance gap of design performance versus actual measured performance during operation of the building, it is important to address unregulated energy use as it is not considered under Approved Document Part L of the Building Regulations.

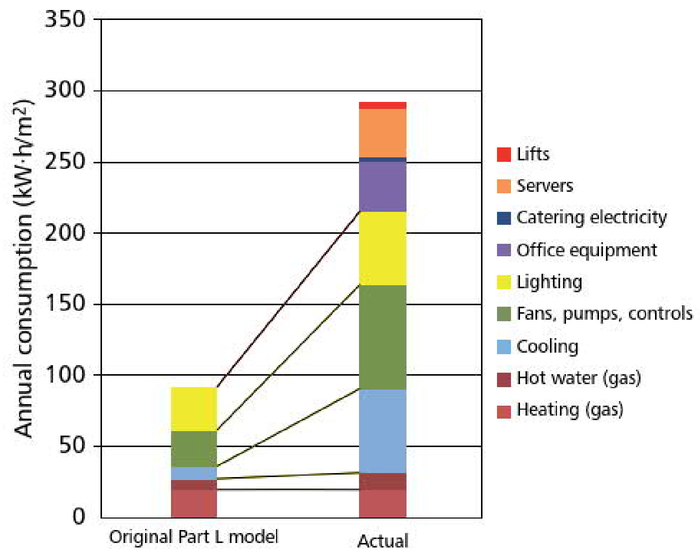


Figure 4.3 Comparison of Building Regulations Approved Document L2A (HM Government, 2010) calculations and monitored energy use after five years of operation, for an example office building

Figure 5-1 Comparison of operational energy use: Part L versus actual measured energy use (extracted from CIBSE TM54:2022)

This section summarizes how the Proposed Development will control unregulated energy use and achieve an ambitious target of energy use intensity (EUI) target, which accounts for both regulated, and unregulated energy use.

5.3.1 Low Energy Culture

Providing building users, and operators with practical guidance on the importance and methods of energy efficiency can lead to effective, cost-free reductions in energy usage, and carbon emissions. Savings can be expected in, for example:

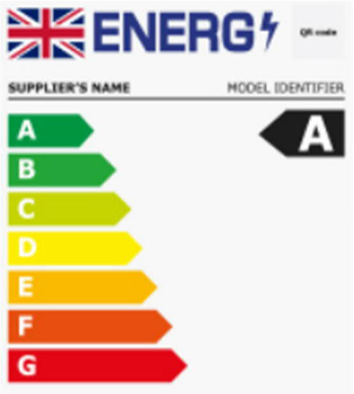
- Operating comfort cooling systems efficiently.
- Lighting Energy: a culture of 'turn-it-off', providing task lighting wherever possible.
- Small Power: prefer electrical equipment with energy labelling, and avoiding monitors, and PCs etc. in standby mode.
- Cooling/Heating Energy: widening 'acceptable' temperature range.
- Vertical transportation: promote the use of stairs.

Training of operators and facility managers is particularly important to provide them with the skills and knowledge to implement and continue to improve an energy management programme.

The amount of energy that can be saved will be dependent upon the motivation of the occupants, and the effectiveness of the awareness programmes. The development will actively encourage a low energy culture as part of its building operation, and commercial leasing strategy.

5.3.2 Low Energy White Goods

White goods are to be provided with a certified energy label. These are rated from A to G, with G being the least efficient.



Wherever white goods are provided within the development, including washing machines, dryers, dishwashers, and fridge/freezers, they will achieve:

- Fridges – G ratings already banned. F ratings banned from March 2024.
- Freezers – G ratings already banned. F ratings banned from March 2024.
- Fridge-Freezers – G ratings already banned. F ratings banned from March 2024.
- Washing Machines – F & G ratings banned from March 2024.
- Washer Dryers – F & G ratings banned from March 2024.
- Dishwashers – F & G ratings banned from March 2024.

Information on the EU Energy Efficiency Labelling Scheme of efficient white goods will be provided to the white goods supplied by the developer.

5.3.3 High-Efficiency Vertical Transportation

The vertical transportation systems will be specified with energy-saving features intended to reduce energy use, both while lifts are moving and when in standby mode. Such measures can be particularly beneficial when applied to passenger lifts in large workplaces which commonly deal with high numbers of people moving in, out, and around the building. These measures typically include:

- Specification of modern VVVF drive systems.
- Quantity, size, and speed of passenger lifts optimised to meet agreed performance benchmarks and thereby minimise base energy load.
- Real-time monitoring of prevailing passenger demand and switching lifts in and out of service to minimise the energy consumption while maintaining specified performance benchmarks.
- Provision of energy-efficient lighting.
- Car lighting automatically switched off when cars are not occupied.
- Optimised dispatcher and drive control.

5.4 Be Lean – Reduction on Carbon Emissions

5.4.1 Be Lean – Reduction on Carbon Emissions

Applications should be conditioned to achieve the carbon reductions calculated using SAP 10.2 from Part L 2021.

5.4.2 SAP 10.2 carbon factors – Part L 2021

Based on the above design parameters, a summary of the energy consumption, and CO2 emissions rate for the 'Lean' building can be seen in the Table 1-1 to Table 1-2. The 'Lean' energy efficiency measures described here are calculated to reduce regulated carbon dioxide emissions of the Proposed Development by **15%**, compared to Part L 2021.

Based on the energy-efficient design parameters, a summary of the energy consumption, and CO2 emissions rate for the Lean non-domestic building can be seen in the tables, and figures based on the BRUKL report within Appendix A. The percentage of savings from the "Lean" building using SAP 10.2 carbon factors is **36%**. **Please refer to Section 1.1 tables, Table 1-1 to Table 1-2 for detail results.**

The 'Lean' building exceeds the minimum percentage of savings of 15% required for new non-domestic buildings under Policy SI2 of the London Plan 2021.

6 Cooling, and Overheating

6.1 Cooling Hierarchy

Policy SI 4 of The London Plan (2021) states that major development proposals should reduce potential overheating, and reliance on air-conditioning systems, and demonstrate this in accordance with the following cooling hierarchy:

Table 6-1 London Plan 2021 Cooling Hierarchy, and Proposed Development Strategy

Cooling Hierarchy	Proposed Strategy
Minimise internal heat generation through energy-efficient design	Glazing ratio revised in the south facade to provide enough daylight, and solar control glass applied to minimise solar gains. LED lighting is proposed to reduce internal heat gains.
Reduce the amount of heat entering a building in summer through orientation, shading, albedo, fenestration, insulation, and green roofs, and walls.	The glazing ratio for new built elements has been derived by data-driven design by setting out an ambitious solar gains target, and managing daylight levels, and respond to the solar exposure, and façade orientation. Urban greening strategies on terraces and green roof will contribute to additional shading and creating a microclimate which will contribute to reducing the urban heat island effect.
Manage the heat within the building through exposed internal thermal mass, and high ceilings	No thermal mass is proposed. Building benefits from the existing generous floor to ceiling height.
Passive ventilation	Openable façade allows cross flow into atrium and mixed mode operation.
Mechanical ventilation	Highly efficient mechanical ventilation with heat recovery is proposed for fresh air supply all year round.
Active cooling systems	All previous measures contribute to reduce the peak cooling demand and decrease the size of fan coil units for thermal comfort as well as using efficient HVRF system.

6.2 Overheating Analysis

The full thermal comfort assessment is included in **Appendix B** of this application document and is therefore not repeated in full here. The thermal modelling results demonstrate that the building design and services strategy of comfort cooling can deliver thermal comfort levels in occupied spaces in accordance with the criteria set out in CIBSE Guide A Environmental Design Table 1.5 by using Design Summer Year (DSY) weather file London DSY1, DSY2 and DSY3.

The report shows the scenarios assessed to determine the risk of overheating and thermal comfort conditions. The percentage of annual occupied hours that the operative temperature exceeds 25°C in offices and reception in all the areas assessed considers 3% as the maximum allowance to ensure thermal comfort conditions. The threshold is given by CIBSE Guide A.

Office areas comply with the criteria for the current DSY1 scenario and future weather conditions when the cooling set point is set to 22°C. As specified by the M&E design, this set point sits within the band 24°C ±2. Reception areas are also performing well for both summer and winter operative temperatures checks.

A free-running building relying solely on natural ventilation scenario would not be able to reach adequate levels of thermal comfort due to the deep floor plan of the building which reduces the ventilation effectiveness.

A detailed analysis can be found in **Appendix B.**

6.3 Active Cooling Demand

The GLA's Energy Assessment Guidance requires that developments report the active cooling demand predicted by the energy modelling compliance tool.

Cooling loads taken from compliance tools should only be referred to satisfy GLA's requirement of data collection for monitoring purposes, and it is not indicative of the designed cooling demand of the buildings. Those tools are used for compliance, with a rigid methodology, and the mechanical design will better inform the cooling demand within the occupied areas of the development.

The following measures have therefore been applied to reduce the cooling loads from outset:

- Existing shading elements dimensioned to reduce solar heat gains to the building perimeter, and in particular the office accommodation.

- Proposed stacked terraces on the south facing elevation provide additional shading to the glazed office floors from 2nd to 5th floor.
- Consideration of surrounding buildings to cast shadows on the lower levels.

The active cooling demand for the Proposed Development as per ‘Lean’ BRUKL report (HVAC Systems Performance) is summarized in the table below:

Table 6-2 Active Cooling Demand – 21 Bloomsbury Street ‘Lean’ building

Building	Area weighted average building Cooling & Heating Demand (MJ/m^2)	
	Actual	Notional
21 Bloomsbury Street	77.22	80.64

The results show circa **4.2%** reduction in the cooling demand of office space, compared to the notional building values. This can be attributed to the passive design measures such as optimised glazing ratio in new elements, shading elements, and to the high performing cooling systems integrated to the building, and for office spaces.

For detailed results – see **Appendix A**.

7 ‘Be Clean’ – Heating Infrastructure

This section outlines the feasibility of clean energy supply to the Proposed Development as required by the ‘Be Clean’ stage of the Energy Hierarchy.

After careful selection of appropriate servicing strategies, and plant selection, the design team agreed to meet the energy demand of the Proposed Development using HVRF system.

This section provides justification to why relevant technologies, and systems have been excluded, and summarises the feasibly study carried out by the design team.

7.1 District Heating, and Cooling Networks

The feasibility of connecting the Proposed Development to a district heating (DH) network has been assessed, referring to the London Heat Map (refer to www.londonheatmap.org.uk).

The following image is an extract from the London Heat Map website. The development site is outlined in black; all potential heat supply sites are marked as follows: communal boilers in orange, CHP (Combined Heat and Power) sites in purple.

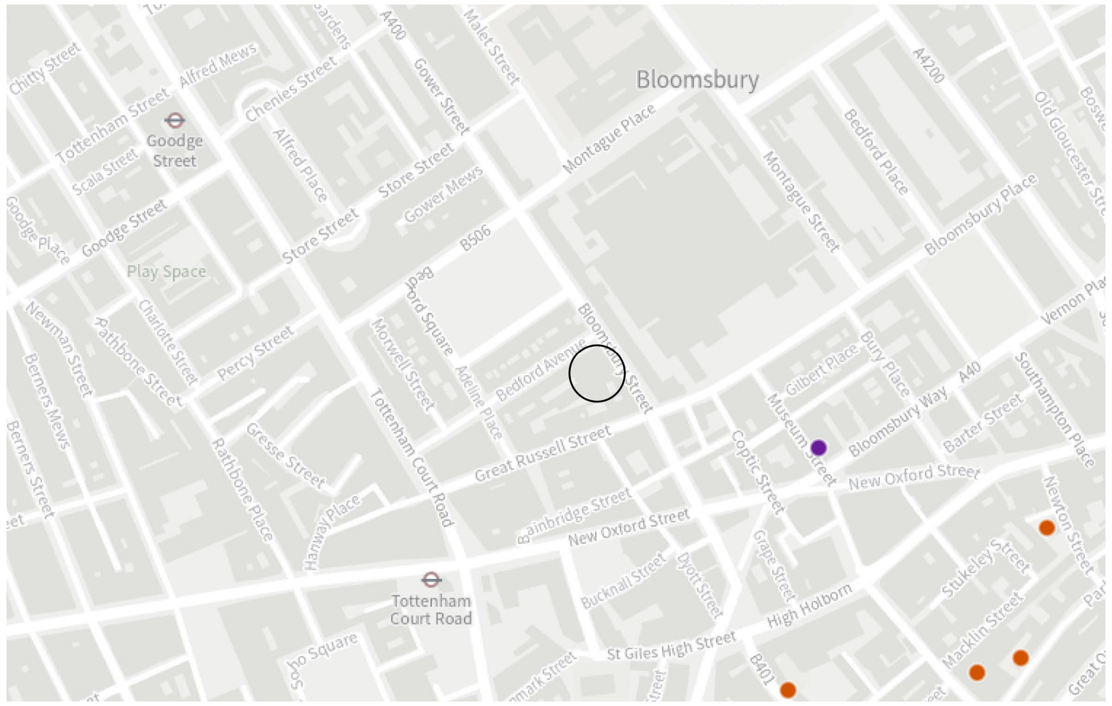


Figure 7-1 Potential heat supply sites at 21 Bloomsbury Street site

Following the research, there are no existing or proposed heat networks for the Proposed Development to connect to in the present or future. The closest is a CHP site, however the distance between the site and 21 Bloomsbury Street is too great.

7.2 Combined Heat, and Power (CHP)

CHP units consume gas in an internal combustion engine or other prime movers (e.g., fuel cell or sterling engine) to provide heat, and electricity. A total of 45% to 55% of the energy value of gas is converted into heat, mainly in the form of hot water for space, and hot water heating. Between 30 to 35% of the energy value is converted to electricity, with the remaining 10 to 25% lost as flue gases.

In the absence of the ability to connect to a district heating network, onsite high-efficiency CHP units will not be proposed on the site to serve the base space heating, and hot water demand with no backup boiler installed.

In addition, regardless of the DH connection, the following reasons supported the design team decision to exclude the CHP technology

1. The building is with office, and amenity areas with low space heating, and DHW demand, and stable cooling load, which increase the opportunity of waste heat recovery through HVRF system.
2. The decarbonized grid will make the onside generation more carbon-intensive process.
3. The need to reduce the carbon, and NOx emissions from the CHP, and boiler operation in this area.
4. Exporting electricity to the grid will not be an economically viable solution from the Proposed Development

7.3 Be Clean – Reduction on Carbon Emissions

The clean emissions are equal to the lean stage figures for this building due to the arguments discussed above.

8 'Be Green' – Renewable Energy

Further energy, and carbon dioxide emissions savings could, in principle, be made through the adoption of renewable technologies. This section provides an appraisal of the renewable energy technologies suitable for the Proposed Development as part of the 'Be Green' stage of the Energy Hierarchy.

The suitability of available technologies is sensitive to several factors, including site constraints, development footprint, surrounding environment, access limitations, and development type.

To this end, the following renewable energy technologies have been investigated to establish their suitability and feasibility.

8.1 Consideration of Low, and Zero Carbon Technologies

8.1.1 Photovoltaic

Photovoltaic panels convert solar energy into electricity and are best placed in an unobstructed location, generally south facing at 30° inclination, ideally. When located vertically, the output can be reduced by about 15%. PV panels provide a visible green label for the building and make use of space at the top of the buildings.

The design includes space allowance for installation of roof-mounted Photovoltaic (PV) panels, however, as the dedicated space area is little, the energy produced by photovoltaics would be minimal, therefore installation of PV panels is not considered for base build.

Photovoltaic panels will not be included within the building design.

8.1.2 Wind Turbines

Wind turbines produce electricity directly from the energy in the wind. This is then fed into the buildings electrical system via a control gear. Two types of wind turbines are available: horizontal axis, and vertical axis. The former tends to be noisy and produce vibration. The latter are quieter in operation, and more suited to installation on buildings but are generally less efficient, and more expensive.

Although wind turbines are a highly visible form of renewable energy, they can normally provide only a very small contribution to the total electrical consumption of buildings in the city and urban locations. Probably visually unacceptable in planning terms, there are also concerns that such a turbine would create unacceptable noise levels during the day, and night. Furthermore, at this stage, the flexibility in façade design is limited.

Wind turbines are not considered to be viable for this development.

8.1.3 Solar Hot Water

Solar hot water panels must be in a generally south facing position, ideally at about 30° to the horizontal. If located vertically, the output is reduced by about 15%.

The scheme investigated is based on installing a nominal active area of high efficiency (evacuated tube) solar hot water panels, accommodated on the roof of the building. Such systems are relatively low maintenance, are a proven technology, and are a visible indication of the development's green aspirations. Although efficient, and cost-effective in implementation, solar hot water systems can only offset a fraction of the domestic hot water demand for the site.

Solar hot water panels are therefore not suitable for this development.

8.1.4 Ground Source Heat Pumps

The proposed building is a commercial office space, designed to balance heating, and cooling demand. The annual overall cooling load is unbalanced with the annual heating load due to the massing, and commercial use of the building. A heat recovery type energy strategy is adopted for the Proposed Development with the use of HVRF system, which adequately balance the heating, and cooling demand of the building throughout the year, providing significant energy efficiency in heating, and cooling generation. Therefore, there is no requirement to store energy, and hence a GSHP will not be suitable application as part of the energy strategy.

Ground source heat pumps are therefore not considered suitable for this development.

8.1.5 Aquifer Heat Pumps

The use of the London aquifer to reject heat to (in cooling mode), and to draw heat from (in heating mode) can reduce emissions from a development, depending on the number of boreholes, and the potential yield. In an open-loop aquifer-based heat pump system, boreholes are sunk into the chalk strata. Aquifer water is pumped up to the surface and stored temporarily in a tank. This water is usually at 12-14°C year-round. The water is passed through a heat exchanger where it heats or cools the condenser water circuit serving the heat pumps. The water is then pumped back into the aquifer. Boreholes are normally sunk in pairs, one abstraction, and one discharge. A licence from the Environment Agency is required to extract aquifer water.

The difficulties of achieving acceptable separation on-site, the central London location of the development, and the distance from water sources would severely restrict the effectiveness of an aquifer system. Also given the relatively small contribution to the site compared with the benefits of the community energy system, it is not proposed to pursue this option for the Proposed Development.

Aquifer source heat pumps are therefore not considered suitable for this development.

8.1.6 Air Source Heat Pumps (ASHP)

Air Source Heat Pumps systems are typically all-electric systems that use heat pumps to provide space heating and cooling to building spaces. They can serve multiple zones in a building, each with different heating, and cooling requirements by simultaneously providing low temperature hot water (LTHW) and chilled water (CHW) to be distributed on demand. When these units are used to provide space heating, air-source heat pumps (ASHP) work similarly to a fridge, but in reverse. It extracts heat from the outside air in the same way that a fridge extracts heat from its inside. The heat they extract from the air is constantly being naturally renewed. According to the GLA Energy Assessment Guide, the space heating provided via ASHP should be considered as a renewable heat source and included in the 'Green' carbon emission.

Due to the space required by ASHPs, the HVRF system is preferred, as it is more compact.

Air Source Heat Pumps are therefore considered not suitable for this development.

8.1.7 Hybrid Variable Refrigerant Flow (HVRF)

Hybrid VRF systems are all electric systems which use modular heat pumps to supply space heating and cooling to building spaces. The system consists of an externally located heat pump heat recovery unit which provides either heating or cooling into a refrigerant circuit by either extracting or expelling heat into the outside air via a refrigerant cycle. The refrigerant is then fed via a piped system to a 'Hybrid Branch Controller' (HBC) unit located within the demise / area being served with heating or cooling. Heat exchangers within the HBC transfer the heating / cooling from the refrigerant circuit to a water circuit to generate either LTHW or CHW which is then fed via a secondary piped system to the terminal heating / cooling unit i.e. FCU. This is where this system differs from a traditional VRF system - where the refrigerant circuit is continued up to the terminal unit - with this arrangement requiring a reduced volume of refrigerant and also reducing the risk of refrigerant leaks in occupied spaces. This allows simpler compliance to the relevant standards (BS EN378) and removes the need for extensive leak detection systems.

Each distinct area i.e. per floor, per tenancy etc. is provided with its own dedicated system (as described above) with multiple terminal units served per outdoor unit and per HBC unit.

HVRF is therefore considered suitable for this development for its low carbon properties and renewable heat source.

8.1.8 Gas Powered Fuel Cells

Fuel Cells are highly efficient electrochemical energy conversion devices. A fuel cell consists of stack combined with sub-systems to form a functional energy solution. Fuel cells, when running on Hydrogen, combine Hydrogen, and Oxygen to produce pure water plus high-grade electric energy with no associated carbon emissions. Therefore, they offer the potential to provide a zero-carbon solution when running on hydrogen generated and stored via renewables. Natural gas-powered fuel cells instead, convert the chemical energy from the methane in natural gas into electricity through a chemical reaction with Oxygen.

A fuel-cell principal output is electricity, along with the harvest of waste heat, which can be utilised in building as a combined heat, and power (CHP) plant. The fuel cells main advantage in comparison to internal combustion driven CHP is their high electrical efficiency. Currently, available fuel cells can reach up to 48% with 200 kW size units. (Minimum single module). The cost of the fuel cells is high as they are, despite numerous installations in London, not mass-produced. The application of fuel cells is limited by the following:

- High capital purchase costs (units not mass-produced to be cost-effective) in comparison to internal combustion engine based (IC) CHP;
- Minimum unit size approx. 200kW per unit;
- Significantly larger footprint in comparison to internal combustion engine CHP;
- Extensive ancillary support units external to the Fuel Cells; and
- Slow response, and start-up.

Associated investment costs are higher compared to other technologies. As the energy strategy is based on all-electric solution, the building does not have natural gas provision. Furthermore, the high investment costs, and issues associated with Hydrogen storages on-site pose serious constraints to the application of these technologies.

Natural Gas and Hydrogen powered fuel cells are therefore not considered suitable for this development.

8.2 Be Green – Reduction on Carbon Emissions

8.2.1 SAP 10.2 – Part L 2021

Based on the above design parameters, a summary of the energy consumption, and CO2 emissions rate for the 'Green' stage at the Proposed Development are shown in Table 8-1.

The 'Green' measures described reduce the regulated carbon dioxide emissions of the commercial areas by **2%** hence the cumulative savings on regulated energy of **38%** against Part L 2021. **Please refer to Section 1.1, Table 1-1 to Table 1-2 for detail results.**

The site-wide percentage of savings resulted in **38%** as per table below.

Table 8-1 Site-Wide Regulated Operational Carbon Dioxide Emissions, and Savings

	CO_2 Savings (Tonnes CO_2/year)	Percentage Savings (%)	Total Regulated Emissions (Tonnes CO_2/year)
Part L 2021 baseline	68.5	-	-
Be Lean	43.8	36%	24.7
Be Clean	43.8	0%	0%
Be Green	42.7	2%	1.1
Cumulative on-site Savings	25.8	38%	-
Total Target Savings - GLA's Target	68.5	100%	
Regulated Annual Surplus	42.7		

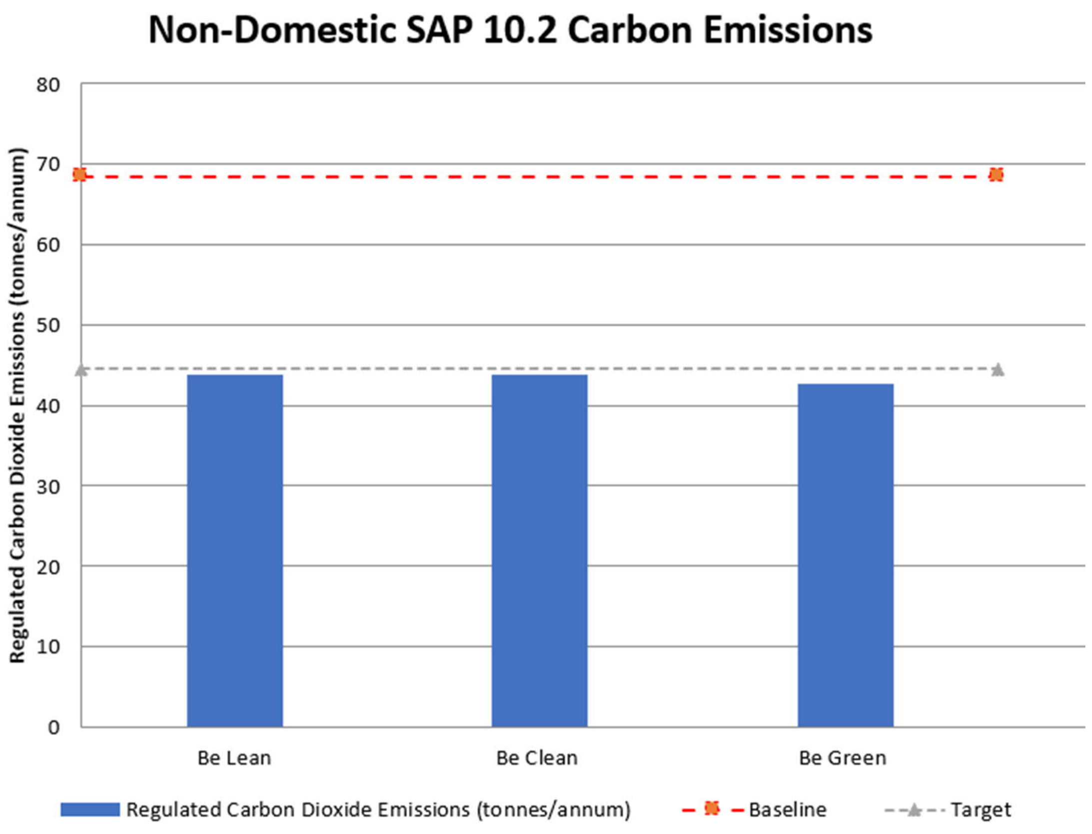


Figure 8-1 GLA's Energy Hierarchy for the Proposed Development as per SAP 10.2 Carbon Factors

9 Energy Unit Intensity

The gap between predicted and actual operational energy of new buildings is acknowledged to be significant. Part of the reason for the energy performance gap in the United Kingdom is that buildings are traditionally designed only to show compliance with the Building Regulations, rather than to target actual energy efficiency through a robust and detailed design for performance exercise.

Figure 9-1 shows a comparison of the energy breakdown estimated following both the Building Regulations Approved Document Part L 2010 and CIBSE TM54 methodology, and the actual building metered data.

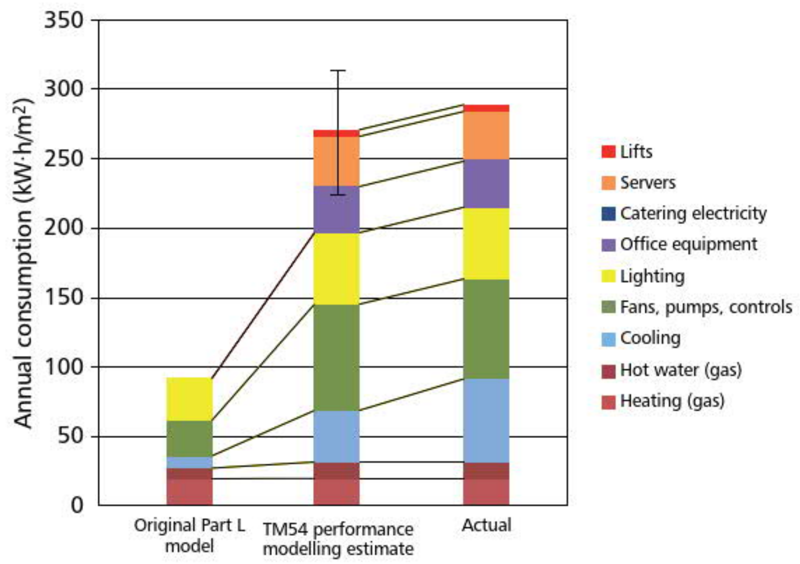


Figure 4.4 Results of applying the methodology to an office building: comparison between Part L 2010 compliance model, performance modelling estimate using TM54 (first edition; 2013), and actual energy use

Figure 9-1 Comparison of Part L calculations and operational performance for a case study. Extract from CIBSE TM54 2022.

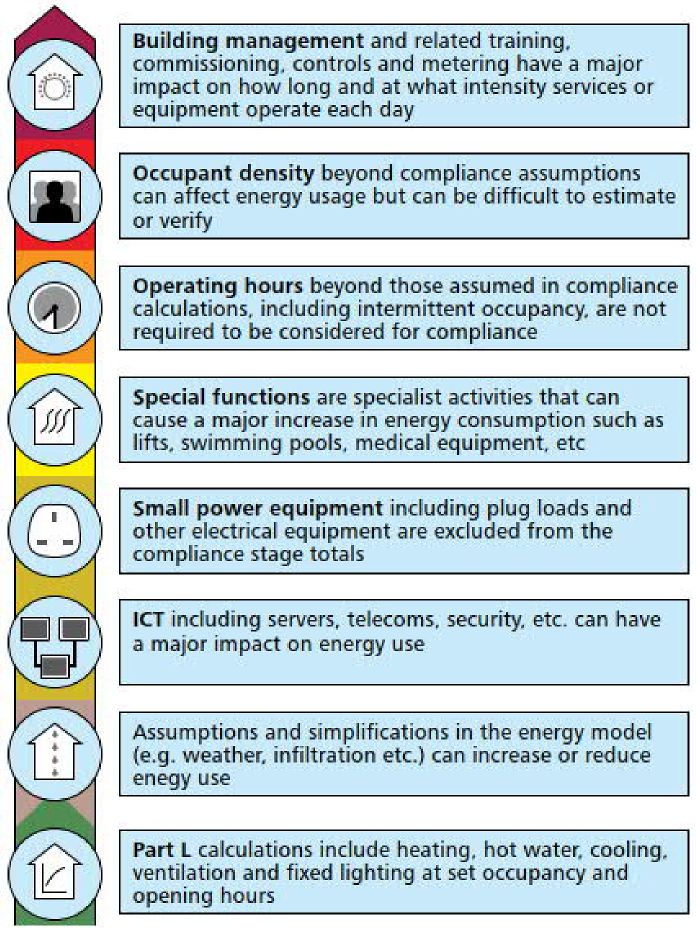


Figure 9-2 Summary of the reasons why Approved Document L compliance calculations differ from operational energy use (based on a Carbon Buzz diagram (http://www.carbonbuzz.org))

One of the main reasons behind the difference between Part L calculation and the monitored data is that compliance calculations are subject to standardisations created for simplification and comparability purposes. For instance, Part L calculation uses standard inputs for operational and occupational hours, as well as weather tapes based on old historic data that will be different from the external conditions in which the building will operate. Secondly, the compliance calculation excludes a large set of energy uses such as small power, lifts and escalators, catering, external lighting etc.

9.1 CIBSE Methodology

Dynamic energy modelling has been carried out using IES-VE Apache sim, approved DSM software by the DCLG (Department for Communities and Local Government), which meets all the requirements in advanced HVAC system and controls capabilities listed in the CIBSE AM11 Building Performance Modelling. An advanced external calculator, highly integrated with the selected DSM software, has been used to support the calculation.

The building energy will be split into two distinct parts, "Base Building Services" for the landlord energy and "Tenant Services" for the end-user energy consumption, as shown in the figure below:

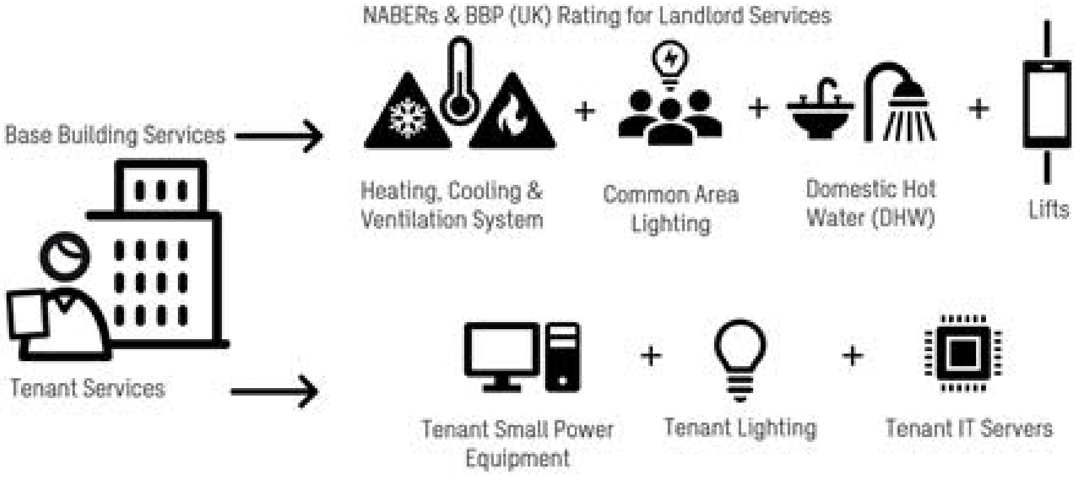


Figure 9-3 Visual representation of the NABERs and BBP proposed building rating system.

Figure 9-4 summarises the CIBSE TM54 methodology for the evaluation of building energy uses, including a summary of the required actions at each step.

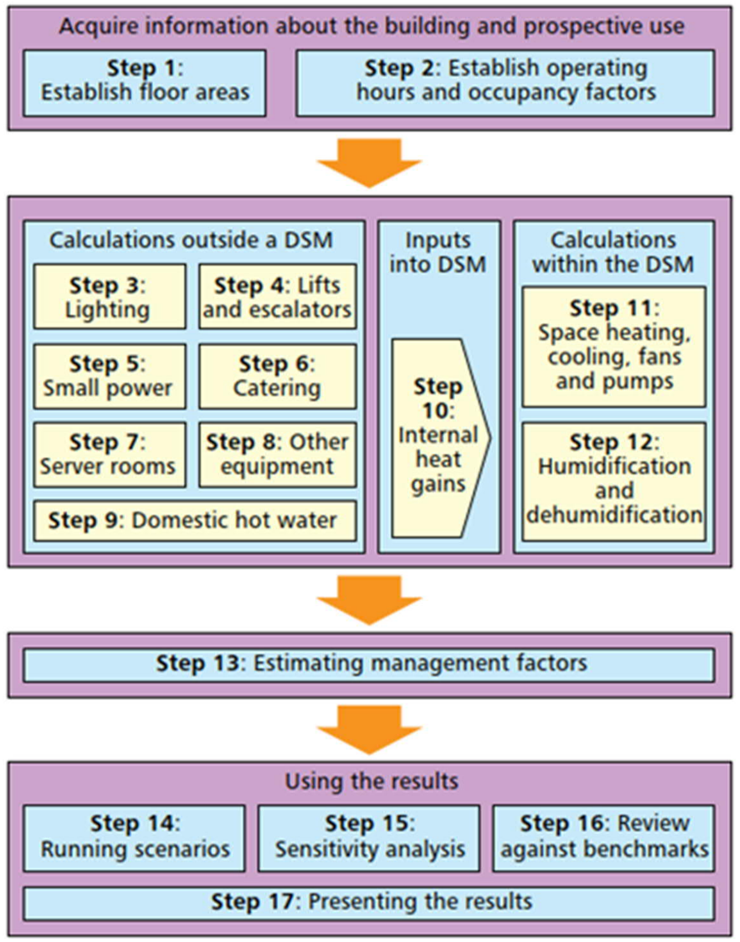


Figure 9-4 CIBSE TM54 Methodology to evaluate operational energy use at the design stage.

For this project, the DSM software was used to capture 21 Bloomsbury's space heating, cooling, office equipment and lighting energy consumptions. Energy types, such as DHW and auxiliary energy required by pumps and fans, were calculated outside the model using an external calculation tool. This calculator follows a dynamic and detailed calculation methodology that complies with or exceed the DSM software capabilities:

- External Lighting and Emergency Lighting consumption has been calculated based on design Lux levels, lamp efficiencies, hours of operation and parasitic loads. Consumption reductions due to daylight dimming and occupancy sensing controls have been considered as well.
- Pump energy, required by the VRF Branch Controller, has been calculated based on the electricity consumption from the data sheet provided by the manufacturer and the hours of operation.
- Cycle extract fans energy has been calculated based on the required air changes levels, occupancy, and systems schedules and SFPs of the selected fans. Fire and Smoke extracts fans energy were also calculated outside thermal model considering 1 hour testing per week.

9.2 Results

The energy unit intensity (EUI) is a measure of the total energy consumed in a building annually. It includes both regulated and unregulated energy but does not include energy use from electrical vehicle charging or any reductions as a result of on-site renewable energy sources.

The results from the CIBSE TM54 analysis can be found in the table below:

Building type	EUI (kWh/m$^2_{GIA}$/year) Excluding renewable energy	Space heating demand (kWh/m$^2_{GIA}$/year) Excluding renewable energy
GLA Target – Offices	55	15.0
21 Bloomsbury Street	76	10.6

The EUI target of 55 kWh/m$^2_{GIA}$ recommended by GLA (taken from LETI Climate Emergency Design Guide and reported as 2035-2050 Paris Proof Target by UKGBC), is equivalent to targeting Base Building operational energy of 35kWh/m2(NLA)/yr, which yields a NABERS UK rating of 6 Stars. Considering the current average office building in London performs at around 2.5 NABERS UK stars, the LETI target is extremely ambitious and poses radical challenges to building services design and building operation.

Whilst we may aspire to target the Paris Proof Target, it is unlikely to be economically viable or reasonably achievable in practice for a city based urban office development. Two of the main limiting factors are likely to be the current optimised glazing to solid ratio, which also leads to fabric U-Values higher than the ones prescribed within the Passive House standards, and the non-feasibility of ground source heat pumps installation to further increase the heating and cooling energy efficiency. Moreover, as the proposed development is an existing structure, the glazing ratio cannot be further reduced and any reductions will likely compromise the visual comfort and daylighting for the end-user occupants.

Furthermore, the building services have been designed and sized following values prescribed by the latest BCO guidelines for internal gains. The Base building energy comprises for only one of the two shares of Whole Building Energy. The Tenant Energy - which is mainly constituted by the sum of tenant equipment energy consumption, tenant lighting energy and server rooms energy - predicted based on the industry guidelines mentioned above, amounts to an energy EUI which is significantly greater than the 35 kWh/m2 NIA (Paris proof target aligned with GLA target of 55 kWh/m2GIA).

Following CIBSE TM54 analysis, the main sources of energy consumption in the building have been found to be:

A Small Power (42%)

B Landlord and Tenant Lighting (17%)

10 Energy Strategy

The energy strategy for the development is an all-electric solution, removing all the incumbent natural gas boilers from the Proposed Development.

The 21 Bloomsbury Street building will be provided with an all-electric energy strategy meaning that there will be no gas, or any fuel system other than electricity, used on a regular day-to-day basis on the site. There is an emergency back-up diesel generator to be used in the event of a loss of power to maintain life safety systems within the building.

10.1 Electrical Supply

The electrical supply to the building will be provided via an incoming high voltage (HV) main to the DNO substation located at lower ground floor level. A connection to the adjacent switchroom then generates a low voltage (LV) which is subsequently distributed around the building to provide power to everywhere that it is required. There is also a life safety switchroom located at level 06 which has a connection to the generator and will provide the emergency power supply if necessary.

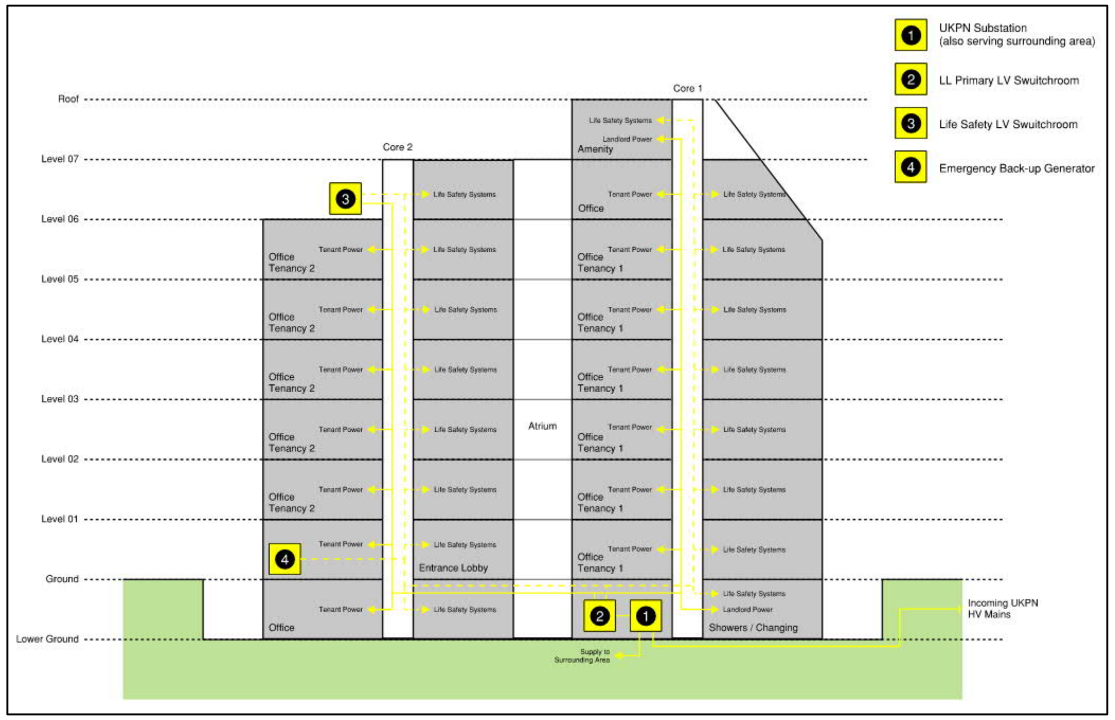


Figure 10-1 Electrical Distribution Strategy

10.2 Heating & Cooling Supply

The heating & cooling to the building is to be provided by a Hybrid Variable Refrigerant Flow (HVRF) system with each tenancy (two per floor and one at lower ground) to be provided with its own dedicated stand-alone system. A bank of outdoor VRF units will be located within a plant area at level 06 and will feed via a refrigerant loop to a branch controller units (HBCs) located at high level within the tenancy being served. From the HBC unit heating or cooling is then provided to fan coil units located at high level within the office space via a water system (LTHW or CHW). Two dedicated landlord VRF units are also provided to facilitate heating and cooling to landlord areas at lower ground / ground and level 07.

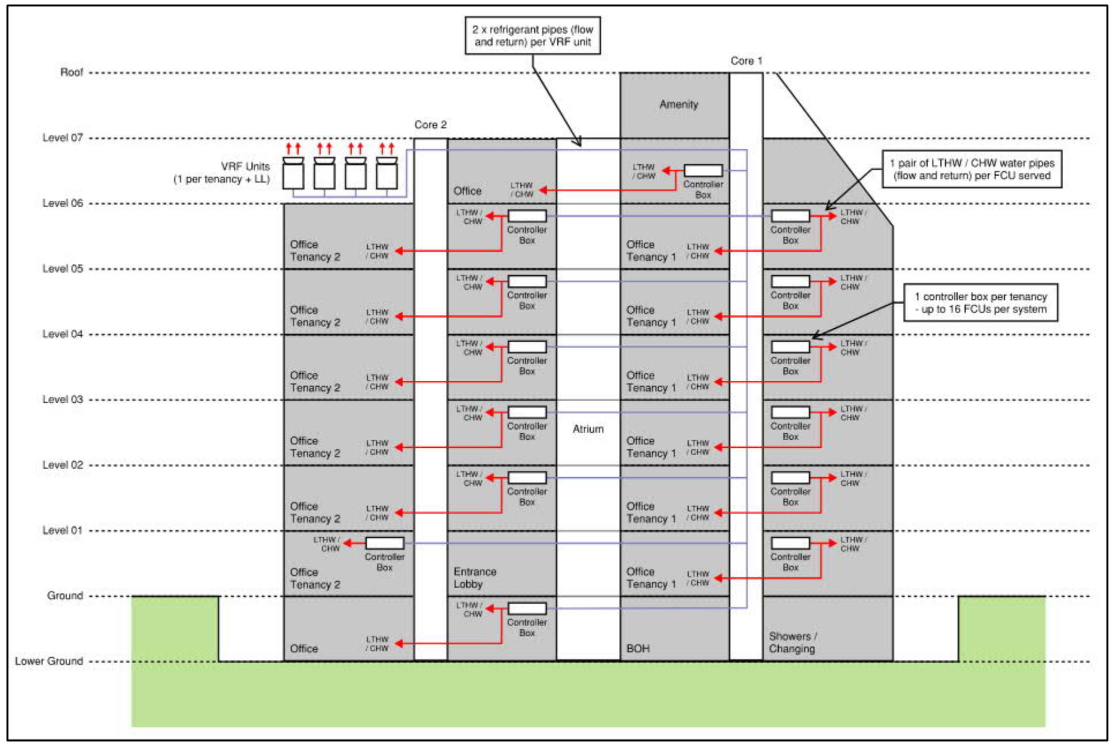


Figure 10-2 Thermal Distribution Strategy

10.3 Hot Water Supply

The lower ground shower facilities shall be provided with hot water via two dedicated electrically driven hot water calorifiers located adjacent to the shower areas to limit transmission losses.

Branch connections from boosted cold water service shall be provided to serve point of use unvented electric hot water heaters in each WC area to provide hot water to wash hand basins.

10.4 Ventilation Strategy

Ventilation to the office spaces is to be provided by on-floor air handling units (AHUs) with one unit proposed per floor located within dedicated plant rooms on each level (lower ground to level 06). These AHUs will be complete with filters, fans, thermal wheels, and integrated heat pumps and will provide fresh air onto the office floors and extract 'stale' air out of the spaces. The amount of fresh air provided will be in excess of the amount recommended by CIBSE and required under BCO guidelines.

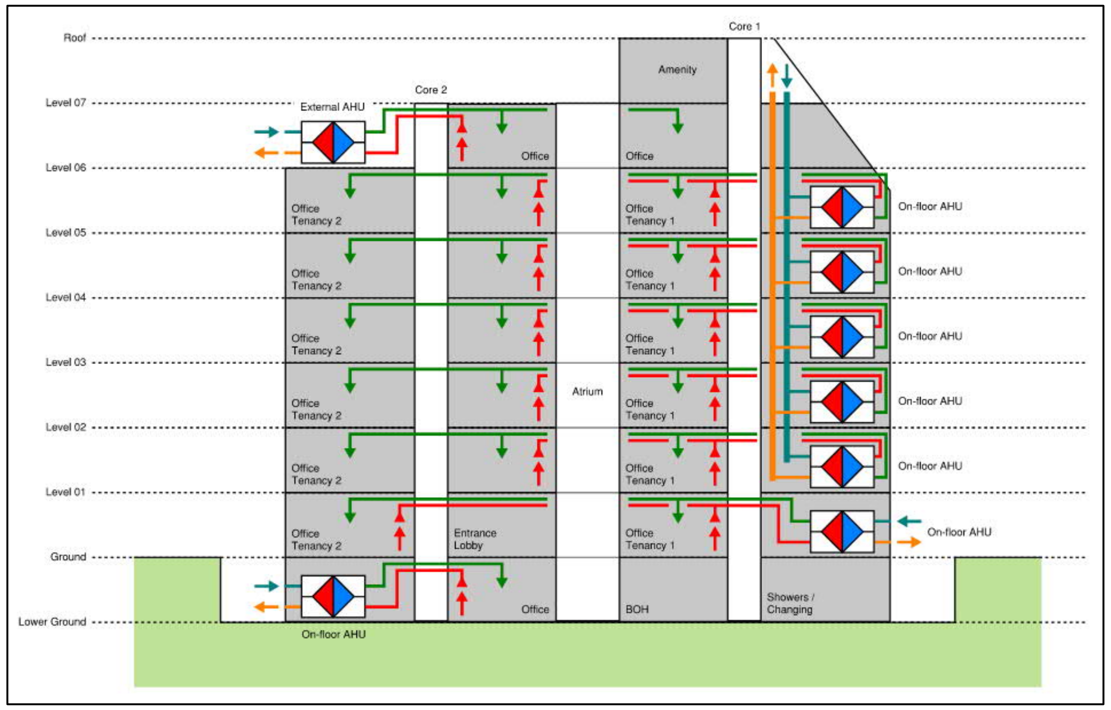


Figure 10-3 Office Ventilation Strategy

A number of other areas within the building i.e. shower / changing areas, washrooms, gym facility, reception area etc. will be ventilated by local heat recovery units (HRUs) which will have intake and exhaust connections to the façade locally and supply and extract from the spaces.

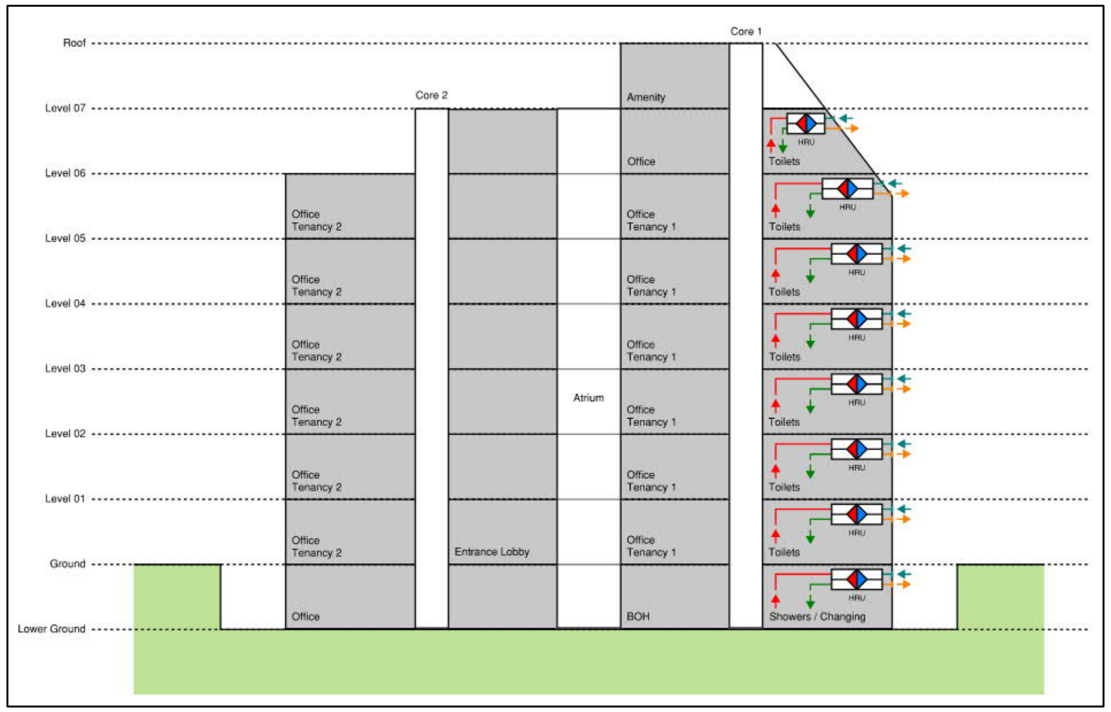


Figure 10-4 Toilet Ventilation Strategy

11 Sustainability Statement

11.1 Sustainable Development

11.1.1 Introduction

Sustainability is ingrained within the fabric of the design, construction, and operational development aspirations of the Proposed Development. The climate emergency dictates urgent, and high-impact action from all stakeholders, with the goal of addressing the aims of the Paris Agreement and supporting the UK Government declaration of Net Zero Carbon by 2050. Only with a clear focus on sustainable development can the UK meet these goals.

With a firm basis of collaboration, innovation, and expertise between many disciplines from Stage 1 of design, the design team have developed a project-specific sustainability framework, and action plan to facilitate the implementation of specific sustainable outcomes. The sustainability plan draws on the knowledge base of the UN Sustainable Development Goals, highlighting those actions relevant to the built environment, and the focus areas for achieving sustainable development. Holistic sustainability is at the heart of the goals set for the project, covering the widest possible array of environmental, and sustainable performance indicators, from materials, and energy to water, and waste. An all-inclusive process, monitored, and reported against at key project delivery stages, ensures that sustainability factors that are intrinsically linked are considered together, and not in isolation.

The project sustainability approach draws on and challenges the most robust current industry best-practice, and targets, which provide a basis for wider industry comparison and benchmarking of the project. These include the RIBA 2030 Climate Challenge, which sets benchmark reduction targets for embodied carbon, and potable water consumption, as well as suitable target metrics from UKGBC Net Zero guidance, London Energy Transformation Initiative (LETI), and Greater London Authority (GLA) requirements set out in the current London Plan 2021. The development will also utilise a Sweco-led framework approach to third-party verified sustainability assessment schemes such as BREEAM, and the WELL Building Standard, hand-picking credits which support the overall sustainability aspirations of the project to deliver the agreed targets.

For the purposes of this application, this sustainability strategy will demonstrate how the aspirational goals, and targets of the Proposed Development underwrite, and support the relevant sustainability-led policies of the London Borough of Camden (both adopted, and proposed), as well as the relevant environmental, and sustainability policies of the GLA's London Plan. The focus is on how these core targets provide a future-proof sustainable urban development which adds value in its local context within in the heart of London, rather than simple box-ticking of policy.

Principles of environmental, social, and economic sustainability are considered throughout the Proposed Development sustainability approach and are covered within various aspects of the submitted planning application documentation. The objectives are also ingrained within the 6 main sustainability themes, and aspirational targets of the development, as set out in the following sections of this submission.

Focus has been placed on material efficiency measures employed for the Proposed Development, and much of its success in this regard is linked to the strategy for major reuse of existing elements of the building that currently sits on site. Section 11.3 goes into further detail on how this approach has supported low carbon development and contributes to the City's Net Zero and carbon reduction aspirations, and how considerations of the synergies and interplay between embodied and operational carbon emissions have informed decision-making.

This highly collaborative, involved, and multi-disciplinary approach has ensured that sustainability is kept at the top of the development agenda and incremental design development during the pre-planning stages is regularly assessed against the project's sustainable outcomes and targets.

The following sections of this report provide the full holistic assessment of the sustainability attributes of the project and demonstrate the strength of the Proposed Development in this regard, underwritten by third party-verified assessment methodologies.

11.1.2 The Proposed Development Sustainability Strategy

Summary of the Sustainability Strategy is as follows:

- All-electrical development by removing the gas-fired boilers and CHP onsite to eliminate the NOx emissions and improve the air quality, adding to the net zero carbon strategy.
- Optimised building façade to reduce energy demand and improve thermal comfort by replacing the existing glazing with low g-value and revising glazing to solid ratio in new elements to control solar gain.
- The building fabric's thermal performance is enhanced by improving U-values for the existing and new elements, taking "Fabric First" approach.

- Achieving **38%** of improvement on operational regulated carbon emissions exceeded the GLA target of 35% against Part L 2021.
- Mixed-mode ventilation strategy, allowing the future tenants to have openable windows, as well as mechanical ventilation to maintain comfort levels.
- Proposed rainwater attenuation tank at ground floor to store rainwater and help mitigate flooding.
- Implementation of green roof increases biodiversity, as well as reduces the urban heat island effect.
- The new stepped terraces with planters add to the biodiversity, as well as provide additional shading and contributes to providing a healthy environment for well-being.
- By maximising retention of the existing materials, structure and façade systems, there is a significant embodied carbon benefit, resulting in 828-911 $kgCO_2e/m^2$ GIA (A-C) of upfront embodied carbon which is lower than the GLA 'aspirational' target.
- Water – aim for at least 40% improvement over the BREEAM 2014 RFO criteria.
- Waste – min. 95% by tonnage resources diverted from landfill.

Some of the key certification targets and elements to include for a robust Sustainability Strategy are included below:

- BREEAM UK Non-domestic Refurbishment and Fit-Out 2014 to achieve "Excellent" for office areas, with an aspiration for "Outstanding".
- WELL Standard v2 'Core' targeting "Gold" with an approach to pre-certificate and certify the building at a later stage.
- Target embodied carbon performance which works towards the achievement of the 'aspirational' targets of the GLA London Plan Guidance Whole Life Carbon Assessments publication (March 2022), as part of London Plan 2021 Policy SI2.
- Urban Greening Factor (UGF) target – London Plan 2021 policy G5 recommends a UGF of 0.3, this is to be calculated by the landscape architects.
- Develop climate change resilience strategy & focus on functional adaptability/design for disassembly.

11.2 Sustainability Certification

11.2.1 BREEAM

BREEAM is a third-party verified holistic sustainability assessment and certification scheme, operated by the Building Research Establishment (BRE). It is the most established sustainability scheme in the world, with more than 590,000 developments certified and 2.3 million developments registered. The BREEAM New Construction assessment methodology is split into 9 environmental categories, with individual credits and criteria within those categories, where credits are awarded based on compliance with best-practice environmental and sustainability performance indicators.

BREEAM assessment forms a key component of the Proposed Development Sustainability Strategy, and the various credits available in the scheme have been purposely selected to support the project targets. The design team recognise that, when used in a framework approach, BREEAM assessment is a powerful tool to underwrite design intent and provide established methodologies for completion of core tasks that deliver sustainable development. BREEAM should always be viewed as framework rather than a box-ticking exercise, with significant interconnectivity between credits allowing sustainable performance to be gauged in consideration of the myriad of impacting factors.

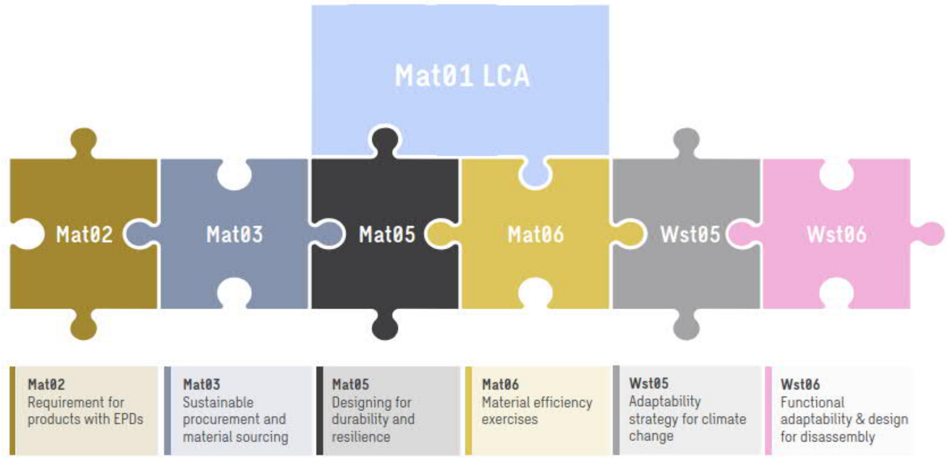


Figure 11-1 Puzzle diagram demonstrating credit interdependence in the BREEAM 2014 RFO assessment methodology (example of credits working to support Mat01 LCA).

BREEAM is also useful as a timeline management device, setting deadline targets for provision of design information in accordance with the RIBA Plan of Works. The latest version of the scheme, BREEAM 2014 RFO New Construction, places heavy emphasis on completion of early actions prior to the conclusion of RIBA 2. This focus on early action and integration of sustainable thought-processes is synchronised with the independent Sustainability Strategy process, therefore the processes are both complementary and interdependent.

The Camden Council's policy also highlights the importance of using BREEAM as a tool to support sustainable development. Policy CC2(h) notes that non-domestic developments of 500 sqm of floorspace or above should achieve "Excellent" in BREEAM assessments, and that its uptake in major development is encouraged to support the application.

The 21 Bloomsbury Street Scheme supports these targets, as outlined below, where 'Excellent' is the targeted rating with an aspiration for 'Outstanding'. The Proposed Development will be assessed under the most appropriate version of the BREEAM methodology, BREEAM 2014 Refurbishment & Fit Out (RFO). It is important to note that due to the refurbishment scope of the development some credits under the BREEAM RFO Scheme are constrained and may not be achievable.

Table 11-1 Table to show the BREEAM assessment for the Proposed Development, including scope, and minimum performance targets.

Assessment	Scheme	Scope	Minimum Target
Office	BREEAM UK Non-domestic Refurbishment and Fit-out 2014	Shell & Core Parts 1, 2 & 3	'Excellent' (score of ≥70%) with aspiration for 'Outstanding'

Please refer to the Sweco BREEAM pre-assessment tracker document for the office appended to this report (**Appendix C**), which demonstrates the credits targeted for the office use to meet this minimum requirement.

BREEAM will be used as a framework to support and underwrite the Proposed Development sustainability strategy. In the headline sections which follow, the strategy shows how key BREEAM credits have been selected to support this, and to address some of the core Camden Council's policy requirements in respect of sustainable development.

11.2.2 The WELL Building Standard

The WELL Building Standard is a leading tool for advancing health and wellbeing in buildings First launched in 2014 after seven years of research. IWBI in collaboration with GBCI administer the certification. WELL v2 released in 2020 has 10 concepts, which consist of a total of 108 features: 24 Preconditions and 96 Optimisations. WELL is attractive as a formal certification for developers and multinational corporate tenants that have strong environmental aspirations and also want to add positive social value.

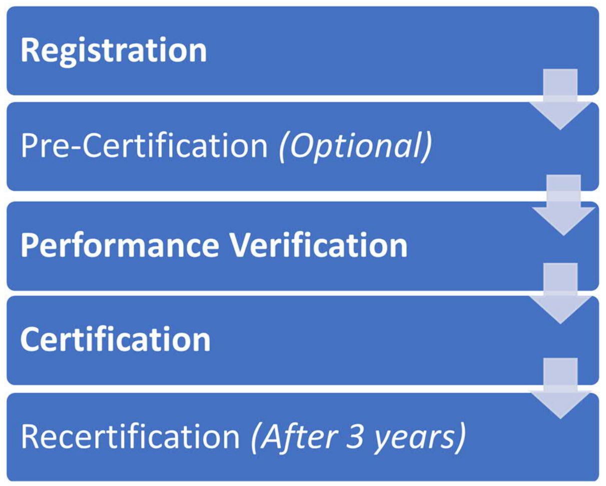
11.2.2.1 WELL v2 Core Certification

WELL v2 is global, flexible, and robust, allowing Shell and Core projects to achieve highest ratings. For each certification level, one must achieve 100% of the 'Preconditions' and a set of 'Optimizations'. Most features are applicable only to the non-leased spaces.

11.2.2.2 Our Approach

The project has been enrolled, once the payment is cleared and reflects on the online account the project will be officially registered, mostly to Q2 2022 addenda. Once registered the Applicant will be able to market the project as **'Pursuing WELL v2 Core Certification'**. The Applicant has decided to undertake 'WELL v2 Core Pre-Certification' after all the workshops for each team have been concluded, Sweco WELL AP will circulate the Evidence Trackers and Templates to collate evidence. The intention is to submit as much 'Implemented Evidence' as possible, once audited and approved it will not be reviewed during the final certification review.

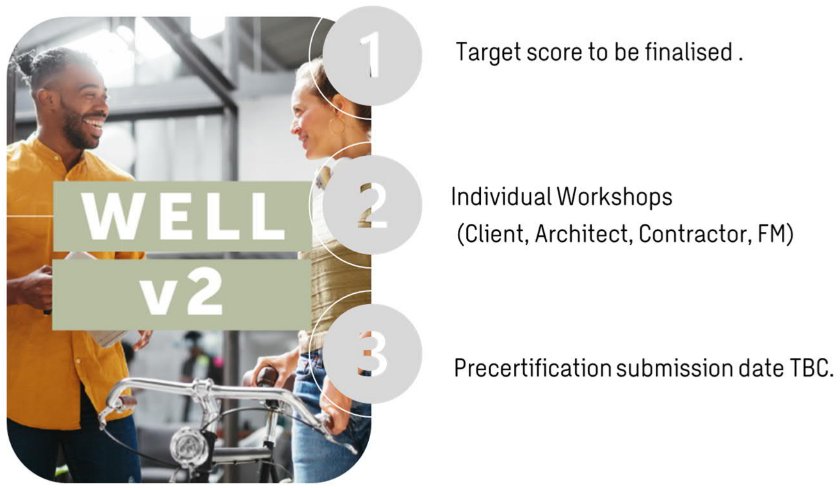
The date to submit the documentation will be confirmed end of Stage 4.



11.2.2.3 Potential Rating

The current target is WELL v2 Core Gold 64.5 Points with a potential to achieve a Platinum rating up to 90 points.

11.2.2.4 Next Steps



11.3 Energy and Carbon Dioxide Emissions

Target a minimum of 35% emissions reduction vs. Part L (SAP 10.2 carbon factors).

Undertake a CIBSE TM54 Advanced Energy Modelling process.

Define an Energy Use Intensity (EUI) target in line with UKGBC guidance.

The energy strategy for the Proposed Development is covered in earlier sections of this report and is therefore not repeated in full within this section. This section intends to provide a brief overview of the targets and goals associated with the energy strategy and describe some of the key actions undertaken at pre-application stages.

The development team set out to achieve a minimum carbon emissions reduction against Building Regulations Part L 2021 of 35%, using the latest SAP 10.2 carbon factors. This is the minimum requirement for commercial developments under the London Plan 2021.

During the pre-application stages, significant focus was placed on ensuring that the building fabric achieved excellent performance, to reduce energy consumption passively prior to the inclusion of active energy reduction strategies. The following passive design features have been incorporated within the building design at application stage:

- Optimised façade design, balancing solar control, daylighting, and occupant view-out, driven by early-stage detailed DSM analysis for new-built areas.
- Optimised glazing: opaque ratio of facades in new elements with greenery to terraces providing additional shade and increasing biodiversity.
- Inclusion of passive shading through use of reveals and existing protruding façade architectural features.
- Onerous performance requirements set to exceed Building Regulations notional requirements, including focus on U-values, g-values, air permeability and thermal bridging within the building fabric for both new and retained elements.

The exemplary proposed building fabric of the Proposed Development and façade optimisation studies to achieve an ambitious solar gain target underlines the considerable efforts made to support the ‘Fabric First’ approach. In the London Plan 2021, the GLA are also now asking for commercial developments to achieve a 15% reduction in emissions from the ‘Lean’ Stage of the energy hierarchy. This has been demonstrated for the Proposed Development, as evidenced in Section 5.4 of this report.

This is supported at the next stage of the Energy Hierarchy by the inclusion of highly efficient heating and cooling system, as described in Section 5.3 of this report.

The result of this combined approach is that the Proposed Development can reduce operational regulated carbon emissions by **38%** against Building Regulation Part L 2021 (with SAP 10.2 carbon factors) exceeding the current GLA target emissions reduction for non-domestic buildings and exceeding the minimum requirement of 35% for major developments in London Plan 2021. This is achieved without reliance on additional on-site generation technologies such as photovoltaic panels. This is particularly relevant when taking a WLC approach to development; the embodied emissions of typical PV units are high, and therefore over time it is likely this will outweigh the positive operational contribution of the panels, leaving the development in an overall worse position with regards to life cycle carbon impact.

It is recognised that emission reductions under Building Regulations Part L only cover part of the operational energy story, with the focus on ‘regulated’ CO2 emissions. Unregulated energy is not included and can contribute a significant proportion to overall energy consumption and consequent emissions. The development team recognise the need for more accurate prediction and calculation of overall energy use and will therefore be undertaking an advanced energy assessment process against CIBSE TM54 during RIBA Stage 3 of design. This will involve various project stakeholders, with scenario modelling to better understand and predict actual energy use and emissions from the development. Use of this method is also preferred as part of the WLC approach and will contribute to a better understand of life cycle emissions within that study.

Use of CIBSE TM54 will also allow the project to establish the Energy Use Intensity (EUI). EUI is the metric describing the total energy consumption of a development, accounting for both regulated and unregulated energy, divided by the building area (either NLA or GIA dependant on the benchmark you are comparing against). EUIs are useful for setting performance-based design goals, and the indicator provides a means to equalise the way energy is compared between various types of buildings, assisting in the benchmarking process. The EUI targets for the Proposed Development will draw upon the target bands for commercial building set out in the UKGBC publications, the LETI Climate Emergency Design Guide and the RIBA 2030 Climate Challenge. All these targets required use of a rigorous design for performance calculations methods such as CIBSE TM54. An EUI target relevant to the Proposed Development will be set at RIBA Stage 3 and then monitored through design, construction and into operation, to help drive overall operational energy and emissions response.

The BREEAM 2014 RFO assessment process will also be engaged to support overall energy efficiency for the Proposed Development. This will include a focus on metering (compliance with CIBSE TM39) and energy monitoring via an active BMS system for Ene02, careful specification of low-energy lighting under Ene03, passive design and assessment of potential for low-carbon technologies under Ene04 (already integrated into this report), and efforts to reduce energy consumption of unregulated systems such as lifts (Ene06). Energy used by the contractor will also be monitored on-site, with the contractor expected to set specific targets for energy consumption and report this regularly through construction.

11.4 Water consumption

40% improvement over the BREEAM 2014 RFO Baseline.

The Proposed Development has set strong aspirational project targets for potable water consumption. The development will seek to achieve this in several ways, through integrating low consumption thinking into the earliest stages of project design, focusing on low flow fittings, and providing crossover with our urban greening aspirations and looking at water management holistically.

The low-consumption culture begins with the intent to specify water-consuming components and sanitaryware with a high standard of water efficiency. Components will be selected in accordance with the EU Water Efficiency Label, targeting the top two ‘green’ bands of this label to provide performance verification and support the project approach. In addition, sanitaryware will have set performance requirements to help facilitate the first stage of water-use reduction from end users. This is based primarily on the performance criteria set out in BS 8542:2011 Table 8.6, which sets out the sanitary components water efficiency criteria and water recycling contributions to achieve certain levels of water efficiency. The project is proposing to target the most onerous of these bands, ‘Outstanding’, to support the low-consumption approach. The credit performance bands in BREEAM Wat 01 also help to underwrite this approach. The minimum standard for BREEAM Excellent in Wat 01 is 1 no. credit, and for ‘Outstanding’ the minimum Wat 01 credit score is 2 no. credits.

The Proposed Development will target a minimum of 3 no. Wat01 credits and go beyond this to seek to achieve further credits, which will be supported by the WUI target approach. This is also in exceedance of the requirements of the London Plan Policy SI 5 item C (2).

Table 11-2 Table to show proposed minimum performance requirements for the sanitaryware components at the Proposed Development.

Water fitting – Non-Domestic Areas	Capacity / flow rate	Units
WC, dual flush (effective)	4	litres
Urinals (2 or more)	1.50	litres/bowl/hour
Wash hand basin taps	4.5	litres/minute
Showers	6	litres/minute
Kitchen sink taps	5	litres/minute

Referring to the BREEAM assessment, engagement, and target of credits such as Wat 02, Wat 03 and Wat 04 also assist in supporting the development's water strategy and answering the requirements of London Plan Policy SI 5 item C (3). Sufficient water metering will be provided within the development, covering both the incoming supply, and monitoring water usage of high-consumption systems and building areas. A water leak detection system will be provided, which will monitor leaks throughout the development and synchronise with the BMS to ensure that leaks are identified and can be mitigated quickly. In addition, sanitary supply shut off devices, such as PIR linked to the lighting systems, will be included to only supply water to spaces (such as WCs and hand basin taps) when it is required. All these solutions support the low flow sanitaryware specification requirements and water recycling approach.

11.5 Flood Risk, Water Management & Drainage

11.5.1 Flood Risk Assessment

Managing flood risk is an important aspect of the sustainability strategy. This issue is particularly relevant to developments seeking to address the impacts of climate change, as an increase in potential for future UK flooding is one of the more likely and better-understood scenarios from the latest UKCP data. The issue also covers factors such as robust design, occupant safety/means of escape and the potential for significant future economic impacts in a flooding scenario, so it is imperative that the risk is understood and mitigated.

RIDA have provided a full, detailed flood risk assessment (FRA) as part of this application, and in accordance with the key policy requirements set out above. This section provides a summary note of the project strategy, and risk, and inclusion of key climate change metrics; please refer to the RIDA FRA for full details of the approach.

The Proposed Development is in flood Zone 1, which is designated as having a low risk of flooding from fluvial/tidal sources. The figure shows the location of the site on the Environment Agency's Flood Map for Planning.

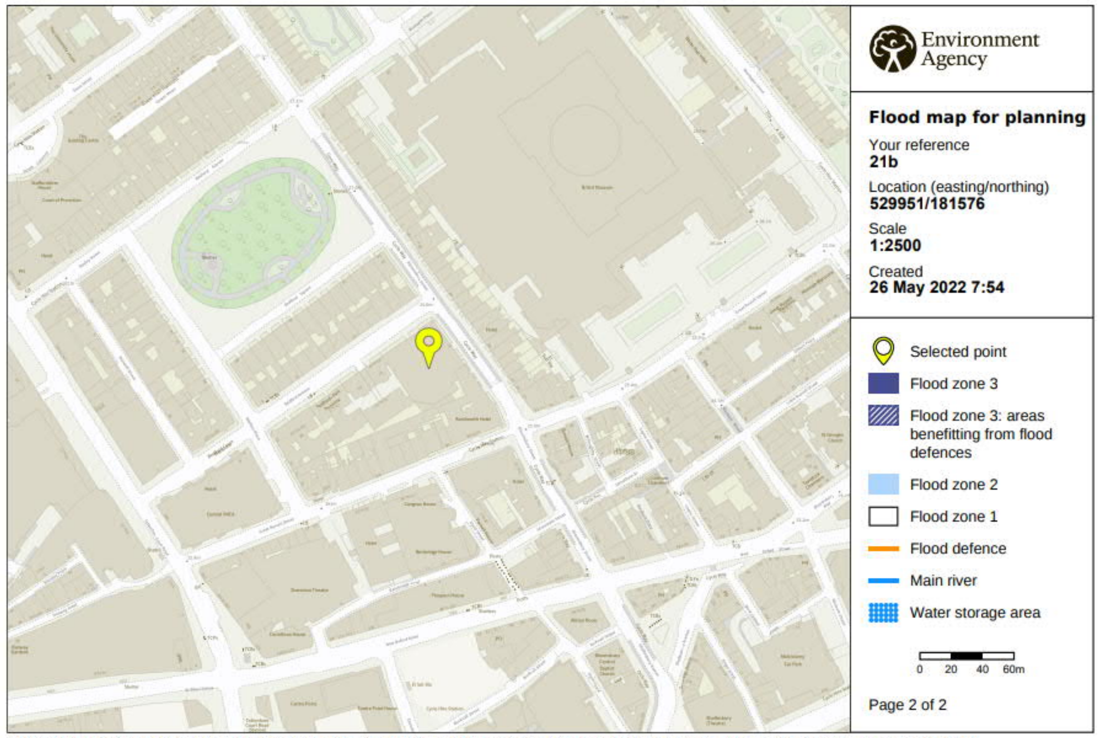


Figure 11-2 Potential flood extent map to show the location of the Proposed Development within Flood Zone 1

Allowances for climate change will be included in the FRA for the Proposed Development. The FRA uses climate change allowances from the Environment Agency for peak river flow, peak rainfall intensity, sea level rise, offshore wind speed, and extreme wave height. Climate change allowances have been made when considering the various sources of flooding. For example, an allowance of 40% increase in peak rainfall intensity from a 1:100-year storm event is applied when considering surface water runoff, and potential for flooding. This allowance has also influenced the Sustainable Drainage Systems (SuDS) design, as referenced in section 11.5.2.

The flood risk from all other sources is 'low', as per the RIDA Flood Risk Assessment. These results will support the award of the BREEAM 2014 RFO Pol03 credit section, and the FRA to be provided for the planning application will be sufficient to award the first 2 no. Pol03 credits.

11.5.2 Sustainable Drainage Systems (SuDS) & Project Approach

Although it is demonstrated that the risk of flooding from surface water flooding is low for the Proposed Development site, it is still imperative that this is effectively managed, and that the new development does not worsen the existing condition. The use of Sustainable Drainage Systems (SuDS) can reduce the impact of urbanisation on watercourse flows, ensure the protection and enhancement of water quality and encourage recharging of groundwater in a manner which mimics nature. Additionally, the NPPF requires that site water should be managed effectively and sustainably, to ensure that the post-development site does not exacerbate the pre-development condition in the 1-in-100-year storm event, whilst being conscious of impact on flood risk and considering the impacts of climate change.

London Plan 2021 Policy SI 13 goes beyond this, with Item B noting that developments should aim to achieve greenfield runoff rates and ensure that runoff is managed as close to source as possible. The policy also provides a drainage hierarchy, in which preference is given to solutions which best deliver sustainable surface water management.

The Proposed Development has embraced this challenge and has utilised the SuDS Management Train to help steer the approach for the development. The SuDS Management Train is a sequential method for using drainage measures, in order of proportional positive impact, to change flow and quality characteristics of the runoff in stages. Source control is preferential in the first instance, as it controls runoff in smaller catchments. Where this does not provide adequate protection in terms of flood risk and watercourse pollution, site control may be required. Regional control can be utilised where there are several sites and communal storage, and mitigation can be provided.

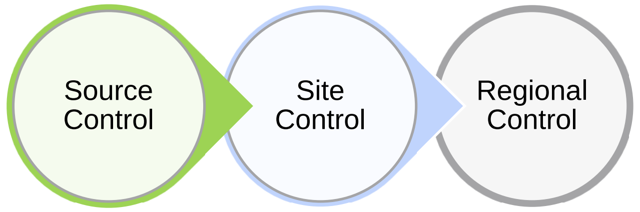


Figure 11-3 The SuDS Management Train

The Proposed Development shows strong position for addressing the intent of Core Strategic Policy 13, in that it embraces a design methodology that accounts for climate change and reduced risk of future flooding within the local context. The approach noted within this section also shows integration of SuDS management processes and hierarchy approach into design. Through this approach, it is also assumed that the full value of BREEAM 2014 RFO Pol03 surface water runoff credits will be achieved, further underlining the positive nature of the approach taken on this development. By aiming for the greenfield runoff rate, which results in a very significant reduction in discharge rate, and addressing the reduction of peak rate runoff, the Proposed Development contributes positively to the London Borough of Camden's flood risk mitigation and sustainable drainage strategy.

11.6 Materials & Embodied Carbon

11.6.1 A Focus on Major Retention

This section of the sustainability statement outlines the approach to material and embodied carbon at the Proposed Development, which forms a critical part of the wider sustainability strategy and Whole Life Carbon Assessment (WLCA).

WLCA is viewed as a key component of the decision-making process on the progression of any refurbishment option, and indeed the decision to prioritise refurbishment over demolition and reconstruction. This theme of consideration of opportunities for refurbishment before demolition is clearly established within the Camden Local Plan Policy CC1 and is picked up in detail within sections 8.15-8.21 of the adopted Local Plan document. There is additional guidance in the supplementary planning guidance document CPG Energy Efficiency and Adaptation (2021), particularly in Section 9, which has also been considered as part of this application submission. This submission looks to address the key requirements of those documents.

WLCA looks at both embodied carbon (carbon associated with materials, products, and systems from raw extraction all the way to end of life) and operational carbon emissions (those associated with operational energy and water consumption) over a defined life-cycle study period and is used to quantify and understand the carbon impacts and proportional distribution within a built asset. The study is based on the European LCA standard EN 15978:2011, with carbon impacts reported using a modular life cycle stages structure, as shown in Figure 11-4.

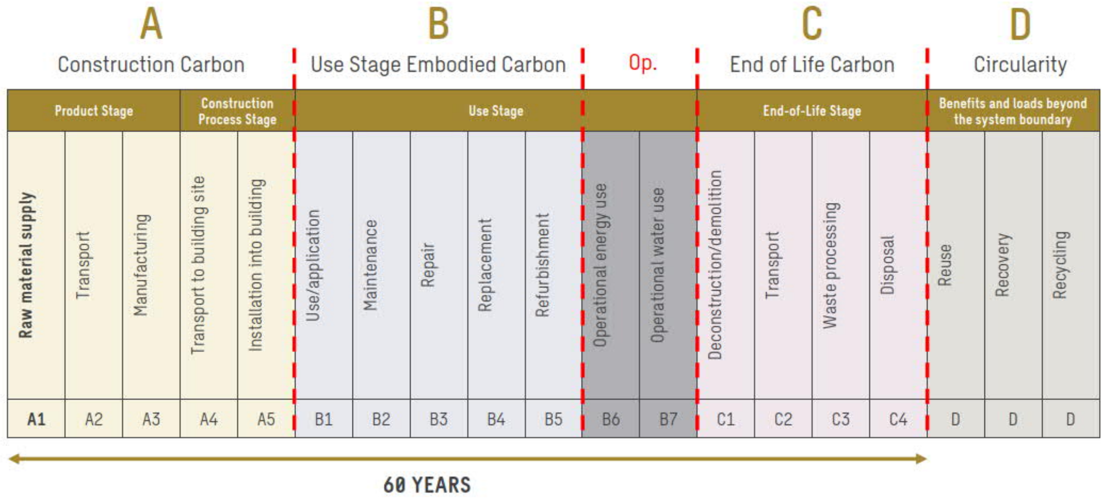


Figure 11-4 EN 15978:2011 modular grid structure showing reportable life cycle carbon stages under a WLCA, with a notional 60-year life cycle study period

There are some key industry terms to understand, that are used throughout the rest of this report section, when looking at whole-life and embodied carbon studies, particularly for reporting and benchmarking purposes. These terms are based on the EN 15978:2011 modular letter banding above, and are grouped/described as follows:

- **Modules A-C (including B6 & B7):** Whole Life Carbon
- **Modules A-C (excluding B6 & B7):** Whole life embodied carbon
- **Modules A1-A5**: upfront embodied carbon (embodied carbon to practical completion)

The terms noted above are reflected in current best-practice industry targets and concurrent benchmarking.

Critically though, WLCA is used to understand the synergies and interplay between embodied and operational emissions, and how a decision made to improve one can directly impact the other. This concept is particularly key for WLCA of refurbishment projects.

Given the current industry focus on reducing life cycle emissions of development projects, and the impact these projects have on the achievement of wider local, regional, and national carbon targets and budgets, consideration of opportunities to refurbish existing buildings have become a core focus for prioritising carbon reduction opportunities in the construction process and over the life cycle. However, when looking at whole life carbon, refurbishment of an existing asset needs careful consideration. While the choice to refurbish an existing asset may save a significant quantum of embodied carbon (subject to what is retained and what is newly installed), the ability to achieve strong operational energy performance can be constrained. Therefore, a balanced WLCA that considers both embodied and operational emissions impact together is key to informed decision-making.

For embodied carbon, the argument for prioritising refurbishment is quite clear. In a typical new-build commercial development, the structural elements of a building typically make up >50% of the upfront embodied carbon emissions at practical completion. The proportional embodied carbon impact of structural components for a typical new-build London-based commercial office (in the Sweco UK WLCA portfolio) is shown in Figure 11-5.

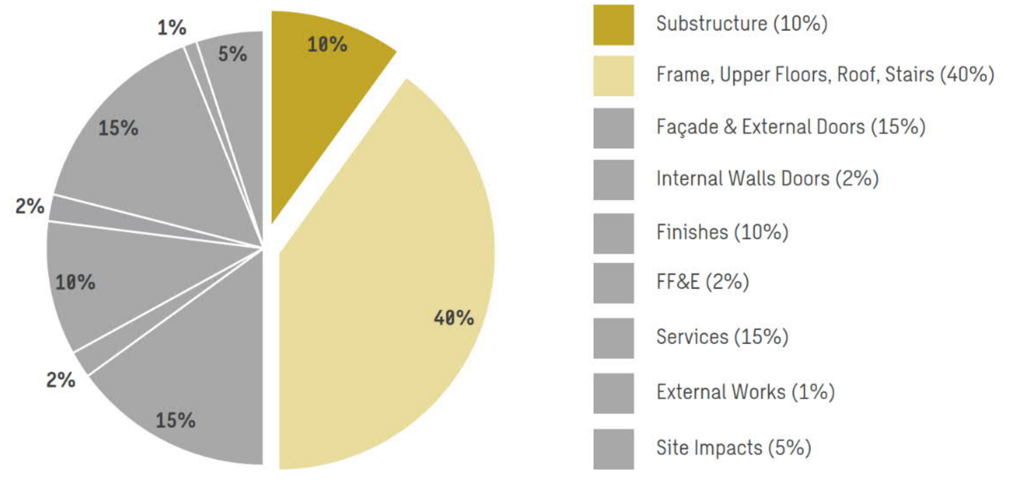


Figure 11-5 typical proportional distribution of upfront embodied carbon (A1-A5) between building components in a commercial office, with the structural element impacts highlighted

Given the significance of the impact on embodied carbon generated through construction of new structural elements, it is widely accepted that in many cases pursuing and approach that prioritises and maximises opportunities to retain these elements in situ and refurbish the development, rather than focus on the demolition and construction of a new development, can have a positive impact on upfront and life cycle embodied carbon performance. In terms of embodied carbon, other elements are treated in a similar way; for example, retaining façade elements is often (but not always) the most embodied-carbon-efficient solution, given that the impact of installing new facades is significant. In this siloed view, it can initially seem like the most carbon-efficient solution is always to retain as many of the existing materials as possible and avoid new construction.

However, the extent of the refurbishment is particularly important in the whole-life context, when bringing operational emissions into the story. Building elements such as the facades and the building services are key here. For example, while it may be the most embodied-carbon-efficient solution to retain as much of the existing façade as possible, the age, condition, and performance (amongst other considerations) of the existing facade system is critical to ensuring that it is able to contribute to a reduction in energy demand in the first instance, thus ensuring that the development performs efficiently over its operational life. With key industry publications such as LETI's Climate Emergency Design Guide putting significant emphasis on the need to take a 'Fabric First' approach to low-energy, low-carbon futureproofed design, ensuring that the façade performs to a high standard is of critical importance to the overall whole life carbon story and meeting project targets.

Given the speed at which the industry has needed to progressively tighten performance requirements for building envelopes over the last few years to support this 'Fabric First' approach, this often means that when undertaking a refurbishment, intervention is required to the façade. The intent is to ensure that its performance will meet the expectations of today's market and achieve the Energy Use Intensity (EUI) benchmarks that are required to support the drive towards Net Zero. Although this often works to improve operational energy performance, there is a consequent penalty in embodied carbon (for new materials such as glazing/framing, insulation, or even entire new façade systems), dependent on the extent of intervention that is required.

The same thinking applies to building services systems, which are also critical for both operational and embodied carbon performance. Even the major retention of structural elements is important to consider, as issues such as location of cores and existing structural members (i.e., beams and columns) can constrain the implementation of the most efficient distribution routes for services and placement of plant equipment, which can have knock-on impacts on both the operational and embodied carbon performance at the whole-building scale.

The above underlines why it is so important to consider the whole life carbon emissions story when prioritising major refurbishment, with the scope of refurbishment and the consequent interplay between operational and embodied emissions being a critical aspect of decision-making for low-carbon development in the longer term. The intent of this initial feasibility report is to present a number of options in this way and compare them based on a high-level WLCA analysis.

11.6.2 Project Targets & Development Approach

The development strategy has been informed by current industry best-practice guidance, and benchmarks, including those from UKGBC, RIBA, LETI, and the GLA, as well as the methodology requirements of the RICS Professional Statement Whole life carbon assessments for the built environment (2017) publication. The development team have reviewed all of the current guidance documents available at pre-application stage.

The targets for the Proposed Development were established at the beginning of RIBA Stage 2 and were informed by the intent to retain significant elements of the structure and parts of other key elements such as the facades, as well as looking at opportunities to maximise reuse and retention internally. The extent of retained vs. new elements helped to determine the appropriate benchmarks for a development of this scale, location, and typology. It is also recognised that for the building fabric and services in particular, some level of upgrades and overhauls were required to support the onerous energy (and consequently carbon) performance targets and deliver a futureproofed development that supports Camden's Net Zero agenda. This is an important consideration for the whole life carbon context and for overall decision-making on carbon reduction.

The Proposed Development is targeting an 'upfront' embodied carbon intensity that is in line with the 'aspirational' targets as set out within the GLA London Plan Guidance Whole Life Carbon Assessments document (March 2022), with an intensity of **<600kgCO_2e/m^2 GIA A1-A5**. In this latest version of the GLA publication, this now aligns with a LETI 'C' rating within LETI's Embodied Carbon Target Alignment (June 2021) publication, which LETI describes as 'current best practice'. The use of the 'upfront' target is to ensure that any new materials that are required for the Proposed Development are interrogated for opportunities to reduce embodied carbon impact.

The relevant targets from the GLA WLCAG are set out in Figure 11-6.

Benchmark Type	EN 15978 Modules	Commercial EC Intensity ($kgCO_2e/m^2$ GIA)
Typical Benchmark	A-C	<1,400
	A1-A5	<950
	B & C	<450
GLA Aspirational Benchmark	A-C	<970
	A1-A5	<600
	B & C	<370

Figure 11-6 Banding of the GLA WLCA (March 2022) Appendix 2 Table A2.1 commercial embodied carbon targets as intensities in kgCO2e/m2 GIA, with the A1-A5 'aspirational' performance band highlighted. The Proposed Development is aiming to improve on this performance.

The Proposed Development will explore opportunities to go beyond GLA aspirational targets where it is possible to do so, given the current proposed intent to retain as much of the existing building as possible. The current targets set out within this application document would represent a best-practice development in line with current guidance under the London Plan 2021, and in line with the latest GLA London Plan Guidance Whole Life Carbon Assessments publication (March 2022). Targets for upfront embodied carbon are likely to be revised downwards given the current results demonstrated in Section 11.6.3.

It is also likely that a whole-life embodied carbon target (A-C) will be developed at RIBA Stage 3, but this is more problematic for refurbishment projects and requires further investigation to ensure this is pitched in the right way.

11.6.3 Reducing Carbon at the Proposed Development

The Proposed Development has focused on maximising retention of the existing materials, which has a significant embodied carbon benefit for the scheme. The current structure and façade systems facilitate this level of retention.

A significant proportion of the existing structure is retained, with over **2,233 tCO_2e** is saved through major retention of structural systems. The existing superstructure is typically steel frame and composite re-entrant metal deck (with concrete topping), with a reinforced concrete-led substructure, the details of which are subject to further investigation of historic drawings. Retaining such a high quantum of existing structure at the Proposed Development realises significant carbon savings through the prioritisation of refurbishment over construction of a new development. There will be minor demolition and some additional new structure added in the form of infill elements to the atrium, extending the rear massing from 3rd to 6th floor, a new atrium roof at 6th floor and a set-back extension at 7th floor. New staircases will also be formed within the atrium from ground floor to 5th floor.

Visuals of the retained and new elements of the Proposed Development can be observed in Figure 11-7, provided by Structural Engineer HTS. The grey colours are retained materials, and other colours represent new materials for the extensions and additions.

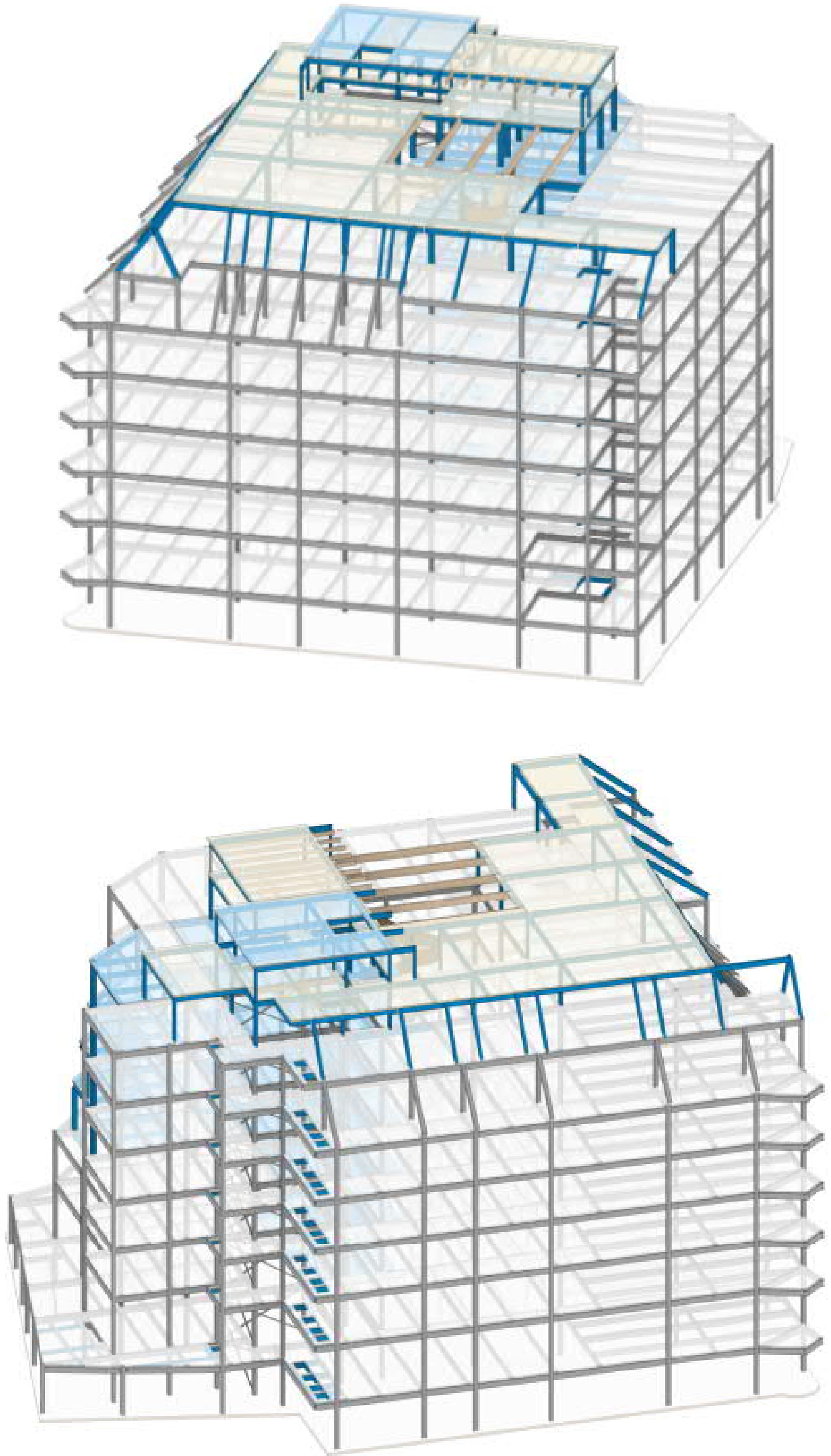


Figure 11-7 Isometric images of the Proposed Development from structural engineer HTS, with retained structure in grey colours and new structure in other colours (blues/browns/yellows).

Any new structural materials added to the Proposed Development will be interrogated for embodied carbon performance as part of the WLCA and will be selected using embodied carbon as a key performance indicator. This will include the following key considerations and investigations:

- Investigate opportunities for procurement of new steel members manufactured through the electric arc furnace (EAF) route, with a focus on the location of EAF operation and the recycled content (which is secondary to location of EAF and energy mix).
- Explore options to procure reinforcement bar with a high recycled content and define limits for sourcing distances and set carbon factor limits within specifications.
- Prioritise replacement of cement in a concrete mix with secondary cementitious materials (such as GGBS) and set maximum cement contents for specific concrete mixes to control the mixes through construction, as well as ensuring that appropriate concrete grades are applied to relevant applications.
- Evaluate how use of structural timber within the extensions may improve the performance of the Proposed Development, making considerations for utilising the benefits of sequestration by looking at quantifying whole life embodied carbon impacts through the latter stages of the design process and into construction and operation.
- Ensure that any emissions from demolition of materials are managed in an effective way to reduce carbon associated with site activities.
- Manage transport distances (often over multiple legs) from structural materials to ensure that their carbon impacts are managed, balanced against opportunities for reducing the carbon associated with manufacturing.

The façade at the Proposed Development has also undergone a thorough review in whole life carbon terms. The intent has been to maximise the retention of the existing façade as far as possible to reduce embodied carbon impact, but to make some improvements to ensure that the balance between operational energy performance and embodied carbon is maintained. The current design replaces the existing windows to improve thermal performance, airtightness, U-values and g-values. This comes at a cost in terms of embodied carbon but underwrites the 'fabric first' approach to low energy design and supports the aims of Camden Local Plan Policy CC1 on the prioritisation of energy performance improvements to existing buildings. This is also supported by the 'Lean' performance of the proposed development in the Energy Strategy section, which shows a **36%** improvement over the Part L baseline from passive measures. The replacement of the existing excessively glazed southern elevation with a new rear extension and terraces allow better control of solar gains and operational energy performance, again supporting the energy performance targets but coming at an embodied carbon cost, albeit significantly lower than compared to a 100% new-build façade system.

In addition to the focus on maximising retention of the structural and façade elements, the development team will also explore how materials being demolished and stripped out from the building can be maximised from a re-use potential. A detailed pre-demolition / strip-out audit will be produced which quantifies the various waste streams and also proposes a number of potential avenues for recycling and reuse of materials within major groups. This aligns with the requirement in Section 9.6 of the Camden supplementary planning guidance document CPG Energy Efficiency and Adaptation (2021), which suggests that where materials are removed from the building during redevelopment, this should take place.

All of these actions contribute to improved embodied carbon performance compared to a typical new-build development. However, as discussed earlier in this sub-section, there will still be new materials that will be installed as part of the refurbishment, typically in the finishes, fittings and building services categories, which are likely to make up the majority of the upfront embodied carbon performance. This is in addition to the structural and façade modifications and changes previously mentioned.

To focus on reducing upfront embodied carbon, the following investigations and opportunities will be conducted during the upcoming phases of the design process:

- Review finishes and prioritise elements with the highest embodied carbon impact and look at opportunities to reduce them.
- Consider opportunities for maximising recycling content in glass, subject to the availability of EPD data that can accurately quantify this impact and in consideration of the decarbonisation roadmap of the glass industry.
- Model the building services emissions impact, given that this will be a significant impactor on the carbon performance of the sit-out works.
- Explore opportunities to further reduce the carbon impact of services, focusing on big-hitter items such as pipework, ductwork and containment in particular.

While it is appreciated that Section 9.6 of the Camden supplementary planning guidance document CPG Energy Efficiency and Adaptation (2021) notes that full whole life carbon assessment (WLCA) is only formally required for buildings where substantial retention and refurbishment are not a viable option, a WLCA has been conducted for the Proposed Development at pre-application stage. This has been undertaken in accordance with the GLA London Plan Guidance for Whole Life Carbon Assessments (March 2022), and by virtue of this, in accordance with the RICS Professional Statement on WLCA.

The baseline study undertaken by Sweco suggests that the upfront embodied carbon of the Proposed Development is **351-386 kgCO_2e/m^2 GIA (A1-A5)**; this includes a 10% buffer margin as appropriate to early-stage WLCAs. This is significantly beyond the initial target of <600 kgCO_2e/m^2 GIA (A1-A5) as part of the GLA's 'aspirational' target band, showing the significant improvements to embodied carbon that can be made when maximising major retention of structures is a viable option. A full accounting of this can be provided via a GLA spreadsheet if required, but this is not thought to be necessary for this project given the policy requirements.

Figure 11-8 shows a breakdown of the embodied carbon between elemental categories (as defined by RICS). As expected from a major refurbishment, the services element, which is 100% new, makes up the majority of the emissions at 32% of the total. Likewise with finishes, which are 100% new and make up 19% of the total impact, The impact of the finishes is dominated by the raised access flooring, which is the single most emissive element of this assessment.

Even though the majority of the structure is retained, the additional elements and the various infills still have a significant impact on the overall upfront carbon, further underlining how important structure is to this story.

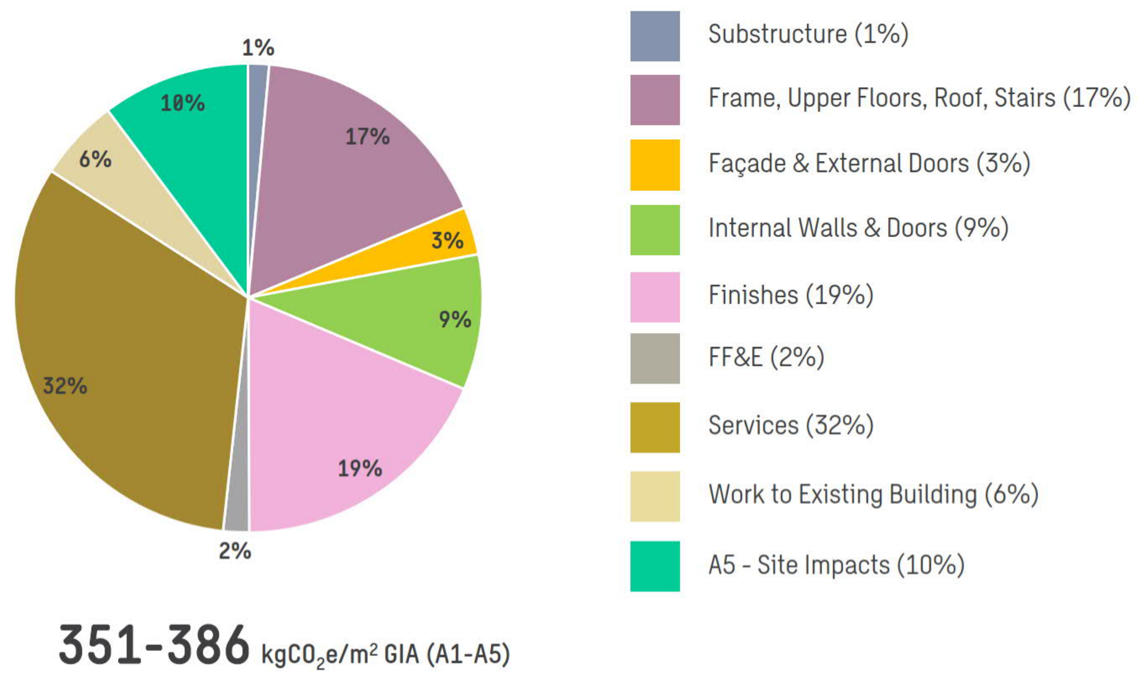


Figure 11-8 Breakdown of upfront embodied carbon emissions by elemental group for the Proposed Development, looking at Modules A1-A5 only.

The WLCA will be used to inform post-planning decision-making on options to further reduce the embodied carbon impact of the new materials in the Proposed Development. Many of these options have already been set out earlier in this sub-section. The process will be used to drive further savings on embodied carbon and provide the basis for further investigation of options for reducing both operational and embodied emissions.

The development will not focus solely on upfront embodied carbon; the WLCA has also quantified the A-C embodied carbon, which currently sits at **828-911 $kgCO_2e/m^2$ GIA (A-C)**, including the 10% margin again. This is again lower than the GLA 'aspirational' target. However, this is predated on a 60-year study period in line with RICS and GLA guidance, and this may not be suitable for all refurbishment projects. This will be reviewed at the next stage for its suitability for this specific development and site.

11.6.4 Material Data – EPDs

Environmental Product Declarations (EPDs) form the basis of the WLC assessment process, particularly for embodied carbon of materials. They are the third-party verified quantified assessment of a product or material's life cycle impacts, either from cradle-to-gate (raw extraction to delivery on site), or cradle-to-grave (raw extraction to demolition & disposal). EPDs are used in the WLC process to provide the data for embodied carbon, and databases such as One Click LCA, which Sweco utilise for WLC, have >25,000 EPDs in the system to complete this work. EPD data is also directly requested for supporting embodied carbon assessment as part of the RICS method.

Although the number of EPDs in software seems large, this is only a very small fraction of construction products, and materials available on the market today. Some materials groups are more likely to have supporting EPD than others; for example, there is good EPD availability for concrete, gypsum, and insulation products, but only very limited EPD information for building services equipment.

The project team may request EPDs from a wider range of materials should the research conducted with the supply chain at RIBA 3 suggest that it is possible to do so without significantly limiting procurement decisions. To help stimulate uptake of such information from suppliers, EPD will be requested as part of the procurement process, and the availability of EPD will be used as one of the key decision-making factors in sustainable materials procurement. Preference will be given to those who can provide this detail, subject to assessment against other core performance goals linked with the sustainable procurement exercise.

For items such as building services, where the uptake of EPDs is particularly poor, this can impact the accuracy of the WLC assessment, and therefore has the potential to skew the calculation of upfront embodied carbon for any net zero carbon claims. The design team will issue out and encourage manufacturers to return the CIBSE TM65 datasheets (Form A as a minimum) to facilitate better representation of building services products and systems in the WLC assessment. CIBSE TM65 provides a methodology to better account for the complexity of these systems in an LCA study and is actively implemented at Sweco to improve the accuracy of WLC results.

11.6.5 Sustainable Procurement of Materials

Where new materials are utilised, the Proposed Development will seek to ensure that the principles of sustainable procurement are ingrained within the materials decision-making process. The BREEAM UK Refurbishment and Fit-out 2014 process is particularly effective in this regard, specifically within the Mat 03 credit section which can be used to steer success.

The required process for the Proposed Development has been established within a Sustainable Procurement Policy (SPP). The SPP will be used to guide sustainable procurement for the Proposed Development. This process also aligns closely with other material and waste considerations of the project; the WLC analysis, requirement for EPD, material efficiency measures, adaptability to climate change, pre-demolition audit and general project waste aspirations can all be influenced by the SPP. The SPP also captures the key themes required by the BREEAM Mat 03 process, which sets out what is expected from these documents.

The SPP includes advice and measures to influence sustainable procurement of several major material groups, as defined by the WLC assessment. The contents of the Procurement Plan can largely be split into 3 cores 'themes', which contribute to the decision-making process when selecting sustainable materials. This includes the following:

Embodied Impact

Healthy Materials

Responsible Sourcing

The implementation of the above will be monitored through the project procurement phases and into construction, to ensure that the requirements are upheld. It is likely the outputs of the SPP will be used to inform Pre-Qualification Questionnaires (PQQs) for potential material suppliers for the Proposed Development, to ensure that the aims of the plan are implemented. Regular review of the SPP will also take place throughout the project, in line with project progression against the RIBA Plan of Works. This will ensure that the SPP is able to influence project decision-making, rather than be an early-stages BREEAM item that is then ticked off and forgotten. This is a good example of how BREEAM methodologies are used as a framework approach to drive value in sustainable design.

Some key materials will have mandatory requirements in respect of responsible sourcing. 100% of timber products used within the scope of the Proposed Development, be that in temporary works, formwork or in construction itself, will be procured in accordance with the UK Government's Timber Procurement Policy, and will be required to carry FSC (or equal approved) responsible sourcing certification. The project team understands that failure to comply with this standard will result in the inability to secure any BREEAM rating for the project, and therefore compliance is essential.

11.7 Waste Management

11.7.1 Demolition & Strip-Out

The Proposed Development is taking a 'whole life' view of waste, aiming to tie waste targets in with the WLC process and opportunities to embrace circular economy principles. The process begins with an assessment and quantification of the ability to reuse materials from existing structures and buildings on the development site, prioritising reuse in situ in the first instance and then individual reuse or refurbishment of products and materials in the new development where possible/suitable. These materials should be considered alongside new materials and construction techniques that support a low-waste ethos, using the frameworks and approaches set out in Section 11.6 to help design out wastage, as well as inform and drive selection of materials and products which help realise this goal. Further to this, suitably onerous site waste targets should be set both to produce construction waste and for diverting excavation, demolition, and construction waste from landfill. The third part of this process is ensuring that suitable facilities and management procedures are in place to support a low-waste operational culture, which ensures waste is managed effectively through design, construction, and operation.

Although a significant quantum of material is being retained in situ, there will still be an element of strip-out and some demolition to support the Proposed Development. The first important step in resource efficiency is to engage in a process of quantification and identification of products and materials within the existing building that could potentially be reused in new applications for the Proposed Development. This encourages principles of circularity and reuse and enables opportunities to be identified. The timing of such a study is also important; it needs to be undertaken early enough in the design process for there still to be opportunity to integrate some of the reuse opportunities into the developing design.

A strip-out audit has been completed by General Demolition for the development at pre-application stage for this purpose. The pre-strip out audit has identified the key materials that will arise because of demolition and associated works on site.

A summary of the materials identified, and targets are outlined in the below.

Table 11-3 Material identified summary

Potential Waste	Predicted Weight, kg	Reuse/Recovery Potential	Predicted Recovery or Reuse, %	Predicted Landfill, %
Tiles & Ceramic	200	Full recycling	100	0
Timber	33,000	Reuse via timber social enterprises, recovery secondary	100	0
Plastic	150	Full recycling	100	0
Glass	1,000	Full recycling	100	0
Plasterboard	40,000	Recovery to new gypsum products	100	0
Floor Coverings	38,000	If in reasonable condition offer for reuse	100	0
Metals	tbc	Full recycling providing no contamination	100	0
Furniture	tbc	If in reasonable condition offer for reuse	-	-
Liquids	-	System draining (e.g. fire system)	-	-
Hazardous	-	None	-	100
Mixed Waste	745	Careful selection of waste remover to achieve high diversion rate	98	2

11.7.2 Construction Waste Management

In the next stage of waste management for the Proposed Development, onerous waste management targets will be set for excavation, relevant demolition/strip-out of the existing asset and construction waste generated by the development. It is expected that site operators and contractors will be held to the achievement of these targets as part of a contractual agreement, which will support Camden's approach to delivering low waste.

The current waste management targets are set at less than 4.5m^3 of construction waste generated per 100m^2 (GIA), driven by the BREEAM 2014 RFO Wst01 assessment. These are typically onerous targets for projects to achieve but may be supported by the extent of material reuse at the Proposed Development, particularly in the structural applications. High-waste materials such as plasterboards will be targeted for low-waste activities.

The development will also target a minimum of 90% of all demolition, excavation and construction waste diverted from landfill. The targets set for the Proposed Development in respect of diversion of resources from landfill are more onerous than those required by the BREEAM 2014 RFO assessment. This demonstrates the strong intent of the project to manage waste associated with construction sustainably and in accordance with current best practice.

Recycling rates for major construction waste materials will also be expected to be set with input from the main contractor on appointment. The main contractor should set onerous but achievable targets in respect of the recycling of construction waste, as this is specific to the material of product in question. The Resource Management Plan (RMP) described below will be expected to set out the routes to recycling and the locations of key facilities close to the site, in the same way as the information is provided in the pre-demolition/strip-out audit.

Effective monitoring and recording of site waste will also be a requirement of the project, again driven largely by the BREEAM 2014 RFO assessment process. Resource Management Plans (RMP) will be required for both construction waste and demolition waste. Draft versions with waste estimates and calculations showing how the project waste targets might be achieved are required prior to construction, and these should be checked against the final RMP documents with actual site waste to assess the effectiveness of target setting and demonstrate 'lessons learned'.

11.7.3 Operational Waste Management

Another key aspect of whole life waste consideration is how waste is managed during the operation of the building and ensuring that adequate provision is provided to support building occupants in their sustainable waste decision-making. This is typically through the provision of facilities for recycling and composting of organic waste streams, and through the accessibility of these services to building occupants and facilities management teams. Lack of such facilities can undermine the strong low-waste approach set out during design and construction of the Proposed Development. This is also a key part of the Camden Council's Local Plan Policy CC5.

Requirements for operational waste management are also driven by the BREEAM 2014 RFO credit process, particularly the Wst 03 credit, which is a mandatory credit for the achievement of BREEAM 'Excellent'. This upholds similar a number of Camden's waste requirements, but also includes better separation of recyclable waste streams, labelling and provision for cleaning facilities associated with organic waste. The BREEAM Wst 03 credit it targeted for the Proposed Development, as per the BREEAM Pre Assessment in **Appendix C**.

11.8 Flexible Design & Future Adaptability

The development team recognise that design for minimised whole life carbon impact does not just relate to the capital embodied carbon and the operational impacts of the building systems over time. This is reflected in the choice of a dual-benchmarking approach that provides a whole-life overview and analysis basis. Facilitating future flexibility has the ability to reduce waste and costs associated with future fit-out or refurbishment works, improves the ability to cost-effectively reuse and recycle materials, increases the lifetime value of materials and products, and encourages circular thinking. This can be more problematic with an existing frame system like at the Proposed Development, as a significant amount of inherent flexibility is related to the structure. However, by virtue of this application proposal it can be demonstrated that the current structure is already flexible and adaptable to meet the changing needs of London and still deliver a strong asset that contributes positively to Camden's net zero carbon goals.

The BREEAM 2014 RFO Wst 06 credit section deals specifically with design for disassembly and the potential for future functional adaptability of spaces and can be used effectively to pool ideas and collate key measures of the Proposed Development that facilitate future flexibility and adaptability. As per the BREEAM pre-assessment provided in **Appendix C**, the credit has been targeted for this development and input has been provided from the structural and architectural teams during the RIBA 2 design period. The intent of the early-stage assessment (before the end of RIBA 2), is to collate thoughts and ideas on how future flexibility will be achieved, considering structural, architectural and MEPH engineering strategies to support this.

In line with the commentary at the start of this section, the structural commentary notes some of the constraints placed on major refurbishment projects in respect of facilitating future flexibility and adaptability compared to a new-build development. As the majority of the building is an existing retained structure, there is restricted scope to design in adaptability. The original design loads have already been tested to achieve additional extension massing. The choice to extend, rather than leave future opportunity for adaptation, has been agreed. There are also site-based constraints that limit the ability to extend the building vertically or horizontally in the future, any more than has been accommodated through this application.

11.9 Air Quality & Pollution

11.9.1 External Air Quality

The developments total traffic emissions will be compared with the development benchmark to determine if acceptable whether the site could be classified as air quality neutral based on the proposed usage. The building will not generate any significant emissions; the proposed energy strategy comprises a heating strategy to be achieved through HVRF system with VRF units located on the roof.

Regarding BREEAM Pol01; mechanical cooling will be minimised using passive design features, as discussed earlier within this report. Having limited loads, the intention is to provide a high-efficiency on-floor air handling units with heat recovery heat exchangers to supply fresh air to ceiling-mounted fan coil units to further provide space heating, and cooling.

11.9.2 Maintaining Internal Air Quality

When considering air quality performance, it is important to consider mitigation of internal air quality impacts for the building occupants as well as the external air quality concerns raised in the policy documentation. The Proposed Development is designed to ensure that optimal indoor air quality is maintained for the building occupants and uses the best-practice methodologies set out in BREEAM and WELL to help establish this.

An indoor air quality plan (IAQP) will be developed at RIBA Stage 3, in accordance with the BREEAM Hea 02 methodology and WELL Air section and once the ventilation strategy reaches a well-defined stage of design development, to facilitate maintenance of good indoor air quality. The IAQP will define sources of indoor air pollutants and will establish mitigation and flush-out measures based on the specific ventilation design and construction practices for the development. The study will also set out a strategy for avoidance of deleterious and high-VOC internal fixings and finishes and propose a strategy for specification and determination of low-impact materials. This will be further underwritten by the engagement with BREEAM approaches to this subject, which provide supporting information and set targets for VOC and internal air pollutant compliance.

The primary focus of ambient air quality is limited to a small number of pollutants (NO2, PM10 and PM2.5), while for indoor air quality there are a far greater range of pollutants which need to be considered in addition to NO2, PM10 and PM2.5 including volatile organ compounds (VOCs) and CO. There are limited regulations and legislation on indoor air quality in new buildings other than the requirements in Part F of the building regulations regarding ventilation and workplace exposure limits for employers. It is recommended that an indoor air quality strategy is developed for the development which focuses on materials used in the development, ingress of pollutants from outdoor air, sources of pollutants indoors and recirculation of air within the building due to mechanical ventilation.

The Proposed Development's indoor air quality will be enhanced by:

- Mechanical ventilation system which ensures suitable air flow changes and where air is sourced from an external location, that it is located away from pollution emissions and most likely filtered to improve the air quality indoors in relation to outdoors.
- Forced ventilation/extraction in rooms or enclosed spaces where there are direct emission sources, like for example commercial kitchens.
- Consideration of pressure differentials in tall buildings with voids from ground level to the top of the building where air movement can pull in ground level pollution and 'suck' it up to the higher levels.
- Restrictions for smoking/vaping throughout the Proposed Development.
- Maintain damp or covered soil in all planting areas to minimise the potential for soil dust.
- Use of only necessary and appropriate pest control practices, and nonchemical methods where possible.
- Provision of regular cleaning of all areas used by bicycles, to minimise dirt and dust.

11.9.3 Noise Pollution

Acoustic consultants will be appointed to provide a Noise Impact Assessment as part of this application submission, to accord with the requirements for addressing, and mitigating external noise impacts of the new plant for the development.

A plant noise assessment has also been undertaken, and this study demonstrates that noise emissions from mechanical plant equipment are expected to comply with the requirements. A high-performance acoustic enclosure for the VRF units at the proposed roof location is proposed to mitigate noise pollution.

11.9.4 Light Pollution

Potential impacts of light pollution will be managed at the Proposed Development. The development team recognises that such pollution is not limited to localised light spill and has knock-on impacts on other sustainability features such as ecological enhancement, and therefore, needs to be considered in the round alongside those strategies.

Features from the BREEAM 2014 RFO 'Pol 04 – reduction of night-time light pollution' credit section will be used as a base method for limiting external light pollution, where relevant to the base build design. All external lighting will be designed in accordance with the Institute of Lighting Professionals (ILP) Guidance note for the reduction of obtrusive light, 2011, which sets standards to limit external light pollution from developments. The standard allows the development to meet the following key recommendations:

- Limit the average upward light ratio of luminaires to restrict sky glow.
- Limit illuminance at the windows of nearby properties for which light trespass may be an issue.
- Limit intensity of each light source in particularly obtrusive directions beyond the boundaries of the site.

Where relevant, the Proposed Development's lighting provision will create a safe and welcoming environment to terraces or external areas during hours of darkness at the same time set to limit external light pollution. External lighting will also be required to support the low-energy ethos of the development and will need to meet the performance requirements associated with external lighting set out in BREEAM 2014 RFO credits Hea 01, and Ene 03, specifically achieving a luminous efficacy of >60lm/W. Considerations of both light spill, and energy performance will be made in appreciation of one another at the Proposed Development.

11.10 Health, and Wellbeing

Air quality, and noise pollution are the greatest external environmental issues for the future occupants of the Proposed Development. As previously mentioned, the Proposed Development will be air quality neutral. The WELL Building Standard focus heavily on the air quality performance of the building, and by adopting its framework the following will be encouraged:

- Air quality sensors, and display implementation, where possible.
- Construction management practices to avoid contamination of ducts, and ventilation systems.
- Consideration of potential to increase ventilation rates for enhanced indoor air quality such as with the façade openings for natural ventilation.
- Healthy material pre-specification, and guidance for future tenant fit out, and cleaning practices.

Thermal comfort can be maximised through managing solar gains, integrating exposed concrete soffits coupled with openable windows for free cooling using night-time ventilation responding to the emerging policies on mitigating the risk of overheating from London Plan Policy SI 4. Further effects on physical health, and wellbeing of its occupants, and visitors can be seen in the public realm design, and proposals to reduce traffic prioritise pedestrians, and cyclist's arrival. Social well-being is encouraged by creating a central open space which is open to the public, and fosters encounters, and a mix of uses. Moreover, affordable workspace will be provided where collaborative working can be developed.

11.11 Adaptation to Climate Change

Ensuring that a development is adaptable to potential future variation of climate is a feature that feeds into most sections within this report and is ingrained within the project approach, and therefore this section does not need to be exhaustive in its list of measures that have been included in design, as they are captured elsewhere.

A formal risk assessment will be provided post-planning in accordance with the BREEAM 2014 RFO Wst 05 Climate Change Adaptability credit section, at the conclusion of RIBA Stage 2. This assessment will draw on the latest scientific research on UK climate change, including research and data from UKCCC and UKCP18, to set out the risks associated with future variations in temperature, flood risk, precipitation, drought, storm events and localised air pollution. The document will challenge the design team to consider the potential impacts of hazards and determine how these will be mitigated through robust and adaptable design. The RIBA 2 measures will be reviewed at RIBA 4 to ensure that the proposals have been implemented in final design ahead of construction.

Some key features and design measures have already been highlighted within this energy and sustainability application document. They can be summarised as follows:

Changes in temperature & solar radiation
Overheating studies & assessments.
BREEAM Hea04 thermal modelling for future weather scenario.
Potential to combat UHI effect through urban greening strategy.

Flood risk & drainage
FRA completed which shows development is at low risk of flooding.
SuDS calculations include 40% allowance for climate change.
Dual benefit SuDS proposed with runoff/greening benefits.

Localised air pollution
All-electric strategy with zero on-site NOx emissions.
Internal buildings services design facilitates good indoor air quality.

The document provided by the design team at the conclusion of RIBA 2 will set out all the proposed measures, with input from S&T, HTS and Sweco MEPH, who are required as part of the BREEAM process to provide feedback on this for completion of the mitigation strategy. It is important that these items are considered at the early project stages to facilitate early consideration of their potential impacts and ensure that the design has not progressed past the stage by which they can be feasibly implemented without significant redesign or cost uplift.

The Wst05 credit is targeted in BREEAM, as per the BREEAM pre-assessment trackers set out in **Appendix C**. Given the current performance of the design at pre-application stage, it is also expected that the development will be able to achieve the ‘exemplary’ credit associated with climate change adaptability, which is achieved by securing certain credits in other BREEAM sections that are believed to facilitate a climate-resilient design.

11.12 Biodiversity & Green Infrastructure

Enhancing site biodiversity and facilitating urban greening is one of the six core development strategies for the Proposed Development. The development team have acknowledged that focus on this area has wider benefits to the scheme beyond simply providing better habitats for wildlife, and also enhances the strategies related to surface water management, occupant health and wellbeing, and potentially helping to tackle an aspect of the Urban Heat Island (UHI) phenomenon. This section also links with key aspects of the LBC’s Local Plan such related to urban greening resilience and the part it has to play in the approach to combating climate change in Camden.

The Urban Greening Factor (UGF) is a recent addition within the London Plan Policy G5 – Urban Greening. The UGF model has been developed by the Mayor to assist boroughs and developers in determining the appropriate provision of urban greening for new development. A ‘factor’, between 0 and 1, is applied to various surface cover types as a simplified measure to account for the benefits provided by soils, vegetation, and water as a proxy of how their provision facilitates a range of positive interventions such as improved health, climate change adaptation and biodiversity conservation. Those surface cover types that contribute most positively to these goals have a contributing UGF closer to 1. At the other end of the spectrum, sealed impermeable surfaces have a contributing UGF of 0. The overall UGF is an area weighted average of planted and hardstanding areas.

London Plan Policy G5 requires commercial developments to achieve a UGF of 0.3, to demonstrate the positive contribution to urban greening, but also in appreciation of the fact that all already of the public realm be publicly accessible and provide good amenity spaces, which is not always conducive of large species-rich planted areas.

Please refer to the Stiff+Trevillion’s Design & Access Statement submitted with this application documentation for details on the approach to urban greening, ecological enhancement, and the latest Urban Greening Factor calculations.

The delivery of the urban greening strategy at the Proposed Development also serves to connect and contribute to other sustainability goals of the project, including those associated with surface water management and air pollution. The dual benefit of urban greening and managing surface water runoff is well documented, and ‘mimicking nature’ by utilising green surfaces and soil moisture storage capacities is one of the core principles of SuDS management and integration. Project team liaison with the SQE have included discussions regarding the use of green infrastructure within surface water management and where this can be feasibly implemented within the public realm. Designs are to be finalised in due course.

Provision of urban greening is also understood to have positive health and wellbeing benefits for building occupants. Enhancing biophilic design is a cornerstone of the WELL Building Standard approach, and the mental & physical health benefits of providing outdoor space with greenery and interactive environments for building occupants is well understood. Some of the measures that facilitate this are set out in Section 11.11 (Health & Wellbeing).

The BREEAM 2014 RFO scheme also has an ecology framework, which better supports positive ecological outcomes. The Proposed Development is targeting a significant number of credits in the BREEAM 2014 RFO Ecology section, as set out in the pre-assessment tracker in **Appendix C**.

11.13 Sustainable Transport

The Transport Statement completed by Momentum details the transport implications and strategies within the Proposed Development.

The proposals support the principles of TfL’s Healthy Streets Approach and those of the Mayor’s Transport Strategy, including Vision Zero. They aim to create a safe and attractive new workplace and venue at a highly accessible location in Camden. The Site’s design has centred around making a place in which people feel relaxed and safe, with places to stop and rest and things to see and do.

The Travel Plan sets out a package of sustainable transport measures to be incorporated into the design and verified prior to the project Handover.

The BREEAM 2014 RFO Tra01-05 requirements have guided the sustainable transport measures on site. Therefore, all credits have been targeted for Tra01 to Tra05.

Key policy references for this section:

Local Plan 2017 Policy T1, Policy T2, Policy T3, Policy T4

11.14 Construction

Sustainability and environmental considerations must also be managed throughout construction of the development if the intent within this application document is to be upheld.

A Site Waste Management Plan will be required as part of the BREEAM strategy. This will set out waste management targets to include:

- Non-hazardous waste materials including demolition and excavation waste;
- Accurate data records on waste arising and waste management routes;
- The principal contractor will be required to hold an Environmental Management Scheme such as ISO 14001 and comply with the best practice pollution prevention guidelines PPG6.

During construction, the principal contractor will also have to uphold the construction management credits associated with BREEAM 2014 RFO, which include monitoring of site water use, energy use, waste production and material deliveries to and from the site, and actions in many of the key categories noted above.

SWECO

12 Conclusions

This report has been prepared on behalf of Capital 38 Limited (the "Applicant") to support a planning application for the proposed development at **21 Bloomsbury Street** (the "Proposed Development"). The Proposed Development comprises refurbished building in the London Borough of Camden.

Following the energy and carbon evaluation, it is proposed that extensive energy efficiency measures along with low, and zero carbon (LZC) strategies are incorporated into the design for the Proposed Development. Section 11 of this Sustainability Statement provides details of the sustainability strategy for the Proposed Development. As demonstrated in detail in this assessment, energy, and carbon emissions calculations have confirmed that the proposed energy efficiency design, and LZC applications will achieve:

As demonstrated in detail in this assessment, energy and carbon emissions calculations have confirmed that the proposed energy efficiency design and LZC applications will achieve:

- **Regulated carbon dioxide savings of 2% relative to a New-Build Part L 2021 at Be Green stage and 36% at Be Lean stage, using SAP 10.2 carbon factors;**
- **BREEAM UK Refurbishment and Fit-out 2014 targeting "Excellent" for office areas with aspiration for "Outstanding";**
- **WELL Standard v2 'Core' targeting "Gold" with an approach to pre-certificate and certify the building at a later stage;**
- **All-electrical development by removing the gas-fired boilers and CHP onsite to eliminate the NOx emissions and improve the air quality, which have a great potential to be true net zero carbon development;**
- **The Energy Unit Intensity and space heating demand, calculated used the CIBSE TM54 methodology, are 75.99 kWh/m^2/year and 10.58 kWh/m^2/year respectively;**
- **Life Cycle Analysis (LCA) using the RICS published standards to assess the embodied carbon impact and inform the early stage building design.**

In support of the above key sustainability metrics and overall project approach, several core sustainability 'themes' have been established for the Proposed Development, around which a set of targets and methodological requirements have been set. These themes are those that are expected to drive sustainable development in Camden. Section 11 of this report expands on the processes and implementation of measures to support the successful realisation of these aims at pre-application stage, and the methods by which they will be supported and implemented through the latter stages of design, into construction and eventual operation.

Certification

Target a minimum of BREEAM UK Non-domestic Refurbishment and Fit-Out 2014 to achieve 'Excellent' (≥70%).
Target WELL Standard v2 'Core' – 'Gold' and follow the pre-certification process.

Operational Energy & Carbon Emissions

Target a minimum of 35% emissions reduction vs. Part L (SAP 10.2 carbon factors).
Undertake a Design for Performance (DfP) process, establishing a target NABERS star rating.
Define an Energy Use Intensity (EUI) target in line with UKGBC guidance.

Embodied Carbon

Undertake full whole life carbon analysis for the Proposed Development, delivered to the RICS Professional Statement methodology.
Target an embodied carbon intensity of <970 $kgCO_2e$/m2 GIA, covering EN 15978:2011 Modules A-C (whole life embodied carbon).
Integrate Circular Economy principles into the WLC approach.

Managing Water Resources

Target a 40% reduction in potable water consumption against the BREEAM 2014 RFO Wat01 baseline performance.
Consider the integration of Sustainable Drainage Solutions (SuDS).

Managing Waste

Engage with a 'whole life waste approach, and Circular Design principles.
Target a minimum 90% diversion rate from landfill for non-hazardous construction, and demolition waste.

Appendix A – Part L BRUKL Reports

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

21 Bloomsbury Existing

As built

Date: Tue Jul 12 11:56:12 2022

Administrative information

Building Details

Address: 21 Bloomsbury Street, London, WC1B 3HF

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.15

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.15

BRUKL compliance check version: v6.1.b.0

Certifier details

Name: Kartik Amrania

Telephone number: 44(0)1628623423

Address: Sweco UK, 1 Bath Road, Maidenhead, SL6 4AQ

Foundation area [m²]: 1391.67

The CO_2 emission and primary energy rates of the building must not exceed the targets

The building does not comply with England Building Regulations Part L 2021

Target CO_2 emission rate (TER), $kgCO_2/m^2.annum$	3.03	
Building CO_2 emission rate (BER), $kgCO_2/m^2.annum$	6.45	
Target primary energy rate (TPER), $kWh/m^2.annum$	32.9	
Building primary energy rate (BPER), $kWh/m^2.annum$	70.64	
Do the building's emission and primary energy rates exceed the targets?	BER > TER	BPER > TPER

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

Fabric element	$U_{a\text{-}Limit}$	$U_{a\text{-}Calc}$	$U_{i\text{-}Calc}$	First surface with maximum value
Walls*	0.26	0.45	0.45	LG000005:Surf[2]
Floors	0.18	0.25	0.25	LG000000:Surf[0]
Pitched roofs	0.16	-	-	No Pitched roofs in building
Flat roofs	0.18	0.18	0.18	LG000006:Surf[1]
Windows** and roof windows	1.6	1.41	1.41	LG000009:Surf[1]
Rooflights***	2.2	-	-	No roof lights in building
Personnel doors^	1.6	3	3	LG000005:Surf[1]
Vehicle access & similar large doors	1.3	-	-	No Vehicle access doors in building
High usage entrance doors	3	-	-	No High usage entrance doors in building

$U_{a\text{-}Limit}$ = Limiting area-weighted average U-values [W/(m²K)]

$U_{a\text{-}Calc}$ = Calculated area-weighted average U-values [W/(m²K)]

$U_{i\text{-}Calc}$ = Calculated maximum individual element U-values [W/(m²K)]

* Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

** Display windows and similar glazing are excluded from the U-value check.

*** Values for rooflights refer to the horizontal position.

^ For fire doors, limiting U-value is 1.8 W/m²K

N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air permeability	Limiting standard	This building
m³/(h.m²) at 50 Pa	8	3

Building services

For details on the standard values listed below, system-specific guidance, and additional regulatory requirements, refer to the Approved Documents.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	>0.95

1- WC/Shower heating only

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	0.2	-	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

2- circ_heating only_nat vent

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	0.2	-	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

3- Office_FCU_boiler_air cooled chiller

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	2.64	2.6	0	2	0.7
Standard value	2.5*	4.5**	N/A	2^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.

** Standard shown is for air-cooled chillers >=400 kW. For chillers <400 kW, limiting SEER is 4.

^ Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.

"No HWS in project, or hot water is provided by HVAC system"

Zone-level mechanical ventilation, exhaust, and terminal units

ID	System type in the Approved Documents
A	Local supply or extract ventilation units
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal balanced supply and extract ventilation system
E	Local balanced supply and extract ventilation units
F	Other local ventilation units
G	Fan assisted terminal variable air volume units
H	Fan coil units
I	Kitchen extract with the fan remote from the zone and a grease filter

NB: Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	**Zone**	**Standard**
LG00_OFFICE _INT	-	-	-	-	-	-	-	0.5	-	-	N/A
LG00_OFFICE_EXT_NW 1	-	-	-	-	-	-	-	0.5	-	-	N/A
LG00_OFFICE_EXT_NW 2	-	-	-	-	-	-	-	0.5	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	**Zone**	**Standard**
LG00_OFFICE_EXT_NE 1	-	-	-	-	-	-	-	0.5	-	-	N/A
LG00_OFFICE_EXT_NW 3	-	-	-	-	-	-	-	0.5	-	-	N/A
LG00_OFFICE_EXT_N 1	-	-	-	-	-	-	-	0.5	-	-	N/A
L00_OFFICE_Peri_NW	-	-	-	-	-	-	-	0.5	-	-	N/A
L00_OFFICE_Peri_N	-	-	-	-	-	-	-	0.5	-	-	N/A
L00_OFFICE_Peri_NE 1	-	-	-	-	-	-	-	0.5	-	-	N/A
L00_OFFICE_Peri_NE 2	-	-	-	-	-	-	-	0.5	-	-	N/A
L00_OFFICE_Peri_NE 3	-	-	-	-	-	-	-	0.5	-	-	N/A
L00_OFFICE_INT	-	-	-	-	-	-	-	0.5	-	-	N/A
L01_OFFICE_Peri_NW 1	-	-	-	-	-	-	-	0.5	-	-	N/A
L01_OFFICE_Peri_NW 2	-	-	-	-	-	-	-	0.5	-	-	N/A
L01_OFFICE_Peri_NW 3	-	-	-	-	-	-	-	0.5	-	-	N/A
L01_OFFICE_Peri_N	-	-	-	-	-	-	-	0.5	-	-	N/A
L01_OFFICE_Peri_NE	-	-	-	-	-	-	-	0.5	-	-	N/A
L01_OFFICE_INT	-	-	-	-	-	-	-	0.5	-	-	N/A
L01_OFFICE_Peri_S	-	-	-	-	-	-	-	0.5	-	-	N/A
L01_OFFICE_Peri_SE	-	-	-	-	-	-	-	0.5	-	-	N/A
L01_OFFICE_Peri_SW	-	-	-	-	-	-	-	0.5	-	-	N/A
L02_OFFICE_Peri_NW	-	-	-	-	-	-	-	0.5	-	-	N/A
L02_OFFICE_Peri_N	-	-	-	-	-	-	-	0.5	-	-	N/A
L02_OFFICE_Peri_NE	-	-	-	-	-	-	-	0.5	-	-	N/A
L02_OFFICE_Peri_S	-	-	-	-	-	-	-	0.5	-	-	N/A
L02_OFFICE_Peri_SW	-	-	-	-	-	-	-	0.5	-	-	N/A
L02_OFFICE_INT	-	-	-	-	-	-	-	0.5	-	-	N/A
L02_OFFICE_Peri_SE	-	-	-	-	-	-	-	0.5	-	-	N/A
L03_OFFICE_Peri_NW	-	-	-	-	-	-	-	0.5	-	-	N/A
L03_OFFICE_Peri_N	-	-	-	-	-	-	-	0.5	-	-	N/A
L03_OFFICE_Peri_NE	-	-	-	-	-	-	-	0.5	-	-	N/A
L03_OFFICE_Peri_S	-	-	-	-	-	-	-	0.5	-	-	N/A
L03_OFFICE_Peri_SW	-	-	-	-	-	-	-	0.5	-	-	N/A
L03_OFFICE_INT	-	-	-	-	-	-	-	0.5	-	-	N/A
L04_OFFICE_Peri_NW	-	-	-	-	-	-	-	0.5	-	-	N/A
L04_OFFICE_Peri_NE	-	-	-	-	-	-	-	0.5	-	-	N/A
L04_OFFICE_Peri_S	-	-	-	-	-	-	-	0.5	-	-	N/A
L04_OFFICE_Peri_SW	-	-	-	-	-	-	-	0.5	-	-	N/A
L04_OFFICE_INT	-	-	-	-	-	-	-	0.5	-	-	N/A
L05_OFFICE_Peri_NW 1	-	-	-	-	-	-	-	0.5	-	-	N/A
L05_OFFICE_Peri_NW 2	-	-	-	-	-	-	-	0.5	-	-	N/A
L05_OFFICE_Peri_NW 3	-	-	-	-	-	-	-	0.5	-	-	N/A
L05_OFFICE_Peri_NE	-	-	-	-	-	-	-	0.5	-	-	N/A
L05_OFFICE_Peri_S	-	-	-	-	-	-	-	0.5	-	-	N/A
L05_OFFICE_Peri_SW	-	-	-	-	-	-	-	0.5	-	-	N/A
L05_OFFICE_INT	-	-	-	-	-	-	-	0.5	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	Zone	Standard
L02_Office_Peri_SE	-	-	-	-	-	-	-	0.5	-	-	N/A
L03_OFFICE_Peri_SE	-	-	-	-	-	-	-	0.5	-	-	N/A
L04_OFFICE_Peri_SE	-	-	-	-	-	-	-	0.5	-	-	N/A
L05_OFFICE_Peri_SE	-	-	-	-	-	-	-	0.5	-	-	N/A

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
LG00_WC	51	-	-
LG00_SHOWER	51	-	-
LG00_STORE	51	-	-
LG00_STAIRS	51	-	-
LG00_CIRC	51	-	-
LG00_PARKING	51	-	-
LG00_PLANT ROOM	51	-	-
LG00_OFFICE _INT	39	-	-
LG00_OFFICE_EXT_NW 1	40	-	-
LG00_OFFICE_EXT_NW 2	39	-	-
LG00_OFFICE_EXT_NE 1	40	-	-
LG00_OFFICE_EXT_NW 3	39	-	-
LG00_OFFICE_EXT_N 1	40	-	-
LG00_UKPN SUBSTATION	51	-	-
LG00_SWITCH ROOM	51	-	-
LG00_CIRC	51	-	-
LG00_CIRC	51	-	-
LG00_WC	51	-	-
LG00_WASTE COLLECTION	51	-	-
LG00_ATRIUM LOUNGE	51	15	9
L00_OFFICE_Peri_NW	40	-	-
L00_OFFICE_Peri_N	41	-	-
L00_OFFICE_Peri_NE 1	39	-	-
L00_OFFICE_Peri_NE 2	39	-	-
L00_OFFICE_Peri_NE 3	41	-	-
L00_STAIRS 1	51	-	-
L00_STAIRS 2	51	-	-
L00_CIRC	51	-	-
L00_CIRC	51	-	-
L00_CIRC	51	-	-
L00_CIRC	51	-	-
L00_WC	51	-	-
L00_WC	51	-	-
L00_OFFICE_INT	39	-	-
L00_ATRIUM	51	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
L00_WASTE COLLECTION	51	-	-
L01_OFFICE_Peri_NW 1	40	-	-
L01_OFFICE_Peri_NW 2	39	-	-
L01_OFFICE_Peri_NW 3	39	-	-
L01_OFFICE_Peri_N	40	-	-
L01_OFFICE_Peri_NE	39	-	-
L01_OFFICE_INT	39	-	-
L01_OFFICE_Peri_S	39	-	-
L01_OFFICE_Peri_SE	40	-	-
L01_OFFICE_Peri_SW	39	-	-
L01_STAIRS 1	51	-	-
L01_CIRC	51	-	-
L01_WC	51	-	-
L01_CIRC	51	-	-
L01_STAIRS 2	51	-	-
L01_WC	51	-	-
L02_OFFICE_Peri_NW	39	-	-
L02_OFFICE_Peri_N	40	-	-
L02_OFFICE_Peri_NE	39	-	-
L02_OFFICE_Peri_S	40	-	-
L02_OFFICE_Peri_SW	39	-	-
L02_OFFICE_INT	39	-	-
L02_ATRIUM	51	-	-
L02_STAIRS 1	51	-	-
L02_CIRC	51	-	-
L02_WC	51	-	-
L02_WC	51	-	-
L02_STAIRS 2	51	-	-
L02_CIRC	51	-	-
L02_OFFICE_Peri_SE	40	-	-
L03_ATRIUM	51	-	-
L03_STAIRS 1	51	-	-
L03_CIRC	51	-	-
L03_WC	51	-	-
L03_WC	51	-	-
L03_CIRC	51	-	-
L03_STAIRS 2	51	-	-
L03_CIRC	51	-	-
L03_OFFICE_Peri_NW	39	-	-
L03_OFFICE_Peri_N	40	-	-
L03_OFFICE_Peri_NE	39	-	-
L03_OFFICE_Peri_S	41	-	-
L03_OFFICE_Peri_SW	39	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
L03_OFFICE_INT	39	-	-
L03_CIRC	51	-	-
L03_CIRC	51	-	-
L04_OFFICE_Peri_NW	39	-	-
L04_OFFICE_Peri_NE	39	-	-
L04_OFFICE_Peri_S	41	-	-
L04_OFFICE_Peri_SW	39	-	-
L04_OFFICE_INT	39	-	-
L04_ATRIUM	51	-	-
L04_CIRC	51	-	-
L04_CIRC	51	-	-
L04_WC	51	-	-
L04_WC	51	-	-
L04_STAIRS 2	51	-	-
L04_CIRC	51	-	-
L04_CIRC	51	-	-
L04_CIRC	51	-	-
L05_OFFICE_Peri_NW 1	40	-	-
L05_OFFICE_Peri_NW 2	39	-	-
L05_OFFICE_Peri_NW 3	40	-	-
L05_OFFICE_Peri_NE	39	-	-
L05_OFFICE_Peri_S	42	-	-
L05_OFFICE_Peri_SW	39	-	-
L05_OFFICE_INT	39	-	-
L05_STAIRS 1	51	-	-
L05_CIRC	51	-	-
L05_WC	51	-	-
L05_WC	51	-	-
L05_CIRC	51	-	-
L05_ATRIUM	51	-	-
L05_STAIRS 2	51	-	-
L05_CIRC	51	-	-
L05_WC	51	-	-
L05_CIRC	51	-	-
L05_CIRC	51	-	-
L01_ATRIUM	51	-	-
L02_Office_Peri_SE	44	-	-
L02_CIRC	51	-	-
L03_OFFICE_Peri_SE	40	-	-
L04_OFFICE_Peri_SE	40	-	-
L05_OFFICE_Peri_SE	42	-	-

The spaces in the building should have appropriate passive control measures to limit solar gains in summer

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
LG00_OFFICE _INT	NO (-98.3%)	NO
LG00_OFFICE_EXT_NW 1	NO (-76.5%)	NO
LG00_OFFICE_EXT_NW 2	NO (-83.4%)	NO
LG00_OFFICE_EXT_NE 1	NO (-82.7%)	NO
LG00_OFFICE_EXT_NW 3	NO (-81.6%)	NO
LG00_OFFICE_EXT_N 1	NO (-88.6%)	NO
LG00_ATRIUM LOUNGE	N/A	N/A
L00_OFFICE_Peri_NW	NO (-79.8%)	NO
L00_OFFICE_Peri_N	NO (-86.3%)	NO
L00_OFFICE_Peri_NE 1	NO (-82.9%)	NO
L00_OFFICE_Peri_NE 2	NO (-66.2%)	NO
L00_OFFICE_Peri_NE 3	NO (-85.2%)	NO
L00_OFFICE_INT	NO (-76.1%)	NO
L01_OFFICE_Peri_NW 1	NO (-76.6%)	NO
L01_OFFICE_Peri_NW 2	NO (-79.9%)	NO
L01_OFFICE_Peri_NW 3	NO (-79.5%)	NO
L01_OFFICE_Peri_N	NO (-79.2%)	NO
L01_OFFICE_Peri_NE	NO (-76.8%)	NO
L01_OFFICE_INT	NO (-97.4%)	NO
L01_OFFICE_Peri_S	NO (-77.8%)	NO
L01_OFFICE_Peri_SE	NO (-83%)	NO
L01_OFFICE_Peri_SW	NO (-94.6%)	NO
L02_OFFICE_Peri_NW	NO (-73.1%)	NO
L02_OFFICE_Peri_N	NO (-75.8%)	NO
L02_OFFICE_Peri_NE	NO (-71.6%)	NO
L02_OFFICE_Peri_S	NO (-81.9%)	NO
L02_OFFICE_Peri_SW	NO (-93.9%)	NO
L02_OFFICE_INT	NO (-96.7%)	NO
L02_OFFICE_Peri_SE	NO (-64%)	NO
L03_OFFICE_Peri_NW	NO (-72.1%)	NO
L03_OFFICE_Peri_N	NO (-76.5%)	NO
L03_OFFICE_Peri_NE	NO (-65.9%)	NO
L03_OFFICE_Peri_S	NO (-76.5%)	NO
L03_OFFICE_Peri_SW	NO (-92.2%)	NO
L03_OFFICE_INT	NO (-96.2%)	NO
L04_OFFICE_Peri_NW	NO (-69.7%)	NO
L04_OFFICE_Peri_NE	NO (-68.4%)	NO
L04_OFFICE_Peri_S	NO (-73.2%)	NO
L04_OFFICE_Peri_SW	NO (-90.7%)	NO
L04_OFFICE_INT	NO (-95.7%)	NO
L05_OFFICE_Peri_NW 1	NO (-81.9%)	NO
L05_OFFICE_Peri_NW 2	NO (-77.9%)	NO
L05_OFFICE_Peri_NW 3	NO (-85.1%)	NO
L05_OFFICE_Peri_NE	NO (-80.4%)	NO

Zone	Solar gain limit exceeded? (%)	Internal blinds used?
L05_OFFICE_Peri_S	NO (-70.3%)	NO
L05_OFFICE_Peri_SW	NO (-89.6%)	NO
L05_OFFICE_INT	NO (-96.7%)	NO
L02_Office_Peri_SE	NO (-81.2%)	NO
L03_OFFICE_Peri_SE	NO (-58.6%)	NO
L04_OFFICE_Peri_SE	NO (-52.7%)	NO
L05_OFFICE_Peri_SE	NO (-45.6%)	NO

Regulation 25A: Consideration of high efficiency alternative energy systems

Were alternative energy systems considered and analysed as part of the design process?	NO
Is evidence of such assessment available as a separate submission?	NO
Are any such measures included in the proposed design?	NO

Technical Data Sheet (Actual vs. Notional Building)

Building Global Parameters

	Actual	Notional
Floor area [m²]	10590.4	10590.4
External area [m²]	8166.4	8166.4
Weather	LON	LON
Infiltration [m³/hm²@ 50Pa]	3	3
Average conductance [W/K]	3326.32	2862.66
Average U-value [W/m²K]	0.41	0.35
Alpha value* [%]	25.11	10

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

Building Use

% Area	Building Type
	Retail/Financial and Professional Services
	Restaurants and Cafes/Drinking Establishments/Takeaways
100	**Offices and Workshop Businesses**
	General Industrial and Special Industrial Groups
	Storage or Distribution
	Hotels
	Residential Institutions: Hospitals and Care Homes
	Residential Institutions: Residential Schools
	Residential Institutions: Universities and Colleges
	Secure Residential Institutions
	Residential Spaces
	Non-residential Institutions: Community/Day Centre
	Non-residential Institutions: Libraries, Museums, and Galleries
	Non-residential Institutions: Education
	Non-residential Institutions: Primary Health Care Building
	Non-residential Institutions: Crown and County Courts
	General Assembly and Leisure, Night Clubs, and Theatres
	Others: Passenger Terminals
	Others: Emergency Services
	Others: Miscellaneous 24hr Activities
	Others: Car Parks 24 hrs
	Others: Stand Alone Utility Block

Energy Consumption by End Use [kWh/m²]

	Actual	Notional
Heating	4.18	2.86
Cooling	6.99	3.08
Auxiliary	12.15	6.59
Lighting	20.13	9.23
Hot water	4.56	2.36
Equipment*	35.15	35.15
TOTAL**	**48**	**24.13**

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

Energy Production by Technology [kWh/m²]

	Actual	Notional
Photovoltaic systems	0	1.82
Wind turbines	0	0
CHP generators	0	0
Solar thermal systems	0	0
Displaced electricity	*0*	*1.82*

Energy & CO_2 Emissions Summary

	Actual	Notional
Heating + cooling demand [MJ/m²]	72.87	69.28
Primary energy [kWh/m²]	70.64	32.9
Total emissions [kg/m²]	6.45	3.03

HVAC Systems Performance

System Type	Heat dem MJ/m2	Cool dem MJ/m2	Heat con kWh/m2	Cool con kWh/m2	Aux con kWh/m2	Heat SSEEF	Cool SSEER	Heat gen SEFF	Cool gen SEER
[ST] Fan coil systems, [HS] ASHP, [HFT] Electricity, [CFT] Electricity									
Actual	18.3	72.7	2	10	16.8	2.5	2.02	2.64	2.6
Notional	9.7	73.6	1	4.4	9.1	2.78	4.63	----	----
[ST] Central heating using water: radiators, [HS] Direct or storage electric heater, [HFT] Electricity, [CFT] Electricity									
Actual	45.6	0	13.5	0	2	0.94	0	1	0
Notional	44.9	0	8.8	0	1	1.41	0	----	----
[ST] Central heating using water: radiators, [HS] Direct or storage electric heater, [HFT] Electricity, [CFT] Electricity									
Actual	63.5	0	18.8	0	2	0.94	0	1	0
Notional	49.6	0	9.8	0	1.2	1.41	0	----	----
[ST] No Heating or Cooling									
Actual	0	0	0	0	0	0	0	0	0
Notional	0	0	0	0	0	0	0	----	----

Key to terms

Heat dem [MJ/m2]	= Heating energy demand
Cool dem [MJ/m2]	= Cooling energy demand
Heat con [kWh/m2]	= Heating energy consumption
Cool con [kWh/m2]	= Cooling energy consumption
Aux con [kWh/m2]	= Auxiliary energy consumption
Heat SSEFF	= Heating system seasonal efficiency (for notional building, value depends on activity glazing class)
Cool SSEER	= Cooling system seasonal energy efficiency ratio
Heat gen SSEFF	= Heating generator seasonal efficiency
Cool gen SSEER	= Cooling generator seasonal energy efficiency ratio
ST	= System type
HS	= Heat source
HFT	= Heating fuel type
CFT	= Cooling fuel type

BRUKL Output Document

HM Government

Compliance with England Building Regulations Part L 2021

Project name

21 Bloomsbury Street Lean

As designed

Date: Tue Jul 12 10:08:23 2022

Administrative information

Building Details

Address: 21 Bloomsbury Street, London, WC1B 3HF

Certification tool

Calculation engine: Apache

Calculation engine version: 7.0.15

Interface to calculation engine: IES Virtual Environment

Interface to calculation engine version: 7.0.15

BRUKL compliance check version: v6.1.b.0

Certifier details

Name: Kartik Amrania

Telephone number: 44(0)1628623423

Address: Sweco UK, 1 Bath Road, Maidenhead, SL6 4AQ

Foundation area [m²]: 1006.64

The CO_2 emission and primary energy rates of the building must not exceed the targets

The building does not comply with England Building Regulations Part L 2021

Target CO_2 emission rate (TER), $kgCO_2/m^2$annum	3.86	
Building CO_2 emission rate (BER), $kgCO_2/m^2$annum	3.96	
Target primary energy rate (TPER), kWh/m^2annum	42.08	
Building primary energy rate (BPER), kWh/m^2annum	43.24	
Do the building's emission and primary energy rates exceed the targets?	BER > TER	BPER > TPER

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

Fabric element	$U_{a-Limit}$	U_{a-Calc}	U_{i-Calc}	First surface with maximum value
Walls*	0.26	0.25	0.26	LG000005:Surf[3]
Floors	0.18	0.2	0.2	LG000005:Surf[0]
Pitched roofs	0.16	-	-	No Pitched roofs in building
Flat roofs	0.18	0.22	0.35	LG000007:Surf[1]
Windows** and roof windows	1.6	1.4	1.4	00000004:Surf[0]
Rooflights***	2.2	1.81	1.81	0600000B:Surf[0]
Personnel doors^	1.6	1.3	1.3	LG000005:Surf[2]
Vehicle access & similar large doors	1.3	-	-	No Vehicle access doors in building
High usage entrance doors	3	-	-	No High usage entrance doors in building

$U_{a-Limit}$ = Limiting area-weighted average U-values [W/(m²K)]

U_{a-Calc} = Calculated area-weighted average U-values [W/(m²K)]

U_{i-Calc} = Calculated maximum individual element U-values [W/(m²K)]

* Automatic U-value check by the tool does not apply to curtain walls whose limiting standard is similar to that for windows.

** Display windows and similar glazing are excluded from the U-value check.

*** Values for rooflights refer to the horizontal position.

^ For fire doors, limiting U-value is 1.8 W/m²K

N.B.: Neither roof ventilators (inc. smoke vents) nor swimming pool basins are modelled or checked against the limiting standards by the tool.

Air permeability	Limiting standard	This building
$m^3/(h.m^2)$ at 50 Pa	8	3

Building services

For details on the standard values listed below, system-specific guidance, and additional regulatory requirements, refer to the Approved Documents.

Whole building lighting automatic monitoring & targeting with alarms for out-of-range values	YES
Whole building electric power factor achieved by power factor correction	>0.95

1- WC HRU_electric heater

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	0.2	-	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

2- Circ heating only

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	0.2	-	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

3- Office L00-L05 FCU_VRF_AHU

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	2.64	7.63	0	1.65	0.83
Standard value	2.5*	N/A	N/A	2^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.

^ Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.

4- Gym/Cafe FCU_VRF_HRU

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	2.64	7.63	0	1.6	0.8
Standard value	2.5*	N/A	N/A	2^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.

^ Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.

5- Office LG & L06 FCU_VRF_AHU

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	2.64	7.63	0	2.08	0.82
Standard value	2.5*	N/A	N/A	2^	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

* Standard shown is for all types >12 kW output, except absorption and gas engine heat pumps.

^ Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.

6- Shower HRU_electric heater

	Heating efficiency	Cooling efficiency	Radiant efficiency	SFP [W/(l/s)]	HR efficiency
This system	1	-	0.2	-	-
Standard value	N/A	N/A	N/A	N/A	N/A
Automatic monitoring & targeting with alarms for out-of-range values for this HVAC system					YES

"No HWS in project, or hot water is provided by HVAC system"

Zone-level mechanical ventilation, exhaust, and terminal units

ID	System type in the Approved Documents
A	Local supply or extract ventilation units
B	Zonal supply system where the fan is remote from the zone
C	Zonal extract system where the fan is remote from the zone
D	Zonal balanced supply and extract ventilation system
E	Local balanced supply and extract ventilation units
F	Other local ventilation units
G	Fan assisted terminal variable air volume units
H	Fan coil units
I	Kitchen extract with the fan remote from the zone and a grease filter
NB: Limiting SFP may be increased by the amounts specified in the Approved Documents if the installation includes particular components.	

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	Zone	Standard
LG_wc2	-	-	0.5	-	-	-	-	-	-	-	N/A
LG_wc1	-	-	0.5	-	-	-	-	-	-	-	N/A
LG_wc3	-	-	0.5	-	-	-	-	-	-	-	N/A
LG_Atrium-Lounge	-	-	-	-	-	-	-	0.2	-	-	N/A
LG_Cafe	-	-	-	-	-	-	-	0.2	-	-	N/A
00_wc3	-	-	0.5	-	-	-	-	-	-	-	N/A
00_Office peri S	-	-	-	-	-	-	-	0.2	-	-	N/A
00_Office peri SE	-	-	-	-	-	-	-	0.2	-	-	N/A
01_wc1	-	-	0.5	-	-	-	-	-	-	-	N/A
01_wc2	-	-	0.5	-	-	-	-	-	-	-	N/A
04_wc1	-	-	0.5	-	-	-	-	-	-	-	N/A
04_wc2	-	-	0.5	-	-	-	-	-	-	-	N/A
05_wc1	-	-	0.5	-	-	-	-	-	-	-	N/A
05_wc2	-	-	0.5	-	-	-	-	-	-	-	N/A
06_wc1	-	-	0.5	-	-	-	-	-	-	-	N/A
06_wc2	-	-	0.5	-	-	-	-	-	-	-	N/A
06_Office peri SE	-	-	-	-	-	-	-	0.2	-	-	N/A
07_Amenity	-	-	-	-	-	-	-	0.2	-	-	N/A
00_wc1	-	-	0.5	-	-	-	-	-	-	-	N/A
LG_Office peri NE	-	-	-	-	-	-	-	0.2	-	-	N/A
LG_Office corner N	-	-	-	-	-	-	-	0.2	-	-	N/A
00_Reception peri NE	-	-	-	-	-	-	-	0.2	-	-	N/A
00_Reception int	-	-	-	-	-	-	-	0.2	-	-	N/A
00_Office int	-	-	-	-	-	-	-	0.2	-	-	N/A
00_Office peri NE	-	-	-	-	-	-	-	0.2	-	-	N/A
00_Office peri NW1	-	-	-	-	-	-	-	0.2	-	-	N/A
00_Office corner N	-	-	-	-	-	-	-	0.2	-	-	N/A
01_Office peri S	-	-	-	-	-	-	-	0.2	-	-	N/A
01_Office peri SE	-	-	-	-	-	-	-	0.2	-	-	N/A
01_Office peri SW	-	-	-	-	-	-	-	0.2	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	**Zone**	**Standard**
01_Office int2	-	-	-	-	-	-	-	0.2	-	-	N/A
01_Office peri NE	-	-	-	-	-	-	-	0.2	-	-	N/A
01_Office corner N	-	-	-	-	-	-	-	0.2	-	-	N/A
02_wc1	-	-	0.5	-	-	-	-	-	-	-	N/A
02_wc2	-	-	0.5	-	-	-	-	-	-	-	N/A
02_Office int1	-	-	-	-	-	-	-	0.2	-	-	N/A
02_Office peri NW1	-	-	-	-	-	-	-	0.2	-	-	N/A
02_Office peri NE	-	-	-	-	-	-	-	0.2	-	-	N/A
02_Office corner N	-	-	-	-	-	-	-	0.2	-	-	N/A
02_Office peri SE2	-	-	-	-	-	-	-	0.2	-	-	N/A
02_Office peri SW	-	-	-	-	-	-	-	0.2	-	-	N/A
02_Office int2	-	-	-	-	-	-	-	0.2	-	-	N/A
02_Office peri SE1	-	-	-	-	-	-	-	0.2	-	-	N/A
02_Office peri S	-	-	-	-	-	-	-	0.2	-	-	N/A
03_wc1	-	-	0.5	-	-	-	-	-	-	-	N/A
03_wc2	-	-	0.5	-	-	-	-	-	-	-	N/A
03_Office int1	-	-	-	-	-	-	-	0.2	-	-	N/A
03_Office peri NW1	-	-	-	-	-	-	-	0.2	-	-	N/A
03_Office peri NE	-	-	-	-	-	-	-	0.2	-	-	N/A
03_Office corner N	-	-	-	-	-	-	-	0.2	-	-	N/A
03_Office peri SE2	-	-	-	-	-	-	-	0.2	-	-	N/A
03_Office peri SW	-	-	-	-	-	-	-	0.2	-	-	N/A
03_Office int2	-	-	-	-	-	-	-	0.2	-	-	N/A
03_Office peri SE1	-	-	-	-	-	-	-	0.2	-	-	N/A
03_Office peri S	-	-	-	-	-	-	-	0.2	-	-	N/A
04_Office peri SE2	-	-	-	-	-	-	-	0.2	-	-	N/A
04_Office peri SW	-	-	-	-	-	-	-	0.2	-	-	N/A
04_Office int2	-	-	-	-	-	-	-	0.2	-	-	N/A
04_Office peri SE1	-	-	-	-	-	-	-	0.2	-	-	N/A
04_Office peri S	-	-	-	-	-	-	-	0.2	-	-	N/A
05_Office peri SE2	-	-	-	-	-	-	-	0.2	-	-	N/A
05_Office peri SW	-	-	-	-	-	-	-	0.2	-	-	N/A
05_Office int2	-	-	-	-	-	-	-	0.2	-	-	N/A
05_Office peri SE1	-	-	-	-	-	-	-	0.2	-	-	N/A
05_Office peri S	-	-	-	-	-	-	-	0.2	-	-	N/A
05_Office peri NW1	-	-	-	-	-	-	-	0.2	-	-	N/A
05_Office peri NE	-	-	-	-	-	-	-	0.2	-	-	N/A
05_Office peri NW1	-	-	-	-	-	-	-	0.2	-	-	N/A
05_Office peri NW1	-	-	-	-	-	-	-	0.2	-	-	N/A
04_Office peri NW1	-	-	-	-	-	-	-	0.2	-	-	N/A
04_Office peri NE	-	-	-	-	-	-	-	0.2	-	-	N/A
06_Office peri NW1	-	-	-	-	-	-	-	0.2	-	-	N/A
LG_Gym	-	-	-	-	-	-	-	0.2	-	-	N/A

Zone name	SFP [W/(l/s)]									HR efficiency	
ID of system type	A	B	C	D	E	F	G	H	I		
Standard value	0.3	1.1	0.5	2.3	2	0.5	0.5	0.4	1	Zone	Standard
LG_Office int	-	-	-	-	-	-	-	0.2	-	-	N/A
LG_Office peri NW2	-	-	-	-	-	-	-	0.2	-	-	N/A
01_Office peri NW1	-	-	-	-	-	-	-	0.2	-	-	N/A
06_Office peri NW2	-	-	-	-	-	-	-	0.2	-	-	N/A
07_wc	-	-	0.5	-	-	-	-	-	-	-	N/A
06_Office peri SW	-	-	-	-	-	-	-	0.2	-	-	N/A
06_Office int	-	-	-	-	-	-	-	0.2	-	-	N/A
LG_Office peri NW1	-	-	-	-	-	-	-	0.2	-	-	N/A
01_Office int1	-	-	-	-	-	-	-	0.2	-	-	N/A
05_Office int1	-	-	-	-	-	-	-	0.2	-	-	N/A
05_Office int1	-	-	-	-	-	-	-	0.2	-	-	N/A
04_Office int1	-	-	-	-	-	-	-	0.2	-	-	N/A
04_Office int1	-	-	-	-	-	-	-	0.2	-	-	N/A

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
LG_UKPN	100	-	-
LG_Switch room	100	-	-
LG_wc2	100	-	-
LG_wc1	100	-	-
LG_Water storage	100	-	-
LG_Stairs1	100	-	-
LG_Circ2	100	-	-
LG_wc3	100	-	-
LG_Circ3	100	-	-
LG_Atrium-Lounge	91	35	3.857
LG_Bin store	100	-	-
LG_Cafe	100	-	-
LG_AHU room	100	-	-
LG_Circ4	100	-	-
LG_Cycle store	100	-	-
00_Store	100	-	-
00_Stairs1	100	-	-
00_Circ2	100	-	-
00_wc3	100	-	-
00_Lift lobby	100	-	-
00_Generator	100	-	-
00_Stairs2	100	-	-
00_Office peri S	121	-	-
00_Office peri SE	122	-	-
00_Circ3	100	-	-
00_Cupboard	100	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	**Efficacy [lm/W]**	**Efficacy [lm/W]**	**Power density [W/m²]**
Standard value	95	80	0.3
01_AHU room	100	-	-
01_Circ1	100	-	-
01_wc1	100	-	-
01_Stairs1	100	-	-
01_Circ2	100	-	-
01_wc2	100	-	-
01_Circ3	100	-	-
04_Circ1	100	-	-
04_wc1	100	-	-
04_Stairs1	100	-	-
04_Circ2	100	-	-
04_wc2	100	-	-
04_Stairs2	100	-	-
04_Circ3	100	-	-
04_Cupboard	100	-	-
05_Circ1	100	-	-
05_wc1	100	-	-
05_Stairs1	100	-	-
05_Circ2	100	-	-
05_wc2	100	-	-
05_Stairs2	100	-	-
05_Circ3	100	-	-
05_Cupboard	100	-	-
06_Switch room	100	-	-
06_Circ1	100	-	-
06_wc1	100	-	-
06_Stairs1	100	-	-
06_Circ2	100	-	-
06_wc2	100	-	-
06_Stairs2	100	-	-
06_Office peri SE	119	-	-
06_Circ3	100	-	-
07_Stairs1	100	-	-
07_Amenity	76	-	-
00_wc1	100	-	-
00_AHU room	100	-	-
00_platform lift	100	-	-
00_Circ1	100	-	-
LG_Office peri NE	118	-	-
LG_Office corner N	119	-	-
00_Reception peri NE	98	35	3.857
00_Reception int	93	35	3.857
00_Office int	117	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
00_Office peri NE	121	-	-
00_Office peri NW1	118	-	-
00_Office corner N	122	-	-
01_Office peri S	117	-	-
01_Office peri SE	119	-	-
01_Office peri SW	117	-	-
01_Office int2	116	-	-
01_Office peri NE	117	-	-
01_Office corner N	119	-	-
02_Circ1	100	-	-
02_wc1	100	-	-
02_Stairs1	100	-	-
02_Circ2	100	-	-
02_wc2	100	-	-
02_Stairs2	100	-	-
02_Circ3	100	-	-
02_Cupboard	100	-	-
02_AHU room	100	-	-
02_Office int1	116	-	-
02_Office peri NW1	117	-	-
02_Office peri NE	118	-	-
02_Office corner N	119	-	-
02_Office peri SE2	122	-	-
02_Office peri SW	117	-	-
02_Office int2	117	-	-
02_Office peri SE1	117	-	-
02_Office peri S	118	-	-
03_Circ1	100	-	-
03_wc1	100	-	-
03_Stairs1	100	-	-
03_Circ2	100	-	-
03_wc2	100	-	-
03_Stairs2	100	-	-
03_Circ3	100	-	-
03_Cupboard	100	-	-
03_AHU room	100	-	-
03_Office int1	116	-	-
03_Office peri NW1	117	-	-
03_Office peri NE	118	-	-
03_Office corner N	119	-	-
03_Office peri SE2	122	-	-
03_Office peri SW	117	-	-
03_Office int2	117	-	-

General lighting and display lighting	General luminaire	Display light source	
Zone name	Efficacy [lm/W]	Efficacy [lm/W]	Power density [W/m²]
Standard value	95	80	0.3
03_Office peri SE1	117	-	-
03_Office peri S	118	-	-
04_Office peri SE2	122	-	-
04_Office peri SW	117	-	-
04_Office int2	117	-	-
04_Office peri SE1	117	-	-
04_Office peri S	118	-	-
05_Office peri SE2	122	-	-
05_Office peri SW	117	-	-
05_Office int2	117	-	-
05_Office peri SE1	117	-	-
05_Office peri S	118	-	-
05_Office peri NW1	117	-	-
05_Office peri NE	118	-	-
05_Office peri NW1	118	-	-
05_Office peri NW1	119	-	-
05_store	100	-	-
04_Office peri NW1	117	-	-
04_Office peri NE	118	-	-
06_Office peri NW1	122	-	-
LG_Circ5	100	-	-
LG_Gym lobby	100	-	-
LG_Gym	78	-	-
LG_Office int	116	-	-
LG_Office peri NW2	117	-	-
LG_Building management	100	-	-
LG_Hot water storage	100	-	-
LG_store	100	-	-
LG_Circ1	100	-	-
01_Stairs2	100	-	-
01_Office peri NW1	118	-	-
04_AHU room	100	-	-
04_storage	100	-	-
05_storage	100	-	-
05_AHU room	100	-	-
06_Office peri NW2	119	-	-
06_Plant	100	-	-
07_Circ1	100	-	-
07_wc	100	-	-
06_Office peri SW	121	-	-
06_Smoke fans	100	-	-
06_Office int	117	-	-
LG_Office peri NW1	119	-	-