WHOLE LIFECYCLE CARBON ASSESSMENT

238-240 Kilburn High Road

Produced by XCO2 for Osel Architects

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XCO2
56 Kingsway Place
Sans Walk
London EC1R 0LU

+44 (0)20 7700 1000
mail@xco2.com
xco2.com

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EXECUTIVE SUMMARY

A Whole Lifecycle Carbon assessment has been undertaken for the proposed development at 238-240 Kilburn High Road. The site is within the London Borough of Camden. This assessment has been carried out in accordance with the latest published GLA Life-Cycle Carbon Assessments guidance (March 2022); RICS Whole Life Carbon Assessment for the Built Environment Guidance (2nd Edition, September 2023)

The proposals include the demolition of the existing 2 storey commercial building at 238 Kilburn High Road and erection of a new four storey with recessed rooftop mixed use development with Class E accommodation at ground floor and residential units above linked to the existing building at 240 Kilburn High Road.

In line with London Plan Policy SI 2 the development has calculated Whole Lifecycle Carbon through a nationally recognised Whole Life-Cycle Carbon methodology and has demonstrated the actions taken to reduce life-cycle carbon.

The methodology used to determine the expected embodied carbon outlined in this report has been developed according to the requirements set out in the GLA's London Plan Guidance for Whole Life-cycle Carbon Assessments (March 2022) guidance document.

WHOLE LIFECYCLE CARBON ASSESSMENT SUMMARY

The estimated Whole Lifecycle Carbon of the proposed development are shown in Table 1.

Table 1: Estimated Whole Life-Cycle Carbon for the Proposed Development

Proposed Assessment	Sequestered (biogenic) Carbon	Module A1-A5	Module B1-B5	Module B6-B7	Module C1-C4	Module D
TOTAL kg CO_2e	-51,870	448,270	234,881	662,636	57,026	-79,536
TOTAL kg CO_2e/m^2 GIA	-70	530	280	790	70	-100

GLA WLC BENCHMARKS

The London Plan Guidance for Whole Life-cycle Carbon Assessments (March 2022) sets out benchmarks based on previous project assessments. These benchmarks should be used as a guide, providing a range rather than a set value to achieve, and are broken down into life-cycle modules.

In addition to the Business-as-Usual benchmark, a further set of aspirational WLC benchmarks has also been developed which are based upon a 40% reduction from the Business as Usual.

The current predicted performance of the proposed developments against these benchmarks has been detailed in

Table 2: GLA Benchmark(s) for Residential and Proposed Development performance

Modules	GLA WLC benchmark	GLA Aspirational WLC benchmark	238-240 Kilburn High Road
	Kg CO_2e per m^2 (GIA)		
A1-A5 (excluding sequestration)	<850	<500	530
B-C (excluding B6 & B7)	<350	<300	350
A-C (excluding B6 & B7, Including sequestration)	<1200	<800	880

INTRODUCTION

This section introduces the key principles that a Whole Lifecycle Carbon Assessment for the built environment should adopt. It provides a brief description of the development, the policy framework and the methodology employed for this WLC assessment.

As buildings become more energy efficient, operational carbon emissions will make up a smaller proportion of a development's whole life-cycle carbon emissions. It is therefore becoming increasingly important to calculate and reduce carbon emissions associated with other aspects of a development's life cycle; namely, embodied carbon.

SITE & PROPOSAL

The site is located within the London Borough of Camden.

The proposals include demolition of the existing 2 storey commercial building at 238 Kilburn High Road and erection of a new four storey with a recessed rooftop mixed use development with Class E accommodation at ground floor and residential units above linked to the existing building at 240 Kilburn High Road.

Though the existing building is occupied by a functioning commercial unit, it is observed that the site is at a prominent corner location and is not used.

The proposed building with have access from Kilburn High Road and Grangeway. The residential accommodation on the upper levels comprises a total of nine units of which five are new and the remaining four are upgraded and enlarged existing units if the adjacent buildings. All Utility premises are located at the rear of the building.

The proposed demolition of the existing building and the provision of a commercial unit with accommodation above offer a better site usage whilst retaining the existing use.

The approximate location and boundary of the application site is shown in Figure 1 on the next page.

Figure 1: Approximate location of application site

POLICY FRAMEWORK

This Whole Life-cycle Carbon Assessment responds to the relevant Whole Life-cycle Carbon Policies of the London Borough of Camden and the London Plan. The most relevant applicable embodied carbon policies in the context of the proposed development are presented below.

CAMDEN LOCAL PLAN (2017)

POLICY CC1 CLIMATE CHANGE MITIGATION

Policy CC1 focuses on a range of requirements to ensure development minimises the effects of climate change, encouraging them to meet the highest feasible environmental standards. It outlines requirements for development involving substantial demolition, and requirements regarding resource efficiency.

> *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.*

CAMDEN PLANNING GUIDANCE ENERGY EFFICIENCY AND ADAPTATION (2021)

The Camden Council Energy Efficiency and Adaption SPD provides information on key energy and resource issues within the borough and supports Local Plan Policies CC1 Climate change mitigation and CC2 Adapting to climate change.

9. REUSE AND OPTIMISING RESOURCE EFFICIENCY

All development in the borough that requires substantial demolition requires a Whole Life Carbon assessment (including embodied carbon) to be submitted, following the GLA SPG guidance.

THE LONDON PLAN (2021)

This Whole Life-cycle Carbon Assessment responds to the relevant Whole Life-cycle Carbon Policies of the London Plan. The most relevant applicable embodied carbon policies in the context of the proposed development are presented below.

The London Plan (2021) published 2nd March 2021 sets out the Mayor's overarching strategic spatial development strategy for greater London and underpins the planning framework from 2019 up to 2041. This document replaced the London Plan 2016.

The London Plan has a strong sustainability focus with many policies addressing the concern to deliver a sustainable and zero carbon London, particularly addressed in chapter 9 - Sustainable Infrastructure.

The following policies, related to embodied carbon are of relevance for the proposed development:

POLICY SI 2 MINIMISING GREENHOUSE GAS EMISSIONS

The London Plan (2021) includes, under Policy SI 2 Minimising greenhouse gas emissions, a requirement for a Whole Life-cycle Carbon Assessment for all referable development proposals.

> *F. Development proposals referable to the Mayor should calculate whole life-cycle carbon emissions through a nationally recognised Whole Life-Cycle Carbon Assessment and demonstrate actions taken to reduce life-cycle carbon emissions.*

While it is acknowledged that this assessment does not include the requisite B6 – Operational Carbon and B7 – Operational Water modules to form a fully compliant GLA Whole Life-cycle Carbon Assessment, a comparison with the GLA's WLC benchmark & aspirational benchmark is still possible, as is the demonstration of actions taken to reduce life-cycle carbon emissions.

Other supporting polices under the London Plan (2021) include SI 1 Improving Air Quality, SI 4 Managing Heat Risk, SI 5 Water Infrastructure and SI 7 Reducing Waste & Supporting the Circular Economy:

POLICY SI 1 IMPROVING AIR QUALITY

A. Development Plans, through relevant strategic, site-specific and area-based policies, should seek opportunities to identify and deliver further improvements to air quality and should not reduce air quality benefits that result from the Mayor's or boroughs' activities to improve air quality.
B. To tackle poor air quality, protect health and meet legal obligations the following criteria should be addressed:

1) Development proposals should not:
  a) lead to further deterioration of existing poor air quality
  b) create any new areas that exceed air quality limits, or delay the date at which compliance will be achieved in areas that are currently in exceedance of legal limits
  c) create unacceptable risk of high levels of exposure to poor air quality.

2) In order to meet the requirements in Part 1, as a minimum:
  a) development proposals must be at least Air Quality Neutral
  b) development proposals should use design solutions to prevent or minimise increased exposure to existing air pollution and make provision to address local problems of air quality in preference to post-design or retro-fitted mitigation measures
  c) major development proposals must be submitted with an Air Quality Assessment. Air quality assessments should show how the development will meet the requirements of B1
  d) development proposals in Air Quality Focus Areas or that are likely to be used by large numbers of people particularly vulnerable to poor air quality, such as children or older people should demonstrate that design measures have been used to minimise exposure.

C. Masterplans and development briefs for large-scale development proposals subject to an Environmental Impact Assessment should consider how local air quality can be improved across the area of the proposal as part of an air quality positive *approach. To achieve this a statement should be submitted demonstrating:*

1) how proposals have considered ways to maximise benefits to local air quality, and

2) what measures or design features will be put in place to reduce exposure to pollution, and how they will achieve this.

D. In order to reduce the impact on air quality during the construction and demolition phase development proposals must demonstrate how they plan to comply with the Non-Road Mobile Machinery Low Emission Zone and reduce emissions from the demolition and construction of buildings following best practice guidance.

E. Development proposals should ensure that where emissions need to be reduced to meet the requirements of Air Quality Neutral or to make the impact of development on local air quality acceptable, this is done on-site. Where it can be demonstrated that emissions cannot be further reduced by on-site measures, off-site measures to improve local air quality may be acceptable, provided that equivalent air quality benefits can be demonstrated within the area affected by the development.

POLICY SI 5 WATER INFRASTRUCTURE

A. In order to minimise the use of mains water, water supplies and resources should be protected and conserved in a sustainable manner.

B. Development Plans should promote improvements to water supply infrastructure to contribute to security of supply. This should be done in a timely, efficient, and sustainable manner taking energy consumption into account.

C. Development proposals should:

1) through the use of Planning Conditions minimise the use of mains water in line with the Optional Requirement of the Building Regulations (residential development), achieving mains water consumption of 105 litres or less per head per day (excluding allowance of up to five litres for external water consumption)

2) achieve at least the BREEAM excellent standard for the 'Wat 01' water category160 or equivalent (commercial development)

3) incorporate measures such as smart metering, water saving and recycling measures, including retrofitting, to help to achieve lower water consumption rates and to maximise future-proofing.

D. In terms of water quality, Development Plans should:

1) promote the protection and improvement of the water environment in line with the Thames River Basin Management Plan, and should take account of Catchment Plans

2) support wastewater treatment infrastructure investment to accommodate London's growth and climate change impacts. Such infrastructure should be constructed in a timely and sustainable manner taking account of new, smart technologies, intensification opportunities on existing sites, and energy implications. Boroughs should work with Thames Water in relation to local wastewater infrastructure requirements.

E. Development proposals should:

1) seek to improve the water environment and ensure that adequate wastewater infrastructure capacity is provided

POLICY SI 7 REDUCING WASTE AND SUPPORTING THE CIRCULAR ECONOMY

A. Resource conservation, waste reduction, increases in material re-use and recycling, and reductions in waste going for disposal will be achieved by the Mayor, waste planning authorities and industry working in collaboration to:

1) promote a more circular economy that improves resource efficiency and innovation to keep products and materials at their highest use for as long as possible

2) encourage waste minimisation and waste prevention through the reuse of materials and using fewer resources in the production and distribution of products

3) ensure that there is zero biodegradable or recyclable waste to landfill by 2026

4) meet or exceed the municipal waste recycling target of 65 per cent by 2030

5) meet or exceed the targets for each of the following waste and material streams:

a) construction and demolition – 95 per cent reuse/recycling/recovery

b) excavation – 95 per cent beneficial use

6) design developments with adequate, flexible, and easily accessible storage space and collection systems that support, as a minimum, the separate collection of dry recyclables (at least card, paper, mixed plastics, metals, glass) and food.

B. Referable applications should promote circular economy outcomes and aim to be net zero-waste. A Circular Economy Statement should be submitted, to demonstrate:

1) how all materials arising from demolition and remediation works will be re-used and/or recycled
2) how the proposal's design and construction will reduce material demands and enable building materials, components and products to be disassembled and re-used at the end of their useful life
3) opportunities for managing as much waste as possible on site
4) adequate and easily accessible storage space and collection systems to support recycling and re-use
5) how much waste the proposal is expected to generate, and how and where the waste will be managed in accordance with the waste hierarchy
6) how performance will be monitored and reported.

C. Development Plans that apply circular economy principles and set local lower thresholds for the application of Circular Economy Statements for development proposals are supported.

LONDON PLAN (MARCH 2022) GUIDANCE - WHOLE LIFE-CYCLE CARBON ASSESSMENTS

The GLA has also published a Whole Life-cycle Carbon Assessments Guidance (March 2022 which explains how to prepare a WLC assessment for planning application. The GLA has also published a WLC assessment template which provides separate tabs outlining the information that should be submitted at each stage. The London Plan Guidance for Whole Life-cycle Carbon Assessments (March 2022) sets out benchmarks based on previous project assessments. These benchmarks should be used as a guide, providing a range rather than a set value to achieve, and are broken down into life-cycle modules.

A further set of aspirational WLC benchmarks have also been developed which are based upon a 40% reduction in WLC embodied carbon on the first set of WLC benchmarks. Table 3 details these benchmarks.

Table 3: GLA WLC Benchmark for Residential

Modules	WLC benchmark	Aspirational WLC benchmark
	Kg CO_2e per m^2 (GIA)	
A1-A5 (excluding sequestration)	<850	<500
B-C (excluding B6 & B7)	<350	<300
A-C (excluding B6 & B7, including sequestration)	<1200	<800

METHODOLOGY

The methodology followed in preparing this report is in line with the Royal Institute of Chartered Surveyors (RICS) professional statement (PS) and London Plan Guidance on Whole Life-cycle Carbon Assessments for undertaking detailed carbon assessments. The RICS Whole life carbon assessment for the built environment (2023), follows the European standard EN 15978.

This report summarises the actions taken during Stage 2, based on provisional informaiton availible at the time.

LIFE CYCLE STAGES

The life cycle stages covered by the RICS methodology refer to EN 15978, which includes a modular approach to a built asset's life cycle, breaking it down into different stages, as shown in Table 4.

The four main modules are Product stage [A1 – A3], Construction Process stage [A4 – A5], Use stage [B1 – B7] and End of Life stage [C1 – C4]. Module D consists of the potential environmental benefits or burdens of materials beyond the life of the project, and this is usually reported separately to the cradle to grave modules [A – C].

Table 4 shows the life-cycle stages that were considered for the assessment and the assumptions made for some stages due to limitations of the software used.

Table 4: Life-cycle Stages considered for this analysis.

Product Stage			Construction Process Stage		Use Stage							End-of-Life Stage				Benefits and loads beyond the system boundary		
Raw material supply	Transport	Manufacturing	Transport to building site	Installation into building	Use/application	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction/demolition	Transport	Waste processing	Disposal	Reuse	Recovery	Recycling
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D	D	D
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

BUILDING ELEMENTS

The WLC assessment covers all building elements listed in Table 5 (where applicable). Material quantities have been provided by the Quantity Surveyor (Ward Williams Associates). A minimum of at least 95% of the cost allocated to each building element category has been accounted for where information has been given, in line with GLA policy.

Table 5: Building elements as per RICS NRM

Group	Building Element	Applicable	Included
0. Demolition & facilitating works	0.1. Toxic / hazardous / contaminated material treatment	N	N
	0.2. Major demolition works	Y	Y
	0.3. & 0.5. Temporary / enabling works	N	N
	0.4. Specialist groundworks	N	N
1. Substructure	1.1. Substructure	Y	Y
2. Superstructure	2.1. Frame	Y	Y
	2.2. Upper floors incl. balconies	Y	Y
	2.3. Roof	Y	Y
	2.4. Stairs & ramps	Y	Y
	2.5. External walls	Y	Y
	2.6. Windows & external doors	Y	Y
	2.7. Internal walls & partitions	Y	Y
	2.8 Internal doors	Y	Y
3 Finishes	3.1 Wall finishes	Y	Y
	3.2 Floor finishes	Y	Y
	3.3 Ceiling finishes	Y	Y
4 Fittings, furnishings & equipment	4.1 Fittings, furnishings & equipment	Y	Y
5 Building services / MEP	5.1–5.14 Services	Y	Y
6 Prefabricated Buildings and Building Units	6.1 Prefabricated buildings and building unit	N	N
7 Work to existing building	7.1 Minor demolition and alteration works	Y	Y
8 External works	8.1 Site preparation works	Y	Y
	8.2 Roads, paths, paving and surfacing	N	N
	8.3 Soft landscaping, planting and irrigation systems	N	N
	8.4 Fencing, railings and walls	N	N
	8.5 External fixtures	N	N
	8.6 External drainage	N	N
	8.7 External services	N	N
	8.8 Minor building works and ancillary buildings	N	N

SOFTWARE TOOLS

The tool used for this assessment is eTool which follows BS EN 15978, is IMPACT-compliant, BRE certified, and listed in the GLA Life-Cycle Carbon Assessments Guidance, Appendix 1 as an acceptable tool.

MATERIALS & PRODUCTS

WLC calculations have been carried out using:

- Type III environmental declarations (Environmental Product Declaration (EPD)[1] and equivalent) and datasets in accordance with BS EN 15804; and,
- EPDs and datasets in accordance with ISO 14025 and ISO 14040/44.

Sequestered (biogenic) carbon from the use of timber has been reported separately for A1-A3 stages.

Embodied carbon is difficult to calculate for many MEP systems due to a lack of available data. Where manufacturer specific data was not available, figures for embodied carbon have been taken from the closest matching system within the eTool database. In cases where there are no comparable systems, embodied carbon has been calculated based on the key materials used to manufacture the equipment, by weight.

eTool
A Cerclos Product

[1] An Environmental Product Declaration (EPD) is an independently verified and registered document that communicates transparent and comparable information about the life-cycle environmental impact of products in a credible way. (Environdec)

BIOGENIC CARBON SEQUESTRATION

Biogenic carbon is the carbon that is stored in biological materials, such as timber. This process is commonly referred to as sequestration.

Carbon accumulates in plants through the process of photosynthesis and therefore wood products can contribute to reducing the levels of carbon dioxide in the atmosphere and help mitigate climate change.

When a bio-based material is used for a building product, the carbon will be stored as long as the material service life or until the end of life of the building.

Biogenic carbon must be reported separately if reporting only upfront carbon, but should be included in the total if reporting embodied carbon or whole life carbon.

RESULTS

The proposed development comprises the demolition of the existing building at 238 Kilburn high Road, and erection of a new four storey with recessed rooftop mixed use development with Class E accommodation at ground floor and residential units above. It also includes the partial refurbishment of 240 Kilburn High Road, to link to the residential use.

The substructure consists of assumed concrete foundations and an insulated ground floor RC slab. The superstructure consists of RC columns and load bearing RC walls, as well as 225mm thick flat RC slabs. The external walls consist of facing brickwork, SFS frames with rockwool insulation, internal weather lining and plasterboard internal lining. The fourth floor uses rainscreen cladding, rather than brickwork facing.

Efforts have been made to reduce whole life carbon of concrete elements by utilising 25% GGBS within concrete mixtures used for foundation, sub-structure and superstructure building elements. This is subject to structural engineer approval at the next design stage.

Figure 2 shows the results of the study, which is the scenario that was chosen to form the basis of design decisions. The results show that the highest contribution to the whole life carbon of the project is produced at the *Use Stage* B1-B6, accounting for 61%, combine both operational energy and water, and material repair and replacement over the buildings service life.

The next most significant phase is the A1-A5 the *Product Stage*, accounting for about 30% of the total embodied carbon of the building during its lifetime.

The other contributors, such as *End-of-Life Stage* account for roughly 4% of embodied carbon over the lifetime of the building.

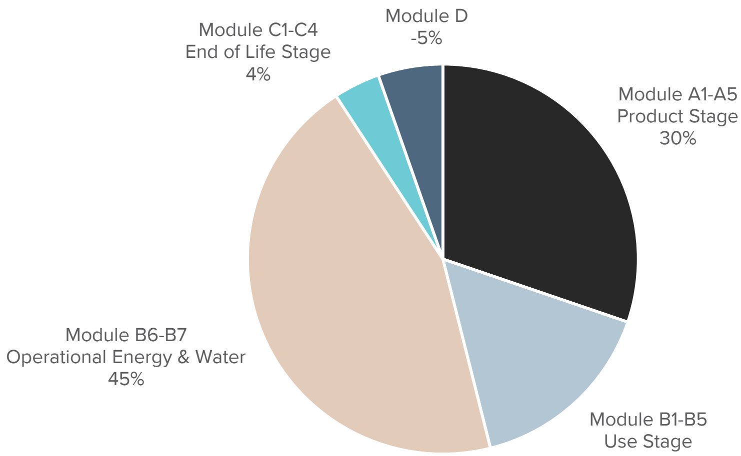

Figure 2: Estimated Whole Life-cycle Carbon by Life-cycle Assessment Module (KgCO2e)

Figure 3 & Figure 4 overleaf show the embodied carbon by building element type. As can be seen from the figures, the element type that has the highest contribution to the embodied carbon for the project is the Superstructure followed by Services elements and then the Finishes elements.

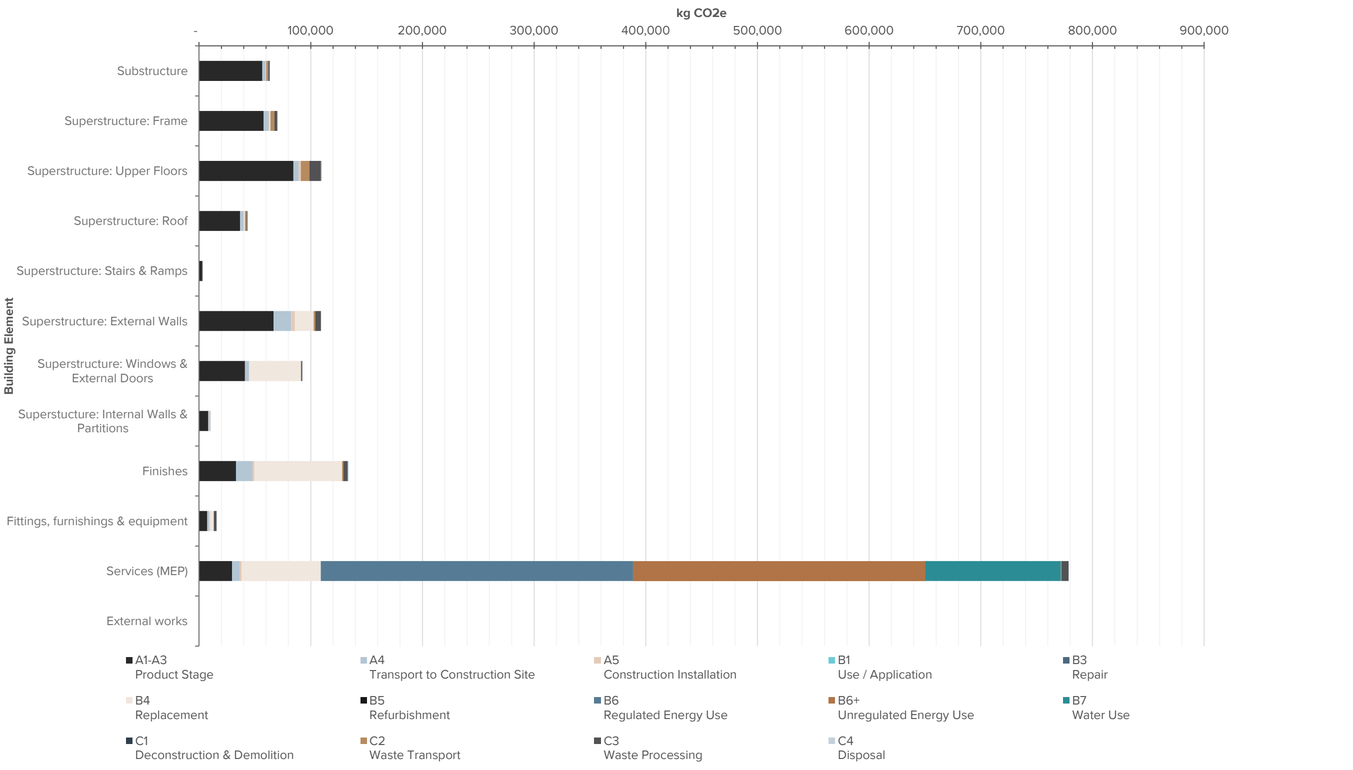

Figure 3: Estimated Whole Life-cycle Carbon by building element category (Kg CO2e)

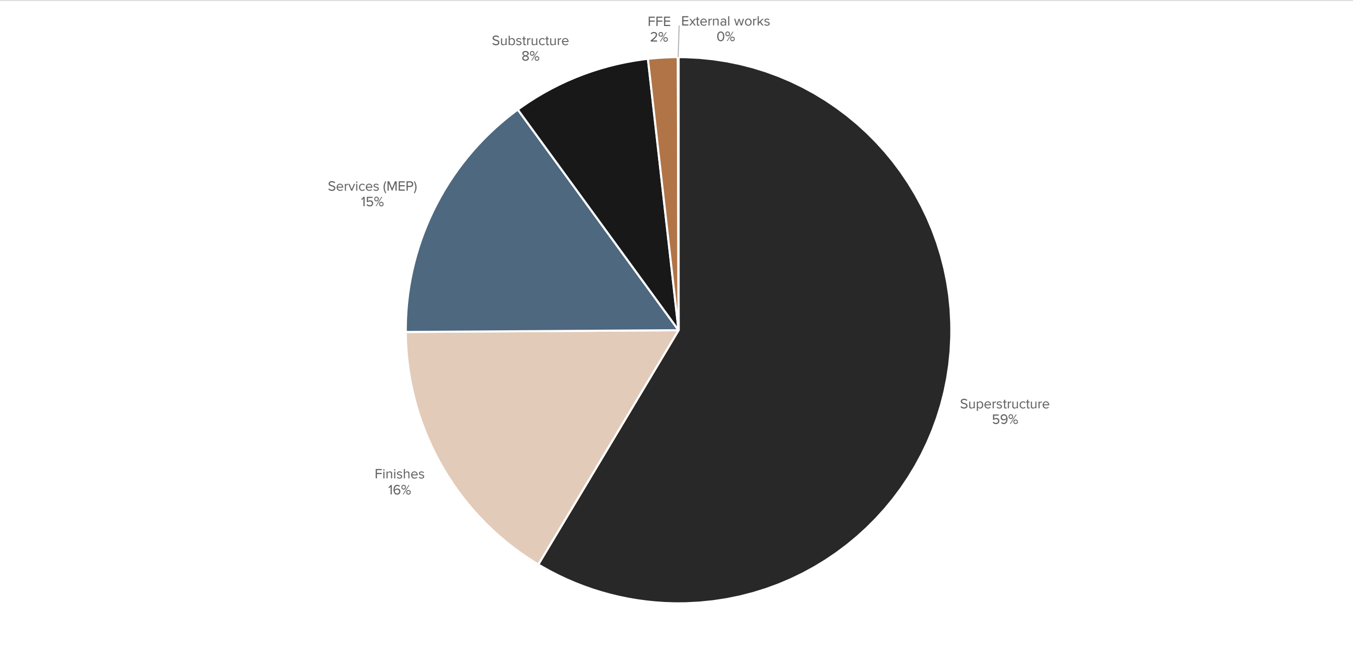

Figure 4: Estimated Embodied Life-cycle Carbon by building element category (%)

REDUCTION MEASURES

Proposed carbon reduction measures were discussed with the team, and carbon reductions were incorporated into the proposed scheme as follows:

1. The use of 25% GGBS within concrete mixtures used for foundation, sub-structure and superstructure building elements. The inclusion of GGBS should be reviewed by a structural engineer at the next design stage

The use of this reduction measure results in carbon reductions of 23,000 kg CO_2e over the projects lifetime, over a baseline scenario with no GGBS. Detailed results can be found in Table 6 below comparing the 'Business as Usual' assessment, (the assessment where no improvements to the design have been implemented to reduce the whole life carbon of the design), and the 'Proposed' assessment (the assessment where the measures detailed above have been implemented).

Table 6: Implemented Whole-life carbon reduction measure(s) (A-C (excluding B6 & B7, including sequestration))

Scenario	Total Kg CO_2e	TOTAL kg CO_2e/m^2 GIA	Reduction - Kg CO_2e	Percentage Reduction %
Business as Usual Assessment	763,200	903	-	-
Proposed Assessment	740,200	875	-23,000	-3.0%

POTENTIAL REDUCTION MEASURES

In addition to the above, additional potential measures were explored to further reduce the Life-cycle embodied carbon from the proposed development.

The following LCA embodied carbon reduction opportunities will be investigated, with a view to achieving further reductions in embodied carbon as illustrated in Table 7.

Table 7: Potential further Whole-life carbon reduction measures (A-C (excluding B6 & B7, including sequestration))

Scenario	Total Kg CO_2e	TOTAL kg CO_2e/m^2 GIA	Reduction - Kg CO_2e	Percentage Reduction %
Scenario 1 - 50% GGBS in Concrete	711,200	841	-29,000	-3.9%
Scenario 2 - Hybrid Window Frames	697,900	825	-42,300	-5.7%
Scenario 3 - Engineered Wood Flooring	721,300	853	-18,900	-2.6%
Scenario 4 – Reused/Recycled Brick in External Wall	701,100	829	-39,100	-5.3%

SCENARIO 1– SUPPLEMENTARY CEMENTITIOUS MATERIAL BLENDS

Cement within concrete is one of the most carbon-intensive materials within the project, and the specification of Supplementary Cementitious Material Blends or SCMs can have a large impact in reducing the embodied carbon associated with its use. Further detail can be found within Table 8 and

Supplementary Cementitious Material Blends, is a catch all term used to describe a wide variety of materials that can be added to concrete mixtures, these include:

- Fly Ash; a by-product of coal combustion in electricity generating power plants.
- Ground Granular Blast Furnace Slag (GGBS); a by-product of the manufacture of iron and steel. (Our chosen option)
- Silica Fume; also known as micro silica this is a by-product material created from the reduction of high purity steel with coal in an electric arc furnace
- Calcium Carbonate Fines (CCF's); a limestone filler material that can help to accelerate the hydration of cement leading to earlier strengths and improving durability of concrete.
- Natural Pozzolans (Such as calcined clays, shale and metakaolin); a variety of naturally occurring materials that have pozzolanic qualities.

In addition to reducing the associated embodied carbon intensity of concretes they are added to, these materials have a variety of other reasons for use such as improving durability, decreasing permeability, aiding pumpability and finishability, mitigating alkali reactivity and improving the overall hardened properties of concrete through hydraulic and pozzolanic activity or both.

Scenario 1 proposes the implementation of further Embodied Carbon reduction measures, including:

- the use of 50% GGBS in Foundations, Substructure and Superstructure.

Any inclusion of GGBS is subject to structural engineer review. The use of GGBS rates of 50% in Foundations, Substructure and Superstructure could result in a reduction of 29,000 kg CO_2e in embodied carbon associated with those elements, over a 25% GGBS rate of specification.

SCENARIO 2 – HYBRID WINDOW FRAMES

Scenario 2 proposes the implementation of further Embodied Carbon reduction measures including:

- The use of Hybrid Timber/Aluminium window frames for the residential development, rather than fully aluminium frames.

The use of hybrid frames significantly reduces the quantity of aluminium in the frame, replacing it with timber products. As they are significantly less carbon intensive, this lowers the embodied carbon of the window frame. This would result in a reduction of 42,300 kg CO_2e in embodied carbon associated with those elements. Further detail can be found within Table 8 and Figure 5.

SCENARIO 3 - ENGINEERED WOOD FLOORING

Scenario 3 proposes the implementation of further embodied carbon reduction measures including.

- the use of Engineered Wood Flooring throughout the development, instead of Vinyl or Linoleum flooring

Since they are made of wood engineered hardwood flooring is the more sustainable option. Vinyl floors are made from PVC resin, which is more carbon intensive to use. Additionally, engineered hardwood floors can be recycled whereas linoleum or vinyl floors typically cannot. Floor specification at this stage is assumed, further details will be investigated at the next design stage.

The use of Engineered Wood Flooring over Linoleum or Vinyl flooring could result in a notable reduction of 18,900 kg CO_2e in embodied carbon associated with those elements. Further detail can be found in Table 8 and Figure 5.

SCENARIO 4 – REUSED/RECYCLED BRICKS FOR EXTERNAL WALLS

Iteration 4 proposes the implementation of further embodied carbon reduction measures including.

- the specification of recycled bricks for the entire façade of the superstructure

Bricks are carbon intensive to produce, and thus specifying recycled / reclaimed bricks could result in a notable reduction of around 39,100 kg CO_2e in embodied carbon associated with those elements. Further detail can be found within Table 8 and Figure 5.

It is worth bearing in mind that reclaimed bricks are often only available in batches of limited quantities, and this should be considered from an early stage to ensure that the implications have been integrated into the architectural design and specification, for example how best to mix batches or specify them for different parts of the building.

Table 8: Estimated life-cycle embodied carbon for all assessment options (kg CO_2e)

Scenario	Sequestered (biogenic) Carbon	Module A1-A5	Module B1-B5	Module B6-B7	Module C1-C4	Module D
Business as Usual Assessment	-51,870	527,441	219,564	662,636	68,019	-70,604
Proposed Assessment	-51,870	500,140	234,881	662,636	57,026	-79,536
Scenario 1 - 50% GGBS in Concrete	-51,870	474,105	218,707	662,636	70,158	-70,604
Scenario 2 - Hybrid Window Frames	-60,048	494,919	206,342	662,636	56,598	-83,172
Scenario 3 - Engineered Wood Flooring	-63,634	501,214	218,536	662,636	65,115	-83,960
Scenario 4 – Reused/Recycled Brick in External Wall	-51,173	475,679	219,564	662,636	57,025	-79,533

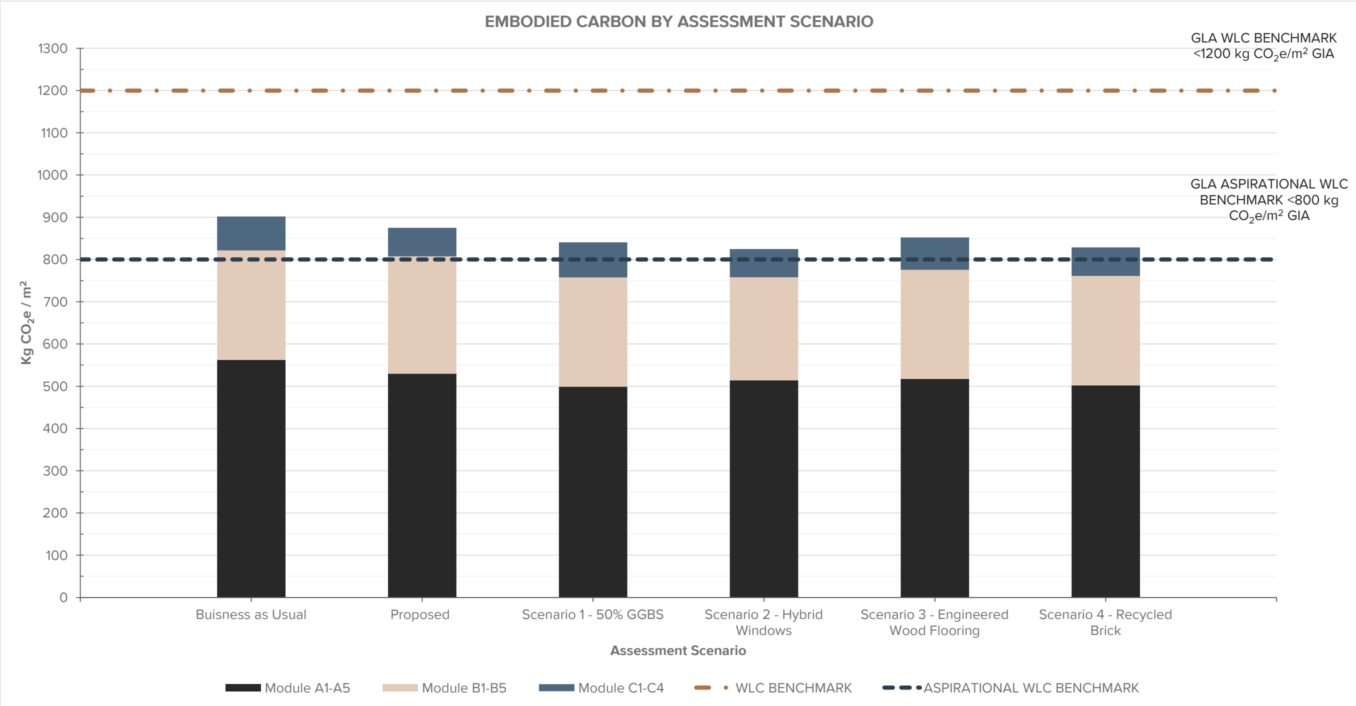

Figure 5: Estimated Life-Cycle Embodied Carbon by Assessment Scenario

CONCLUSION & RECOMMENDATIONS

A Life-cycle Embodied Carbon assessment has been undertaken for the proposed development at 238-240 Kilburn High Road within the London Borough of Camden. The embodied carbon assessment has been carried out in accordance with the latest published GLA 'Whole Life-Cycle Carbon Assessments Guidance (March 2022) as well as the RICS Whole Life Carbon Assessment for the Built Environment Guidance (2nd Edition, September 2023).

The results show that the highest contribution to the embodied carbon of the project is expected to be the superstructure. The following options should be implemented to reduce the building's whole life embodied carbon:

- 25% GGBS in Foundations, Substructure and Superstructure concrete.

Comparing this to the modelled 'Business-as-usual' case of 'no improvements implemented beyond the cost plan quantities', this strategy allowed a predicted reduction in embodied carbon of 23,000 kg CO2e, equivalent to 3.0% of the total life-cycle embodied carbon. The estimated life-cycle embodied carbon assessment option is captured in Table 9 as our recommended option.

Several additional opportunities for carbon reduction were identified to be investigated at the next stage, with a view to achieving further reductions in whole life carbon, as outlined in Table 10. The largest potential reduction could be made by the use of the use of Hybrid Windows (Scenario 2) and 50% GGBFS in concrete used for foundation, substructure, and superstructure elements (Scenario 1). The use of re-use or recycled bricks for the external wall would also offer significant savings (Scenario 4).

Table 9: Estimated life-cycle embodied carbon for the proposed assessment (A-C (excluding B6 & B7, including sequestration))

Assessment	Sequestered (biogenic) Carbon	Module A1-A5	Module B1-B5	Module B6-B7	Module C1-C4	Module D
TOTAL kg CO_2e	-51,870	448,270	234,881	662,636	57,026	-79,536
TOTAL kg CO_2e/m^2 GIA	-70	530	280	790	70	-100

Table 10: Potential reduction measures scenarios (A-C (excluding B6 & B7, including sequestration))

Scenario	Total Kg CO_2e	TOTAL kg CO_2e/m^2 GIA	Reduction - Kg CO_2e	Percentage Reduction %
Scenario 1 - 50% GGBS in Concrete	711,200	841	-29,000	-3.9%
Scenario 2 - Hybrid Window Frames	697,900	825	-42,300	-5.7%
Scenario 3 - Engineered Wood Flooring	721,300	853	-18,900	-2.6%
Scenario 4 – Reused/Recycled Brick in External Wall	701,100	829	-39,100	-5.3%

BENCHMARKING

Following the GLA Whole Lifecycle Carbon assessments guidance, the estimated embodied carbon has been compared against the benchmark provided by the GLA in the WLC assessments guidance, shown in Appendix B.

The results of Modules A1-A5 and B & C, have been compared against the WLC benchmark for apartments, and the Aspirational WLC benchmark which is based on the World Green Building Council's target to achieve a 40% reduction in Whole life-cycle embodied carbon by 2030.

The results in Table 11 show the WLC Benchmark figures for a Residential building and estimated embodied carbon of the proposed development. The anticipated embodied carbon of the proposed development is below (i.e. better than) the WLC benchmark for Modules A-C.

The results show the estimated embodied carbon calculated based on the information available to date and provided by the design team. At the current design stage there is a high level of uncertainty in terms of specified materials as well as maintenance/use and end of life considerations. These will be reviewed at the next stage when specifications are detailed.

Table 11: GLA WLC Benchmark for Offices

Modules	**WLC benchmark**	**Aspirational WLC benchmark**	**238-240 Kilburn High Road**
	Kg CO_2e per m^2 (GIA)		
A1-A5	<850	<500	530
B-C (excluding B6 & B7)	<350	<300	350
A-C (excluding B6 & B7)	<1200	<800	880

RECOMMENDATIONS

The 238-240 Kilburn High Road development is currently achieving the GLA benchmark Whole-life carbon targets.

As such, next steps for the project should the following recommendations to ensure that the GLA benchmarks for Whole-life carbon are considered:

1. *Adopt and retain all measures in Proposed Option*

   The WLC figures are fairly near to the benchmark targets, even with the incorporation of the measures in the Proposed Option. It is recommended that all measures are retained as the design progresses to ensure that the embodied carbon figures do not creep upwards above the GLA targets.

2. *Adopt additional options into design.*

   Furthermore, it is recommended that as many as possible of the additional WLC reduction options explored are adopted.

3. *Assess incorporation of existing materials through workshops with demolition contractor.*

   It is also highly recommended that following the project's associated pre-demolition audit that any existing materials onsite are evaluated for incorporation within the proposed design, and to work with the demolition contractor at the next stage to understand what could be salvaged for direct reuse.

While it is recommended that other options (such as those listed in this report) for reducing the proposed developments embodied carbon can and should be considered, any decisions taken should take into account the current stage of the project (Technical Design) which may limit or impact on the implementation of such options.

APPENDIX A – ESTIMATED EMBODIED CARBON ASSESSMENT RESULTS IN FULL

Building element		KG’s of carbon dioxide equivalent																
		Biogenic carbon	A1-A3 Product Stage	A4 Transport to Site	A5 Construct. works	B1 Use	B2 Maintenance	B3 Repair	B4 Replace	B5 Refurbish	B6 Regulated Energy Use	B6+ Unreg. Energy Use	B7 Water Use	C1 Deconst. & Demo.	C2 Waste Transport	C3 Waste Process	C4 Disposal	D Benefits & loads beyond system boundary
0.1	Demolition: Toxic / Hazardous / Contaminated Material Treatment	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0.2	Major Demolition Works	-	-	2,052	1,536	-	-	-	-	-	-	-	-	-	-	-	-	-
0.3	Temporary Support to Adjacent Structures	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0.4	Specialist Ground Works	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0.5	Temporary Diversion Works	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	Substructure	-2,896	56,734	2,996	380	-	-	-	-	-	-	-	-	-	1,851	1,391	248	-1,675
2.1	Frame	-7,856	57,933	4,423	852	-	-	-	707	-	-	-	-	-	3,575	2,608	343	-2,543
2.2	Upper Floors	-10,139	84,530	4,636	2,018	-	-	-	-	-	-	-	-	-	7,707	10,322	818	-9,129
2.3	Roof	-1,839	36,662	3,296	155	-	-	-	946	-	-	-	-	-	1,586	677	146	-10,951
2.4	Stairs & Ramps	-8	2,953	92	4	-	-	-	-	-	-	-	-	-	185	27	8	-224
2.5	External Walls	-7,454	66,802	15,754	3,268	-	-	-	16,806	-	-	-	-	-	1,428	5,037	143	-11,617
2.6	Windows & External Doors	-2,227	41,140	3,539	107	-	-	-	46,295	-	-	-	-	-	337	1,115	50	-13,418
2.7	Internal Walls & Partitions	-17	8,245	674	387	-	-	-	316	-	-	-	-	-	253	54	8	-3,477
2.8	Internal Doors	-4,249	640	227	378	-	-	-	674	-	-	-	-	-	45	1,608	-	920
3	Finishes	-4,113	33,098	14,724	1,662	-	3,006	-	78,574	-	-	-	-	-	1,124	3,979	722	13,856
4	Fittings, furnishings & equipment	-10,941	7,355	1,657	788	-	-	-	3,263	-	-	-	-	-	134	2,426	5	-4,969
5	Services (MEP)	-131	29,519	6,768	1,804	-	13,384	-	70,911	-	279,564	261,746	121,327	-	611	6,372	84	-36,308
6	Prefabricated Buildings & Building Units	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	Work to Existing Building	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8	External works	-	-	308	44	-	-	-	-	-	-	-	-	-	-	-	-	-

XCO2
56 Kingsway Place, Sans Walk
London EC1R 0LU

+44 (0)20 7700 1000
mail@xco2.com
xco2.com