WHOLE LIFE CARBON ASSESSMENT

HOARE-LEA

247 TOTTENHAM COURT ROAD

JULY 2020

Prudential UK Real Estate Nominee 1
Limited and Prudential Real Estate Nominee
2 Limited

JULY 2020

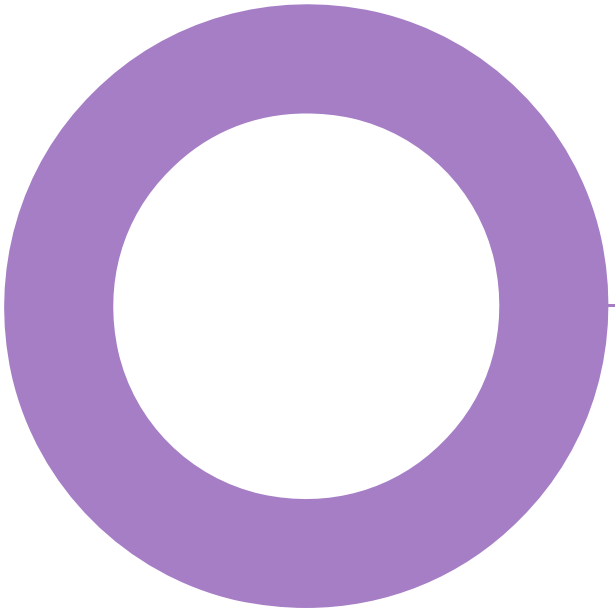
HOARE LEA

247 Tottenham Court Road. London.

Prudential UK Real Estate Nominee 1 Limited and Prudential Real Estate Nominee 2 Limited.

SUSTAINABILITY
WHOLE LIFE CARBON ASSESSMENT

REVISION 14 – 29 JULY 2020



Audit sheet.

Rev.	Date	Description of change / purpose of issue	Prepared	Reviewed	Authorised
12	17/07/2020	Redrafted in Word format. General updates to reflect design scheme	LS	AEB	AEB
13	21/07/2020	Minor amendments	AEB	AEB	AEB
14	29/07/2020	Minor amendments	AEB	AEB	AEB

Project number: 23/23464
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Introduction

This Whole Life Carbon Assessment Report has been prepared on behalf of Prudential UK Real Estate Nominee 1 Limited and Prudential Real Estate Nominee 2 Limited in support of an application at 247 Tottenham Court Road for a full planning permission for:

Demolition of 247 Tottenham Court Road, 3 Bayley Street, 1 Morwell Street, 2-3 Morwell Street and 4 Morwell Street and the erection of a mixed use office led development comprising ground plus five storey building for office (Class B1) use, flexible uses at ground and basement (Class A1/A2/A3 /B1/D1/D2), residential (Class C3) use, basement excavation, provision of roof terraces, roof level plant equipment and enclosures, cycle parking, public realm and other associated works

Executive summary

The applicant is committed to reducing carbon and this report summarises the whole life carbon assessment of the proposed development.

The whole life carbon analysis is assessed over a 60-years and covers embodied carbon in construction and operational carbon arising from annual ongoing energy use.

The strategy has been discussed with the London Borough of Camden and the Camden Design Review Panel.

Options have been assessed for a new-build proposal and refurbishment scenarios.
The scenarios assessed are:

1. Refurbishment (with retained façade)– No modifications to façade; new M&E services with gas-boiler (regulation compliant).
2. Refurbishment (with replacement of façade) – Replacement of façade; new M&E services with gas-boiler (regulation compliant).
3. Proposed development– New energy efficient design; low carbon structure and low carbon mechanical, electrical and public health (MEP) systems.

Whole life carbon summary

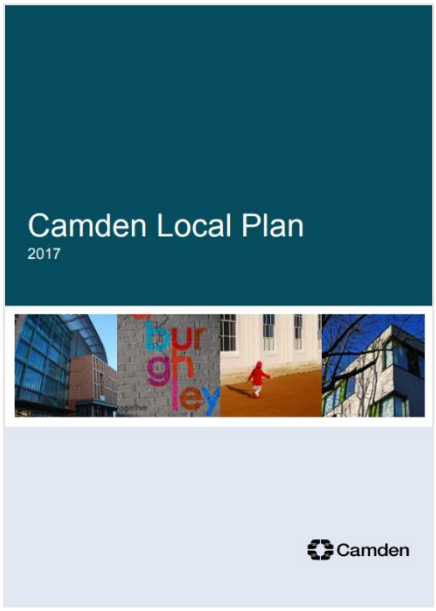
- The existing building massing at the site (comprising several buildings) is poorly suited to adaptation and flexibility.
- The proposed development seeks to be an energy-efficient and low embodied-carbon project.
- The new design will be more adaptable and future proofed than the existing buildings at the site. The development will adopt a strategy to be 'long-life, loose-fit and low-energy'.
- The assessment shows the proposed new low-carbon design strategy will have a lower whole life carbon footprint than the refurbishment scenarios assessed (over 60 years).
- Methods of low carbon construction are being considered for the project, including a review of low embodied carbon super structure & façade and other elements specified with a high content of recycled material.
- We have assumed for the refurbishment scenarios that the level of investment in M&E systems are commensurate with the commercial gains achieved through a refurbishment. This would typically include gas boilers etc, and likely to be the typical market response given the non- ideal building form that lacks adaptability and flexibility.
- The proposed new design offers a flexible modern workplace and modern residential offering that justifies a heat pump installation, commensurate with a future market expectation.
- The assessment has been carried out using OneClick LCA's Carbon Designer tool, together with operational energy benchmarks for the MEP systems, employing future carbon factor projections over 60 years for the decarbonised electricity supply.

Circular Economy Principles

- New building form provides better future adaptation and flexibility than existing form.
- Design includes review of reuse of foundations, where feasible. Demolition material to be used to balance levels and for infill as appropriate.
- Frame to have recycled content optimised for the specified performance.
- The improved slab to slab height, with improved access and open plan design, helps to minimise need for future interventions.
- New building design to include resilient and robust materials for long-life use.
- Building services systems will be designed for ease of maintenance and future climate conditions to minimise frequency of central plant replacement.
- Specification construction, e.g. recycled aggregate in concrete. of reused/ reclaimed materials in new
- Minimal use of plastics in building services installations so that recycled metals can be included in the installations (e.g. steel electrical containment, steel ductwork, steel/copper pipework).

1. Planning Policy Context

The Camden Local Plan (2017) has policies requiring low carbon design and construction, including:



Policy D1 - Design: *'The Council will require that development…is of sustainable and durable construction and adaptable to different activities and land uses.'*

In addition, *'…Design should be durable in construction and where appropriate should be flexible and adaptable for a range of uses over time, a quality known as robustness. Robustness is influenced by factors including the size and shape of rooms, points of access and the depth of floorplates. The overall quality of a building is also a consideration as buildings with character and charm are more likely to be retained and adapted…'*

(Camden Local Plan, Section Design and Heritage, Clause 7.8)

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…promote zero carbon development and require all development to reduce carbon emissions through following steps in the energy hierarchy…'*

In an effort to mitigate climate impacts in construction an appraisal of the construction strategy was undertaken to consider whether parts of the existing buildings could be refurbished.

The analysis summarised in the next section of this report shows the dramatic alterations required to bring the buildings up to current building regulation compliant standards, and thus highlighting the challenges of refurbishment.

Furthermore, the assessment of whole life carbon emissions over 60 years shows that a new build development scenario (with some retention of sub-structure where appropriate) provides a lower overall carbon outcome than the refurbishment scenarios.

The new design also offers greater flexibility and adaptability for future uses, i.e. greater robustness, compared to the existing mix of buildings that occupy the site. The existing collection of structures are difficult to make adaptable and have outdated building services. The proposed new development provides a more efficient use of the land, with greater flexibility and more energy efficient building services installations.

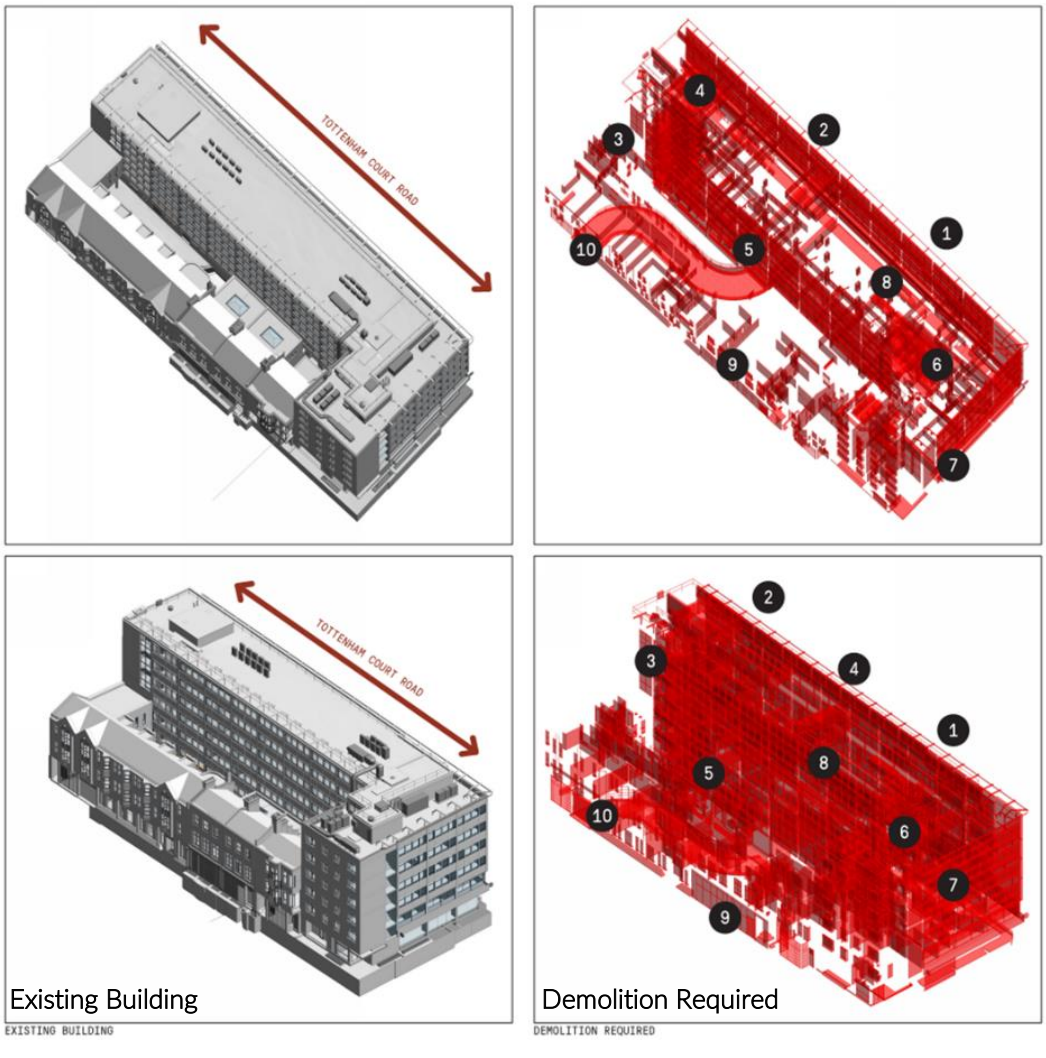
2. Existing building / refurbishment BIM analysis.

The following diagrams show the alterations required to bring the buildings up to a current market standards thus highlighting the challenges of refurbishment (Provided by structural engineers, AKTII).

The below points are a summary of the alterations required to bring the buildings up to a current market/compliant standard from our BIM analysis of the existing building:

1. Existing office building facade approaching end of useful life will need to be replaced with replacement Part L compliant facade (challenges with not over-sailing boundary v's cold bridging)
2. Existing building relies partially on opening windows on Tottenham Court Road elevation to create air movement, however this is harmful to occupants as Tottenham Court Road has high level air pollution levels recorded
3. Currently provides level D/E EPC rating, with predicted improvement only limited to C/D due to existing restraints / conditions.
4. Significantly larger plant required at roof level to facilitate heating and cooling within the building
5. Having to break out slab to accommodate M&E distribution as replacement / new plant has to be housed on the roof which will result into low floor to ceiling heights
6. Having to break out existing structure to accommodate introduction of additional / new lifts / vertical transport
7. Given the extent of the structural interventions the introduction of a replacement facade would significantly reduce the extent of operational carbon.
8. Having to strengthen slab to accommodate introduction of replacement facade (thus further reducing the floor to ceiling heights)
9. Having to break out and re-cast ground floor slab to provide level access on TCR, and to accommodate car free/cycle storage strategy
10. The refurbished building will need to have a new sub-station which will have to be inserted into the existing building(s) structure (the new build will also require this but its inclusion can be efficiently planned from the outset)

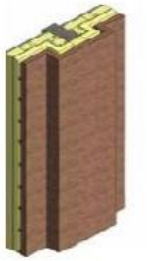
The diagrams show the extent of demolition work required to bring the existing building to a market/compliant standard



EXISTING BUILDING DEMOLITION REQUIRED

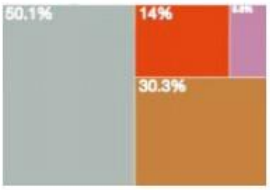
3. Carbon comparison of façade systems.

Examples of embodied carbon emissions for different façade construction methods are shown below. This shows how efforts are being made to reduce embodied carbon in the facade.



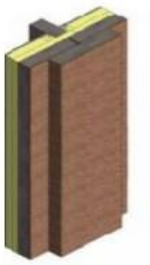
266 kg/CO_2e/m^2

average embodied carbon per m2 of elevational area



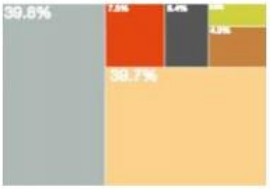
TRADITIONAL MASONARY FACADE:
Typical traditional masonry brick facade - concrete frame, SFS, mineral wool insulation, wall ties, brick

- Steel
- Brick
- Reinforced Concrete
- Plasterboard



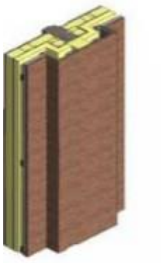
472 kg/CO_2e/m^2

average embodied carbon per m2 of elevational area



PRE-CAST BRICK PANEL FACADE:
Typical pre cast brick panel facade - concrete frame + panel, SFS, mineral wool insulation, brick slip

- Steel
- Pre-cast Concrete
- Reinforced Concrete
- Aluminium
- Brick
- Mineral Wool



737 kg/CO_2e/m^2

average embodied carbon per m2 of elevational area

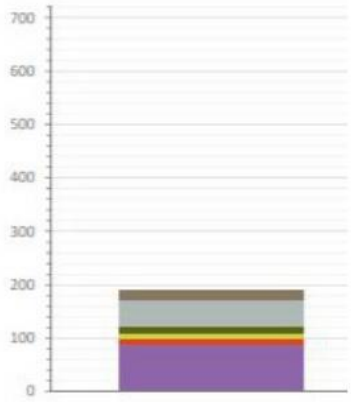
LIGHTWEIGHT BRICK SLIP PANEL FACADE:
Typical lightweight brick slip panel facade - concrete frame, SFS, mineral wool insulation, metal brackets + framing, brick slip

- Steel
- Pre-cast Concrete
- Brick

For information.
(Source: LETI)

189 kg/CO_2e/m^2

average embodied carbon per m2 of elevational area



PROFILED CERAMIC FACADE:
Profiled Ceramic Facade - Concrete frame, SFS, mineral wool insulation, metal brackets + framing, ceramic tiles

- Steel
- Pre-cast Concrete
- Reinforced Concrete
- Zinc
- Aluminium
- Ceramic
- Mineral Wool
- Sheathing

(Source: LETI)

4. Whole life carbon analysis.

The results of the 60-year whole life carbon assessment, for the three scenarios, are show below:

Whole life carbon assessment	Whole life carbon emission metric	1. Refurbishment (Retained Façade)	2. Refurbishment (New Façade)	3. Proposed Development (New Construction)
Embodied Carbon Emissions	$kgCO_2e/m^2$	251	300	471
Operational Carbon Emissions	$kgCO_2e/m^2$	1553	1350	329
Whole Life Carbon Emissions (per unit footprint)	$kgCO_2e/m^2$	1,805	1,650	799
Total Whole Life Carbon Emissions	tCO_2e	19,830	18,130	8863

Summary findings:
The proposed new construction scenario shows the lowest whole life carbon outcome, and therefore aligns with the Camden planning policy requirement to minimise climate impacts (also shown in the figure below).

Although the refreshment scenarios 1 and 2 entail lower embodied carbon emissions they have higher operational carbon emissions over 60 years. Hence, the proposed development shows the overall advantage of the new construction.

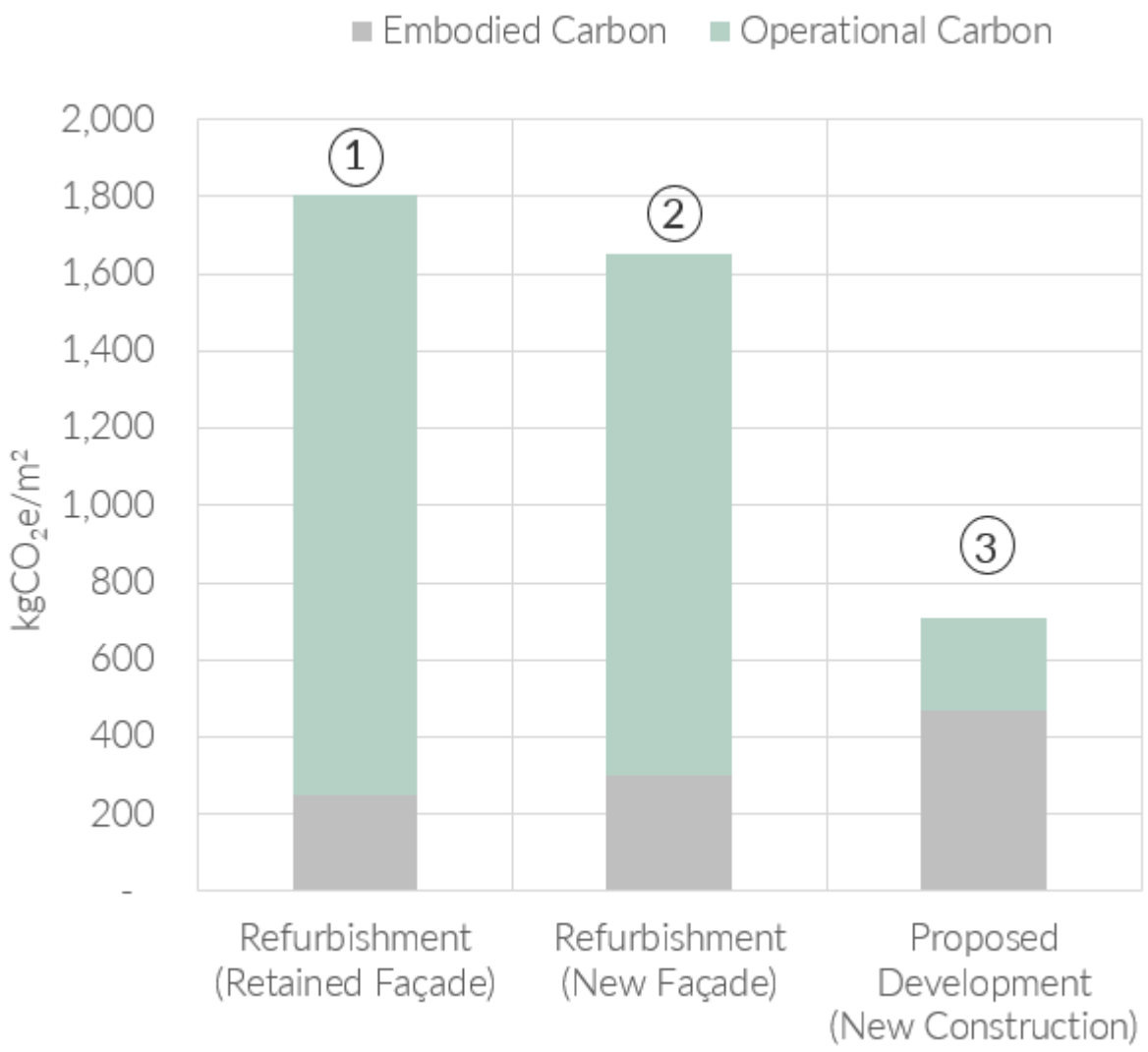
The inclusion of heat pumps in the new construction is a significant factor in reducing the whole life carbon outcome.

Replacing the façade adds embodied carbon but provides a reduction in heating loads.

Retaining the foundations (where appropriate) and employing low embodied carbon construction techniques in the proposed development minimises new embodied carbon.

The proposed design is aiming to meet RIBA 2030 Challenge target for embodied carbon, i.e. less than 500 kgCO2/m2 (target for non-domestic buildings, 2030). The refurbishment scenarios would also meet this target but don't offer the improved operational outcome.

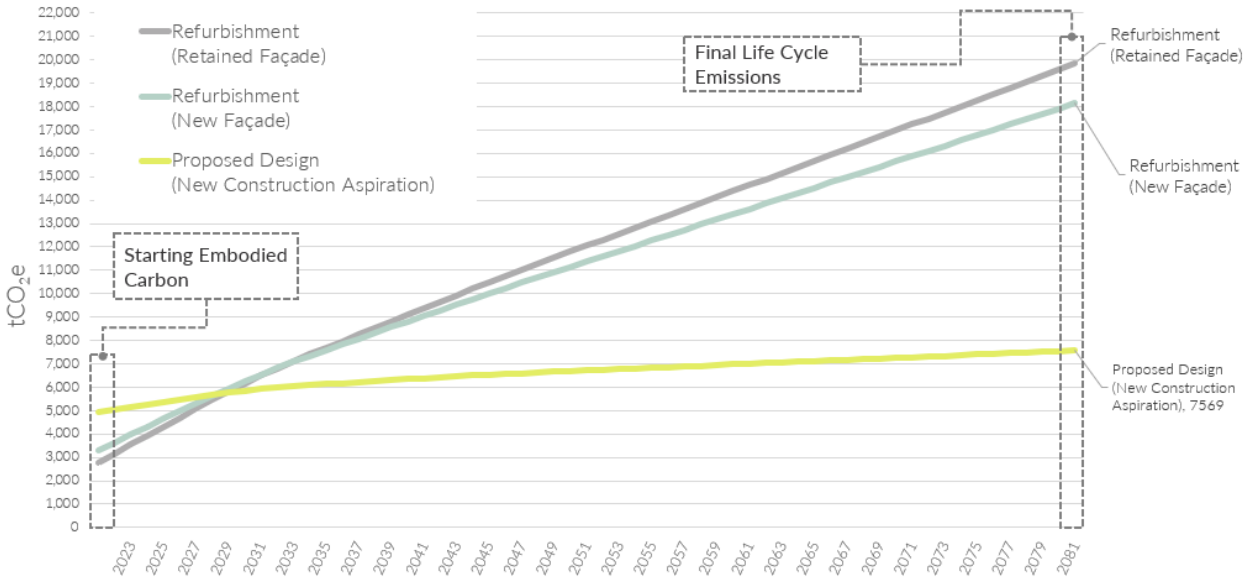
The figure below shows the 60-year cumulative emissions for whole life carbon for the two refurbishment scenarios and the proposed new design.



It shows that despite more carbon emissions arising from embodied carbon in construction, the operational carbon savings are so significant that the whole life outcome justifies the new construction proposed for the site.

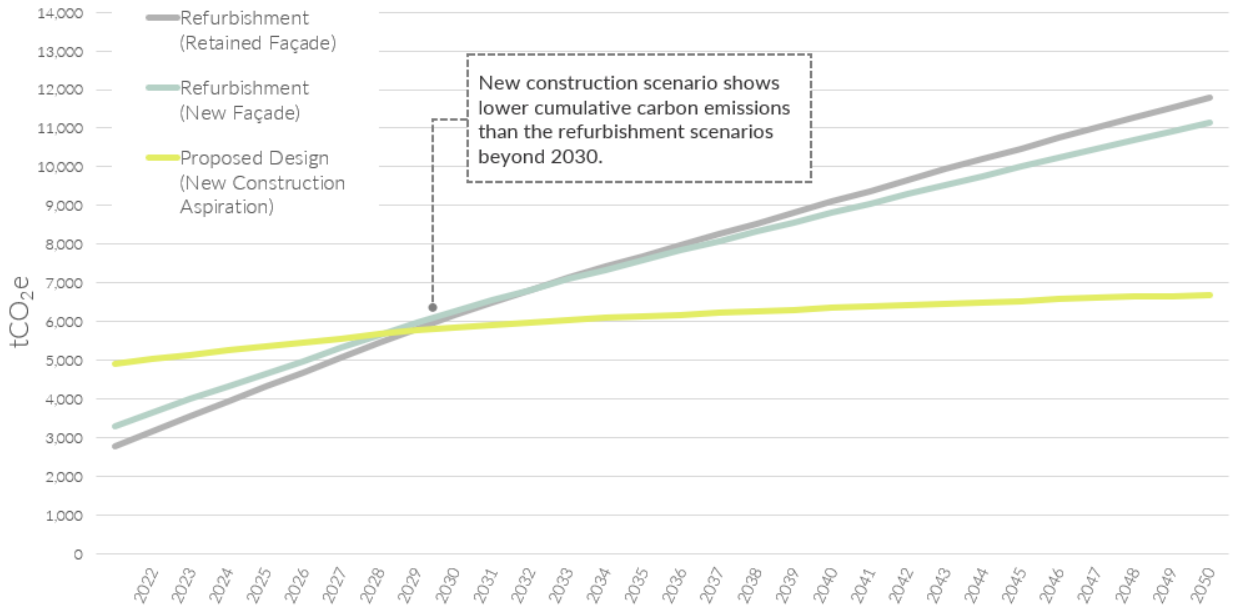
Cumulative Carbon Scenarios (60-year assessment overview)

The figure below shows the cumulative carbon emissions over the 60-year whole life carbon assessment period for the two refurbishment scenarios and the proposed development (new construction) scenario. It shows that at the end of the assessment period the final life cycle emissions for the proposed development (new construction) are lowest.



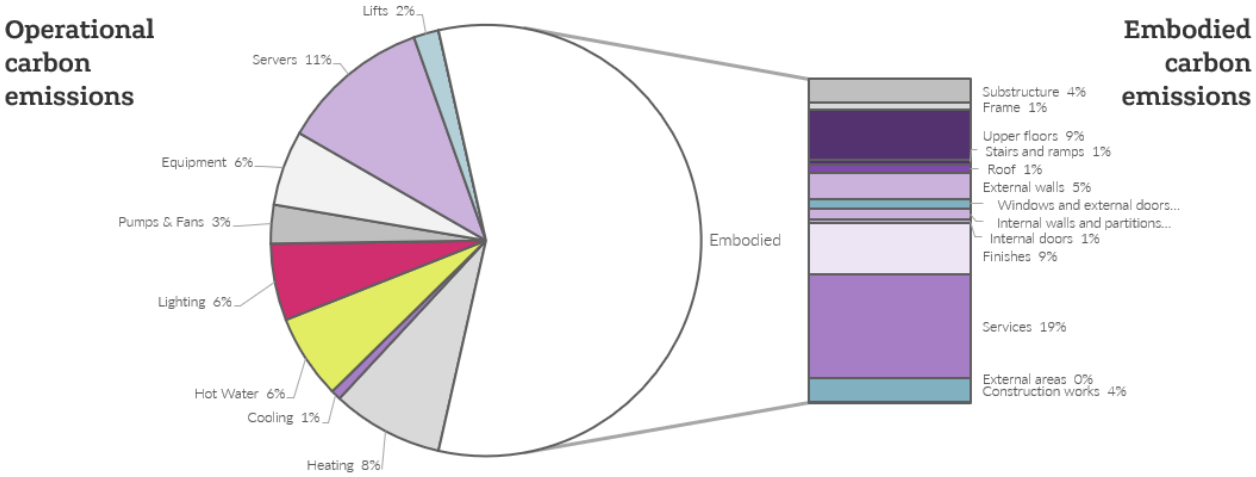
Cumulative carbon emissions (period 2022-2050)

The figure below shows the cumulative carbon emissions, with a focus during the period 2020-2050. It shows the point at which the cumulative emissions for the proposed development (new construction) become lower than the refurbishment scenarios at around 2030.



5. Proposed Development – Carbon analysis (over 60 years)

For information, the figure below shows a breakdown of the carbon emissions, of the various component parts, for the proposed development over 60 years. It shows the aggregated operational carbon emissions and embodied carbon emissions.

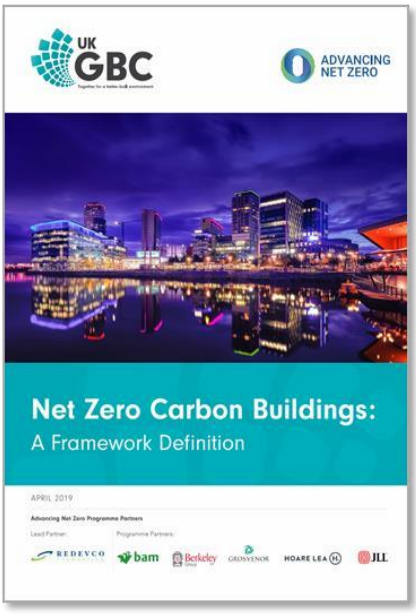


6. Reducing operational carbon emissions.

In accordance with the Camden Local Plan and London Plan the applicant aims to limit climate impact and reduce carbon emissions over the life of the project. It is also supportive of the Camden declaration of the Climate and Biodiversity Emergency using the methods described below.

As the proposed strategy offers a lower whole life emission outcome over 60 years, than the refurbishment scenarios it contributes to limiting national and London carbon budgets.

We have reviewed a potential strategy to target 'net zero' in operation, as outlined below.



Defining net zero.

The proposed development can achieve net zero carbon emissions through adopting the energy hierarchy: be lean, be clean, be green (including offsets as the final step).

Using the UKGBC net zero carbon framework definition a development can achieve net zero status by adopting principles of highly efficient design with on-site renewable energy generation and then investing in carbon offsets /green energy to balance the difference.

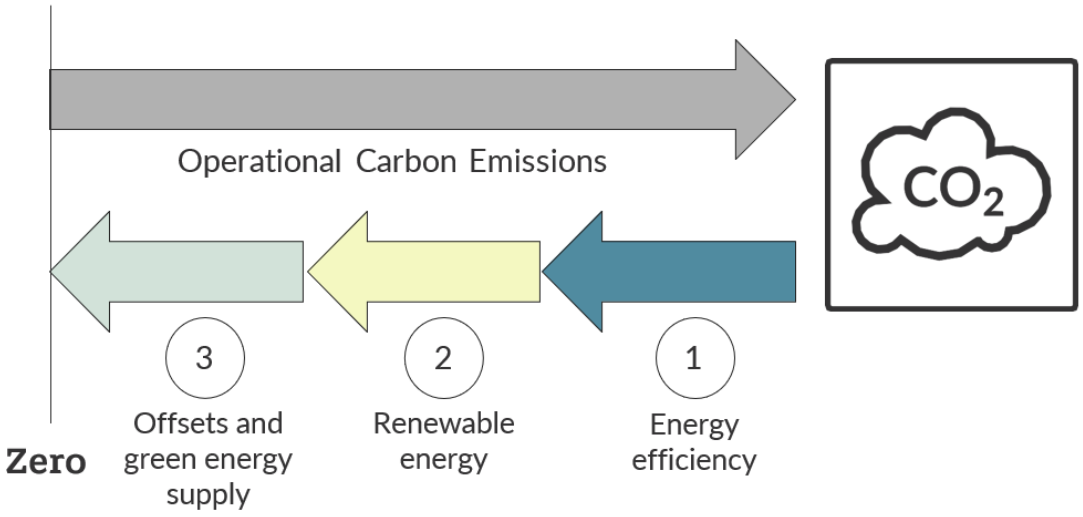
Solar-PVs are proposed in the energy strategy to reduce emissions on-site (more detail is provided in the Energy Strategy Report). However, given the size and density of the development there is insufficient capacity to meet all building energy demand by on-site renewables.

Offsets and green electricity supplies for landlord's services and also potentially tenant areas will therefore be considered.

7. Achieving net zero development

The applicant is committed to limit climate impacts, both at a corporate level and at this specific site and will employ a strategic approach to achieving net zero, based on the methodology set out below (with offsets and/or green energy power purchase agreements to make landlord's systems net zero in operation):

Schematic showing approach to net zero

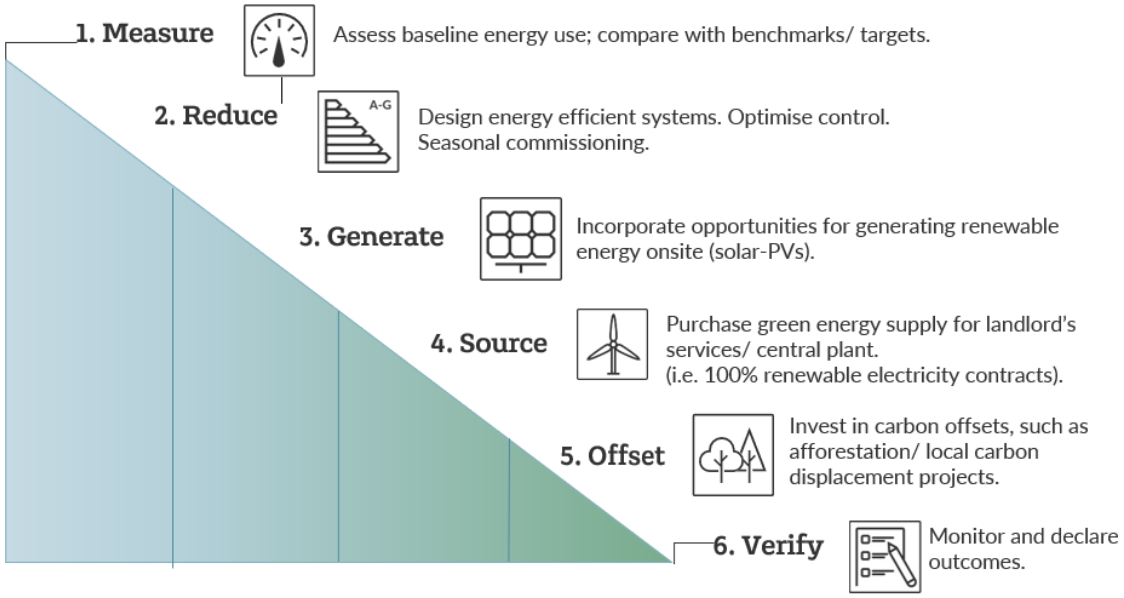


8. Path to net zero – operational carbon strategy

The figure below shows the path to achieving net zero carbon emissions in operation, in line with Camden and London plan policies.

Specifically:

1. The baseline energy demand has been assessed using modelling.
2. Energy demand for the proposed development will be limited by efficient heating, cooling, ventilation and lighting systems.
3. Onsite renewable energy, using roof mounted solar-PV panels, will further reduce carbon emissions (refer to the Energy Strategy Statement).
4. The developer will aim to purchase green power for landlord's power services.
5. The developer will pay the carbon offset payments, as required by London planning policy, to the planning authority.
6. The developer will monitor energy use and carbon emissions.



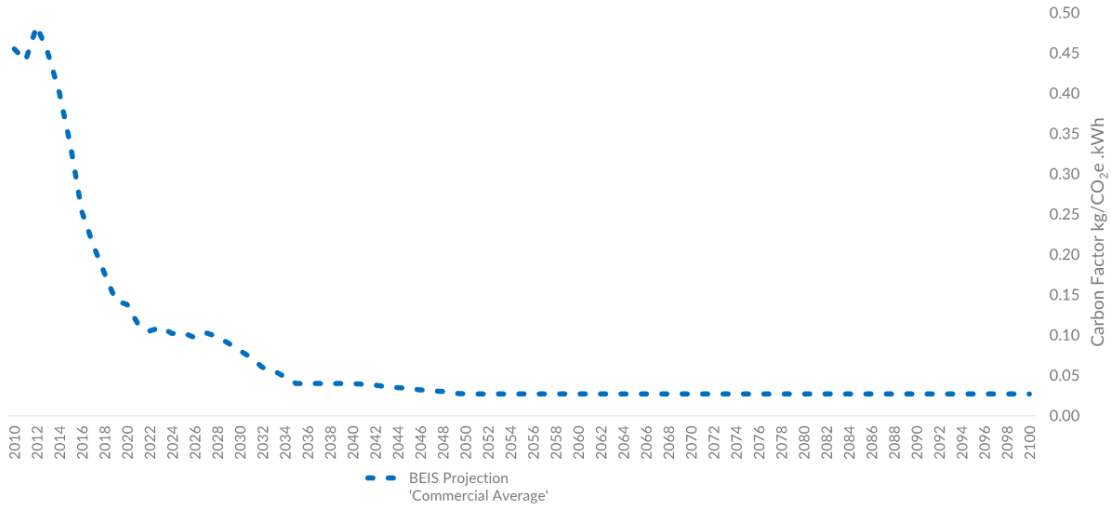
Appendix.

Assumptions and clarifications.

Generic Assumptions
Embodied
Modules included are A1-A3 (Materials), A4 (Transportation), A5 (Construction Process), B4-B5 (Replacement) and C1-C4 (End of Life) (EN15978 Sustainability of construction works)
Asphalt roofing
Terracotta facade
Retained foundations in all scenarios, significantly reducing embodied carbon
Small chiller units have been used to represent the heat pumps as there is a limitation of available EPDs
Floor finishes – 15% parquet, 10% vinyl, 70% carpet, 5% ceramic tiles
Ceiling finishes – 50% suspended ceiling, 50% painted plasterboard
Internal walls composed of steel studs with glass wool insulation
Retail façade and new windows are comprised of aluminium framed glazing
Services include: ventilation ductwork, AHU's, heating/cooling equipment, heating distribution network, cooling distribution network, electrical distribution system, drinking water supply piping network, sewage water drainage network
Operational
Office benchmarks applied across entire development as this building type accounts for the majority of the floor space
Existing Building
Embodied
N/A
Operational
BEIS projection carbon factors have been used
Natural gas carbon factor has been used for heating and hot water
Operational benchmark of 323 kWh/m2 NLA: 263 kWh/m2 GIA. (25% worse than the Better Building Partnership typical office)

Refurbishment (Retained Façade)
Embodied
Retained foundations, superstructure, façade
New stair core and ramps, internal partitions, finishes & building services
Operational
Natural gas carbon factor has been used for heating and hot water
BEIS projection carbon factors have been used for electric items
Operational benchmark of 297 kWh/m2 NLA: 241 kWh/m2 GIA. (Calculated by project services engineers to be 15% worse that the Better Building Partnership typical office)
Refurbishment (Replaced Façade)
Embodied
Retained foundations, superstructure
New façade and windows, stair cores and ramps, internal partitions, finishes & building services
Operational
Natural gas carbon factor has been used for heating and hot water
BEIS projection carbon factors have been used for electric items
Operational benchmark of 258 kWh/m2 NLA: 209 kWh/m2 GIA. Aligns with the Better Building Partnership typical office
Proposed Design
Embodied
Retained foundations, where feasible
Steel frame (60% recycled content) with precast concrete floor deck and screed
Terracotta rainscreen façade with aluminium framed windows
New building services with air source heat pump, air handling plant and distribution
Operational
BEIS Grid decarbonisation carbon factors have been used with the variance applied over the 60 year assessment period
Operational energy target of 160 kWh/m2 NLA: 130 kWh/m2 GIA. Air source heat pumps. Calculated by services engineer from pilot projects in the Better Building Partnership: Design for Performance & aligning with the UKGBC Energy Performance Targets for Offices being delivered between 2020 & 2050.

Decarbonisation factors applied to electricity supply for whole life operational modelling.



Refurbishment Cycles

The whole life carbon assessment considers certain refurbishment/ replacement cycles.

OneClick LCA's default service lengths have been applied to the assessment. This assumes that the façade, windows, structural elements (concrete, steel, CLT), insulation and internal walls will last the lifetime of the building (60 years) and that the foundations are permanent.

Replacement of the finishes and services are accounted for as follows:

- Paints (every 15 years)
- Doors (every 40 years)
- Vapour control layers (every 30 years)
- Bitumen roofing (every 20 years)
- Flooring (every 15-30 years depending on type)
- Heat distribution system (every 30 years)
- Electricity distribution system (every 30 years)
- Water and sewage piping network (every 30 years)
- Air source heat pump / Air handling units (every 25 years)

The same has been applied for all scenarios which include the scenario scope.

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