WHOLE LIFECYCLE CARBON ASSESSMENT

9.604 – Ringers Road

Produced by XCO2 for Ringers Road Properties Ltd.

April 2023

XCO2
56 Kingsway Place
Sans Walk
London EC1R 0LU

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

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Remarks	Updated with new Part L and architectural layouts with additional stairs					
Prepared by	AJ					
Checked by	LW					
Authorised by	RM					
Date	21/04/2023					
Project reference	9.604					

EXECUTIVE SUMMARY

A Whole Lifecycle Carbon assessment has been undertaken for the proposed development at Ringers Road. The site is within the London Borough of Bromley 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 (1st Edition, November 2017).*

The site is located between Ringers Road and Ethelbert Road in Bromley and includes the demolition of existing buildings and construction of a mixed-use development comprising residential units, ancillary residents' facilities (including co-working space) and commercial floor space (Use Class E) across two blocks, along with associated hard and soft landscaping, amenity spaces, cycle and refuse storage.

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	-1,892,800	7,667,600	2,298,900	4,098,300	1,597,800	-397,000
TOTAL kg CO_2e/m^2 GIA	-210	852	255	455	178	-44

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 baseline benchmark, a further set of aspirational WLC benchmarks has also been developed which are based upon a 40% reduction from the baseline.

The current predicted performance of the proposed developments against these benchmarks has been detailed in Table 2.

Table 2: GLA WLC Benchmark for Residential Developments

Modules	GLA WLC benchmark	GLA Aspirational WLC benchmark	Ringers Road - Proposed Scheme
	Kg CO_2e per m^2 (GIA)		
A1-A5	<850	<500	852

Modules	GLA WLC benchmark	GLA Aspirational WLC benchmark	Ringers Road - Proposed Scheme
	Kg CO_2e per m^2 (GIA)		
B-C (excluding B6 & B7)	<350	<350	433
A-C (excluding B6 & B7); including sequestered carbon	<1200	<800	1075

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 between Ringers Road and Ethelbert Road in Bromley and includes the demolition of existing buildings and construction of a mixed-use development comprising residential units, ancillary residents' facilities (including co-working space) and commercial floor space (Use Class E) across two blocks, along with associated hard and soft landscaping, amenity spaces, cycle and refuse storage.

The approximate location and boundary of the application site is shown in Figure 1 below.

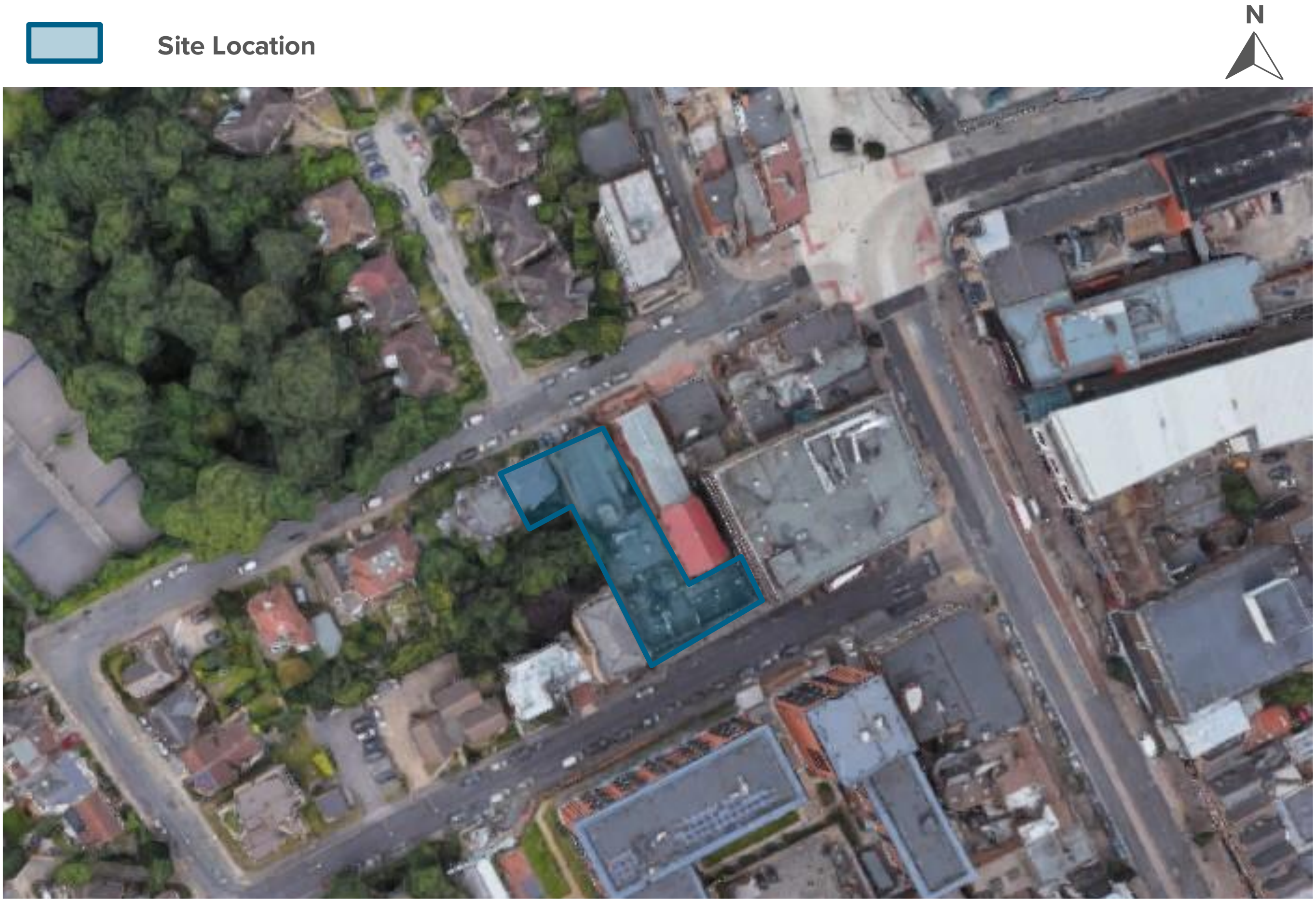


Figure 1: Approximate location of application site

POLICY FRAMEWORK

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

THE LONDON PLAN (2021)

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. As outlined in the WLC Assessments guidance applicants are required to take action at the following stages:

- Pre-application
- Stage 1 submission (i.e. RIBA Stage 2/3)
- Post-construction (i.e. upon commencement of RIBA Stage 6 and prior to the building being handed over, if applicable. Generally, it would be expected that the assessment would be received three months post-construction)

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.

These benchmarks have been detailed in Table 3.

Table 3: GLA WLC Benchmark for Residential

Modules	WLC benchmark	Aspirational WLC benchmark
	Kg CO_2e per m^2 (GIA)	
A1-A5	<850	<500
B-C (excluding B6 & B7)	<350	<300
A-C (excluding B6 & B7)	<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 (2017), follows the European standard EN 15978.

This report summarises the actions taken during stage 2 (Concept Design). The applicant recognises that the Whole Life-cycle Carbon calculations presented in this report will need to be revisited and if appointed, amended at post-construction stage (upon commencement of RIBA Stage 6).

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 (Spider Projects). 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	Y	Y
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	Y	Y
	8.3 Soft landscaping, planting and irrigation systems	N	N
	8.4 Fencing, railings and walls	Y	Y
	8.5 External fixtures	Y	Y
	8.6 External drainage	Y	Y
	8.7 External services	Y	Y
	8.8 Minor building works and ancillary buildings	N	N

SOFTWARE TOOLS

The tool used for this assessment is eTool LCA, 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 LCA 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.

[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)

RESULTS

The proposed development includes the demolition of existing buildings and construction of a residential-led mixed-use development comprising residential units, ancillary residents' facilities (including co-working space) and commercial floor space (Use Class E) across two blocks, along with associated hard and soft landscaping, amenity spaces, cycle and refuse storage.

The substructure consists of a concrete piling foundation & pile cap, RC ground floor, basement retaining walls and basement RC floor slab. The superstructure consists of RC floor slabs spanning between RC columns. The external walls consist of Metsec SFS External wall system with brick and metal cladding. The roof of the building is RC slab with a Green Roof.

Efforts have been made to reduce whole life carbon of concrete elements by utilising 30% GGBS within concrete mixtures used for foundation, sub-structure and superstructure building elements.

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 stage A1-A5 the Product Stage, accounting for about 49% of the total embodied carbon of the building during its lifetime.

The second largest contributor the carbon associated emissions associated with *Operational Energy and Water*, accounts for 26% of total emissions.

The other contributors, the *Use Stage & End-of-Life Stage* account for (15% and 10% respectively) over the lifetime of the building.

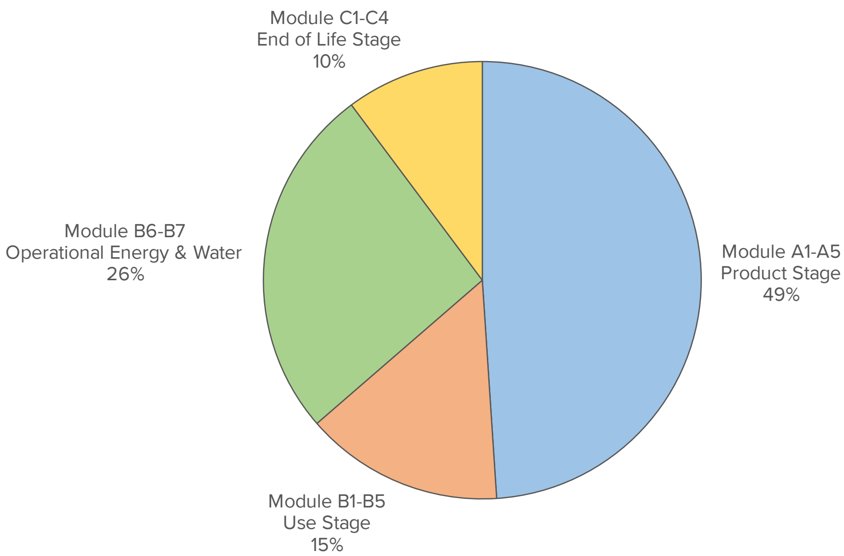


Figure 2: Estimated Embodied Carbon by Life-cycle Assessment Module (KgCO2e)

Figure 3 & Figure 4 overleaf show the Whole Life 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 the finishes and then the sub-structure building elements.

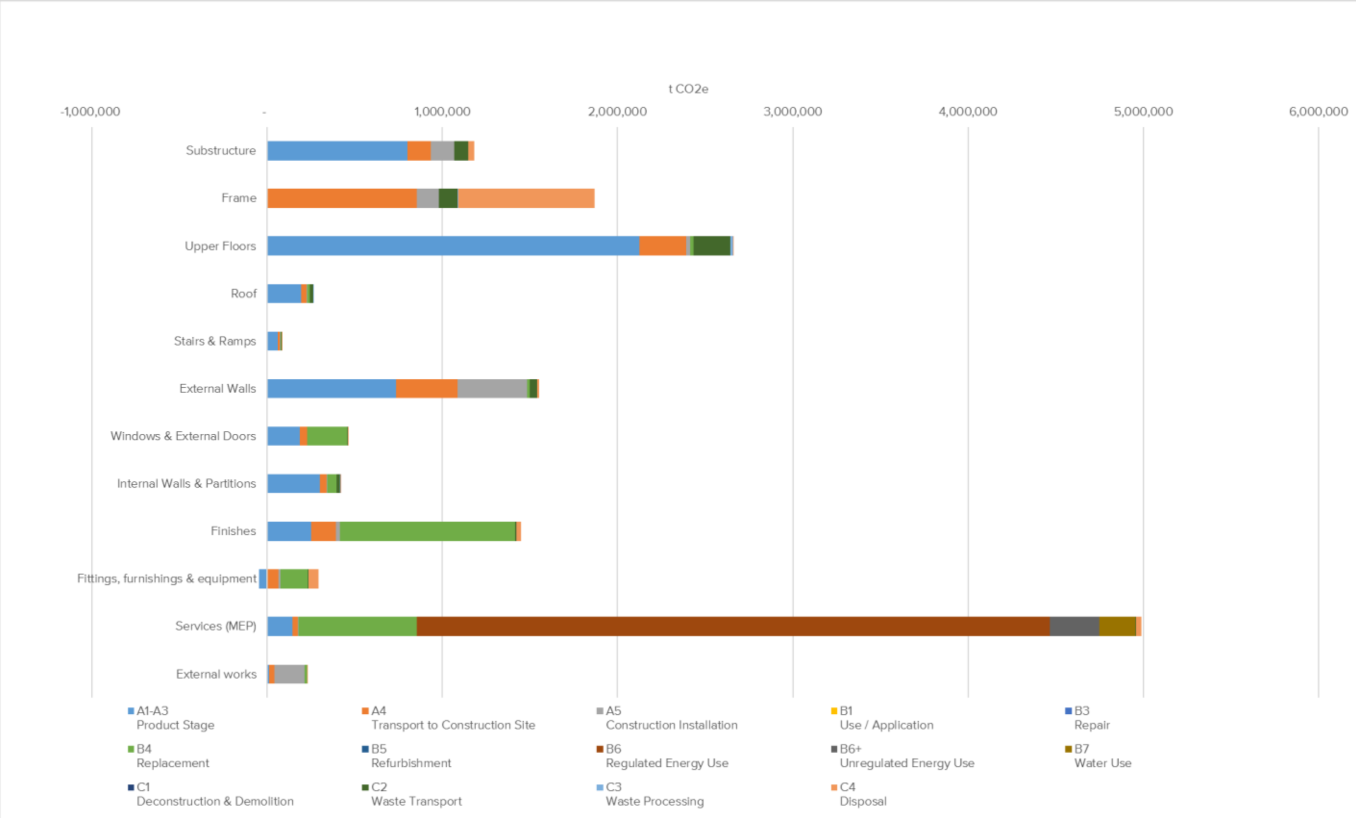


Figure 3: Estimated Whole Lifecycle Carbon by building element category (Kg CO_2e)

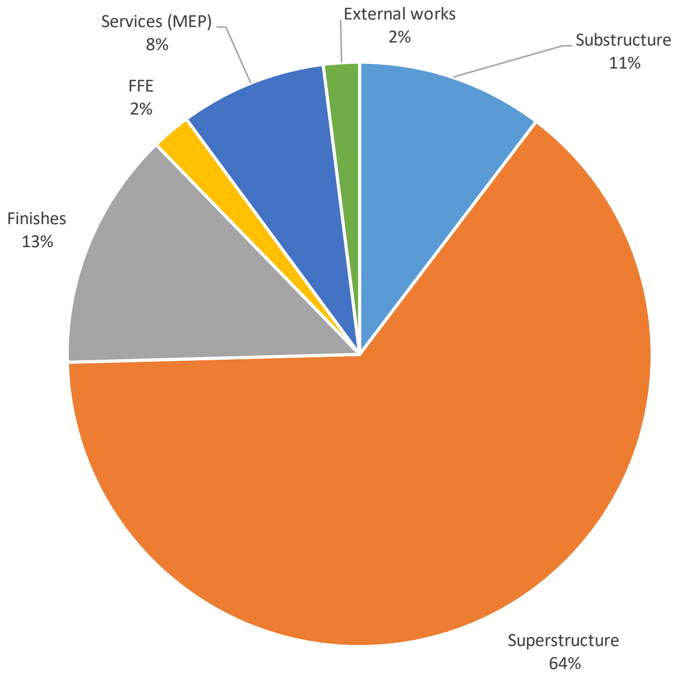


Figure 4: Estimated Embodied Carbon by building element category (%)

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 30% GGBFS within concrete mixtures used for foundation, sub-structure and superstructure building elements.

The use of this reduction measure results in carbon reductions of 506,000 kg CO_2e over the projects lifetime. Detailed results can be found in Table 6 below comparing the 'Baseline' 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: Reduction measures

Scenario	Total Kg CO_2e	TOTAL kg CO_2e/m^2 GIA	Reduction - Kg CO_2e	Percentage Reduction %
Baseline Assessment	10,177,400	1131	-	-
Proposed Assessment	9,671,400	1075	506,000	5.0%

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 embodied carbon reduction measures

Scenario	Total Kg CO_2e	TOTAL kg CO_2e/m^2 GIA	Reduction - Kg CO_2e	Percentage Reduction %
Baseline Assessment	10,177,500	1131	-	-
Proposed Assessment	9,671,500	1075	506,000	5.0%
Scenario 1 – 50% (Substructure) & 40% (Superstructure) GGBFS Cement Replacement	9,383,100	1043	288,300	3.0%
Scenario 2 – Hybrid Aluminium-Timber Windows	9,294,500	1033	376,900	3.9%
Scenario 3 – Plasterboard (20% Recycled Content)	9,284,500	1032	387,000	0.04%
Scenario 4 – Low Impact Refrigerants	9,669,700	1075	1,700	0.0002%

SCENARIO 1 – 50% (SUBSTRUCTURE) & 40% (SUPERSTRUCTURE) 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 Figure 5.

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 (GGBFS); 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% GGBFS in Foundations, Substructure and 40% GGBFS in the Superstructure.

An option looking at removing the basement from the current design would result in the largest notable reduction of 288,300 kg CO2e in embodied carbon associated with those elements. Further detail can be found within Table 9 and Figure 7.

SCENARIO 2 – HYBRID ALUMINIUM-TIMBER WINDOWS

Scenario 2 proposes the implementation of further embodied carbon reduction measures including.

- the use of hybrid aluminium/timber windows throughout the superstructure of the building

Providing the sustainable sourcing of timber products, utilising hybrid windows with timber and aluminium as opposed to purely aluminium could have further carbon reduction of 376,900 kg CO_2e in embodied carbon associated with those elements. Further detail can be found within Table 8 and Figure 5.

SCENARIO 3 – PLASTERBOARD (20% RECYCLED CONTENT

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

- the use of 20% recycled plasterboard for interior finishes throughout the building

The production of plasterboard is carbon intensive and the specification of plasterboard with recycled content could result in a further reduction of 387,000 kg CO_2e in embodied carbon associated with those elements. Further detail can be found within Table 8 and Figure 5.

SCENARIO 4 – LOW IMPACT REFRIGERANTS

Scenario 5 proposes the implementation of further embodied carbon reduction measures including.

- the use of recycled steel for structural steel elements (i.e., columns and beams)

Certain refrigerants can have a Global Warming Potential (GWP) many times the potency of CO2, and thus it is important to specify low-impact refrigerants for services. While a moderately low-impact refrigerant was already specified for the Estimated WLC Emissions Assessment, the specification of the lowest impact refrigerants such as R-407c, R-410a, and R-134a could result in further of 1,700 kg CO_2e in embodied carbon associated with those elements. Further detail can be found in Table 8 and Figure 5.

Table 8: Estimated life-cycle embodied carbon for all assessment options

Scenario	Sequestered (biogenic) Carbon	Module A1-A5	Module B1-B5	Module B6-B7	Module C1-C4	Module D
Baseline Assessment	-1,881,400	8,266,000	2,195,000	4,098,300	1,597,800	-396,963.
Proposed Assessment	-1,892,800	7,667,600	2,298,900	4,098,300	1,597, 800	-396,963
Scenario 1 – 50% (Substructure) & 40% (Superstructure) GGBS Cement Replacement	-1,898,100	7,384,700	2,298,800	4,098,300	1,597, 800	-396,963
Scenario 2 – Hybrid Aluminium-Timber Windows	-1,980,000	7,522,100	2,154,600	4,098,300	1,597, 800	-396,963
Scenario 3 – Plasterboard (20% Recycled Content)	-1,879,300	7,478,300	2,087,700	4,098,300	1,597, 800	-396,963
Scenario 4 – Low Impact Refrigerants	-1,892,800	7,667,100	2,297,700	4,098,300	1,597, 800	-396,963

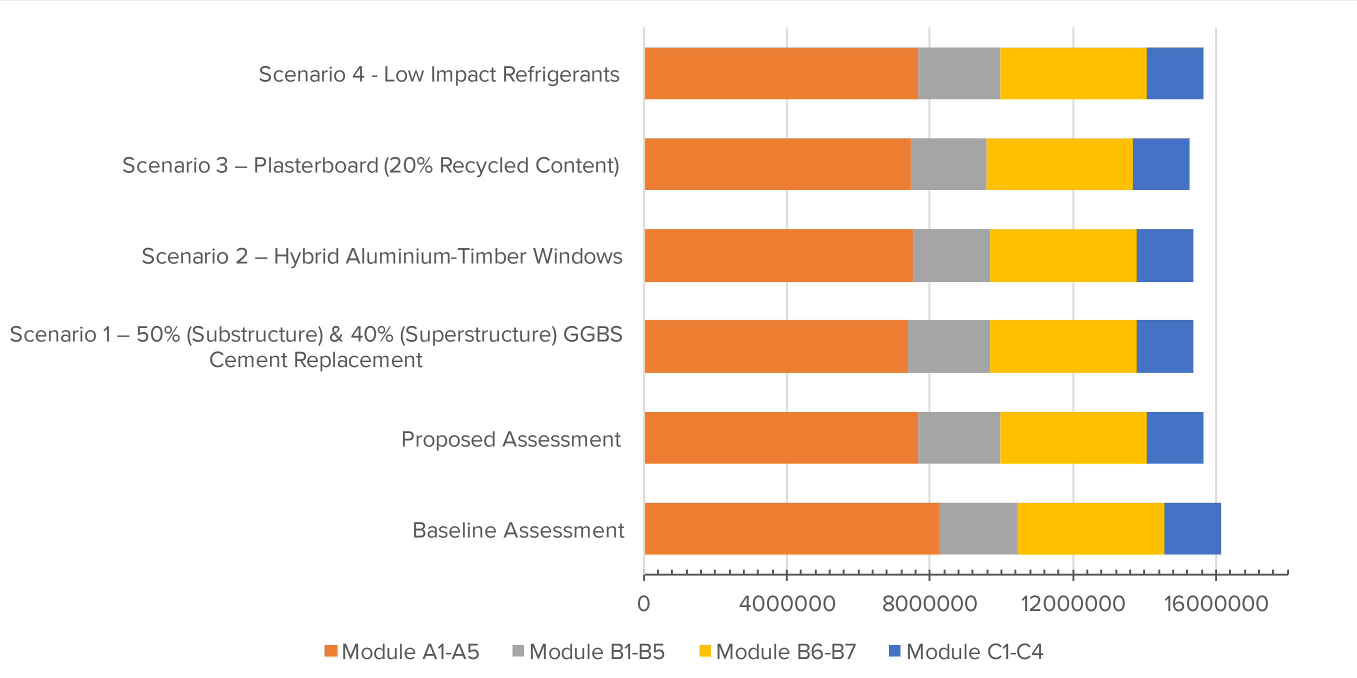
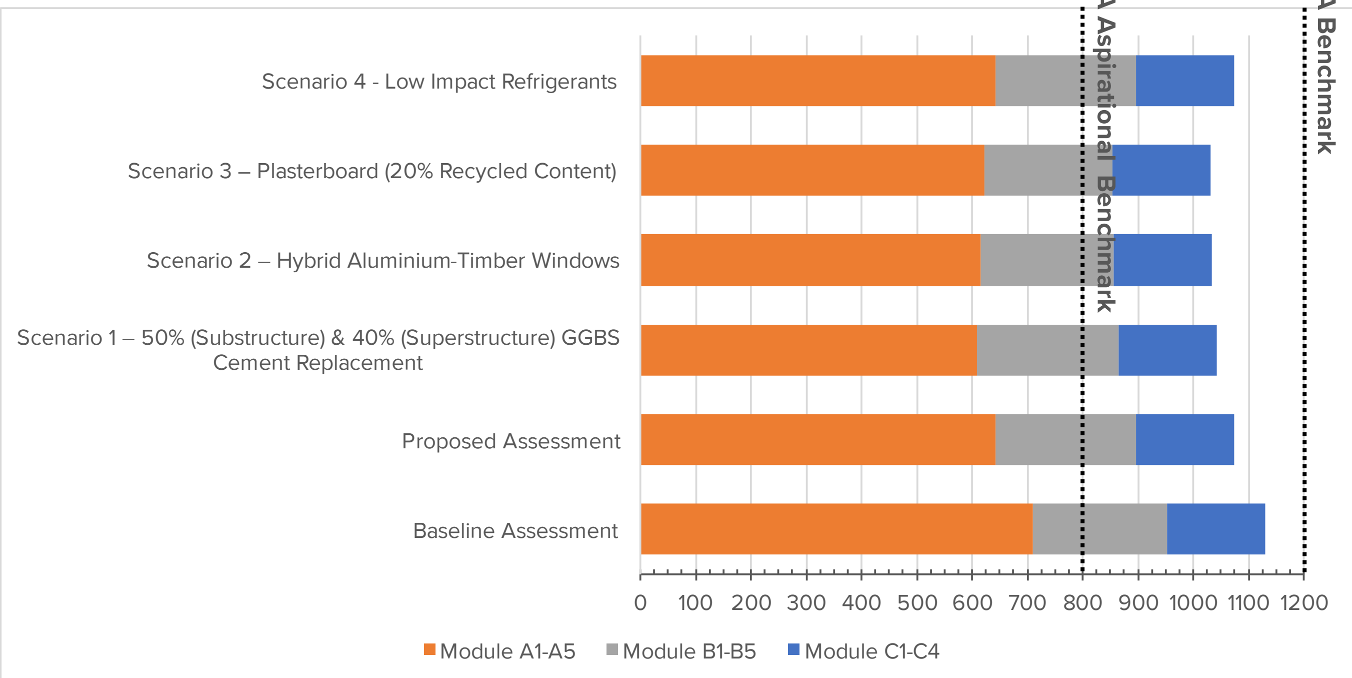


Figure 5: Estimated Life-Cycle Embodied Carbon for all assessment options



CONCLUSIONS & RECOMMENDATIONS

A Whole Lifecycle Carbon assessment has been carried out for the proposed Ringers Road development within the London Borough of Bromley. This 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 (1st Edition, November 2017).

The results show that the highest contribution to the embodied carbon of the project is expected to be the Superstructure followed by the Finishes and Substructure. The following options were implemented in order to reduce the building's whole life embodied carbon:

- The use of 30% Supplementary Cementitious Material Blends (SCMs) in Foundations, Substructure and Superstructure.

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 506,000 kg CO2e, equivalent to 5% of the total life-cycle embodied carbon. The estimated life-cycle embodied carbon assessment option is captured in Table 9 as our recommended option.

A number of 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 using hybrid aluminium-timber windows as part of the design (Scenario 2), followed by the use of 50% GGBFS Cement Replacement in concrete used for foundation and substructure building elements & 40% GGBFS Cement Replacement in concrete used for superstructure elements (Scenario 2).

Table 9: Estimated life-cycle embodied carbon for the proposed assessment

Assessment	Sequestered (biogenic) Carbon	Module A1-A5	Module B1-B5	Module B6-B7	Module C1-C4	Module D
TOTAL kg CO_2e	-1,892,800	7,667,600	2,298,900	4,098,300	1,597,800	-397,000
TOTAL kg CO_2e/m^2 GIA	-210	852	255	455	178	-44

Table 10: Potential reduction measures scenarios

Scenario	Total Kg CO_2e	TOTAL kg CO_2e/m^2 GIA	Reduction - Kg CO_2e	Percentage Reduction %
Scenario 1 – 50% (Substructure) & 40% (Superstructure) GGBFS Cement Replacement	9,383,100	1043	288,300	3.0%
Scenario 2 – Hybrid Aluminium-Timber Windows	9,294,500	1033	376,900	3.9%
Scenario 3 – Plasterboard (20% Recycled Content)	9,284,500	1032	387,000	0.04%
Scenario 4 – Low Impact Refrigerants	9,669,700	1075	1,700	0.0002%

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 at (i.e. the same as) the WLC benchmark for Modules A1-A5.

Results for Modules B-C are higher than the GLA Benchmark, at this stage the estimated embodied carbon for Modules B-C has been 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. It is believed that this is the reason for the higher than benchmark embodied carbon. The maintenance use and end of life considerations will be reviewed at the next stage when specifications are detailed.

Overall, however when looking at the GLA benchmark for modules A-C (excluding B6 & B7) but including carbon sequestration it is demonstrated that the project sits well below this at 1075 Kg CO_2e per m^2 (GIA).

Table 11: GLA WLC Benchmark for Residential Developments

Modules	WLC benchmark	Aspirational WLC benchmark	Ringers Road– Proposed Scheme
	Kg CO_2e per m^2 (GIA)		
A1-A5	<850	<500	852
B-C (excluding B6 & B7)	<350	<300	433
A-C (excluding B6 & B7); including carbon sequestration	<1200	<800	1075

RECOMMENDATIONS

The Ringers Road development is currently achieving the GLA Benchmark for embodied carbon.

To further ensure the robustness of this assessment, 3rd party verification of the embodied carbon LCA referenced in this report would provide a level of additional rigor to the model and results.

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													114,621				
0.3	Temporary Support to Adjacent Structures																	
0.4	Specialist Ground Works																	
0.5	Temporary Diversion Works																	
1	Substructure	-14,437	799,185	136,305	132,333	-297									81,370	182	33,011	10,729
2.1	Frame	-1,674,638	-5,070	851,993	128,964										105,183	5,940	777,680	-74,766
2.2	Upper Floors	-6,673	2,125,251	266,259	21,177				19,922						210,821	15,322	3,781	-153,010
2.3	Roof	-1,856	193,805	31,168	2,495		24,852		16,486						19,061	1,312	-155	-4,819
2.4	Stairs & Ramps	-6,952	60,864	10,734	2,757				3,586						6,190	429	3,827	-3,650
2.5	External Walls	-11,909	734,006	351,741	396,846				17,551						39,208	32	12,183	-12,730
2.6	Windows & External Doors	1,294	187,814	41,210	39				229,515						1,382		600	-374
2.7	Internal Walls & Partitions	2,084	300,908	39,103	3,021				52,057						21,758	2,247	1,099	-58,920

2.8	Internal Doors	-14,530	11,984	2,521	1,208										991		7,604	-7,545
3	Finishes	-45,178	250,927	140,440	23,247		61,701		1,000,062						9,372		23,813	-3,746
4	Fittings, furnishings & equipment	-119,220	-46,054	63,328	12,723				156,612						2,550		57,760	-22,520
5	Services (MEP)	-613	145,845	27,375	7,225		29,312		674,737	0	3,611,589	282,000	204,760		5,376	930	30,695	-64,455
6	Prefabricated Buildings & Building Units																	
7	Work to Existing Building																	
8	External works	-200.9332113	10335.02007	29451.20984	174107.6261		0		12788.01348						1309.708215	175.9598409	136.4484023	-1156.433424
-	Other or overall site construction																	
-	Unclassified																	

XCO2
56 Kingsway Place, Sans Walk
London EC1R 0LU

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