HOARE LEA

Hayes Park West.
London Borough of Hillingdon.
Shall Do Hayes Developments Ltd.

SUSTAINABILITY
STAGE 2 REPORT – WHOLE LIFE CARBON ASSESSMENT

REVISION P02 – 22 OCTOBER 2025

STAGE 2

Audit sheet.

Rev.	Date	Description of change / purpose of issue	Prepared	Reviewed	Authorised
P01	26/09/2025	Draft issue for comment.	N. Rumley	S. Tuteja	J. Drane
P02	22/10/2025	Planning issue following comments.	N. Rumley	J. Pollard	J. Drane

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Contents.

Executive summary.

Purpose of report.
Hoare Lea have been appointed by Shall Do Hayes Development Ltd (hereafter referred to as 'the Applicant') to undertake a Whole Life Carbon Assessment (WLCA) for the Hayes Park West development, located in Hayes Park, Hillingdon, London (hereafter referred to as the 'Proposed Development'). This Whole Life Carbon (WLC) study has focused on providing the estimate of the WLC impact of the three primarily residential buildings. A primary source of input information for the assessment has come from the Stage 2 cost plan provided by Hennessy Godden, with further information provided by the design team.

This report has been prepared in accordance with the following policies:

- Hillingdon Local Plan, 2020 – DMEI 2 Reducing Carbon Emissions
- The London Plan, 2021 – Policy SI2 Minimising greenhouse gas emissions

The assessment has been undertaken in line with Greater London Authority (GLA) Whole Life-Cycle Carbon Assessments guidance, March 2022 and includes a summary of the following:

- Calculations of WLC accounting for upfront carbon, in-use embodied carbon, end of life carbon and operational utility (energy and water) carbon.
- Anticipated operational energy performance based on Part L energy modelling results for the Proposed Development.
- Comparison with industry benchmarks.
- Reduction opportunities to reduce WLC emissions.

Summary of results.
Upfront carbon, embodied carbon and WLC results for the Proposed Development are presented in Table 1 below.

Table 1 Summary of WLCA results, using carbon factors from Standard Assessment Procedure (SAP) 10.2.

	Proposed Development ($kgCO_2e/m^2$)
Upfront carbon (A1-A5)	765
Embodied carbon (A1-A5, B1-B5, C1-C4, incl. sequestration)	1,244
Embodied carbon (A1-A5, B1-B5, C1-C4, excl sequestration)	1,264
WLC (A1-A5, B1-B5, B6,B7, C1-C4, incl. sequestration)	1,621
WLC (A1-A5, B1-B5, B6,B7, C1-C4, excl. sequestration)	1,642

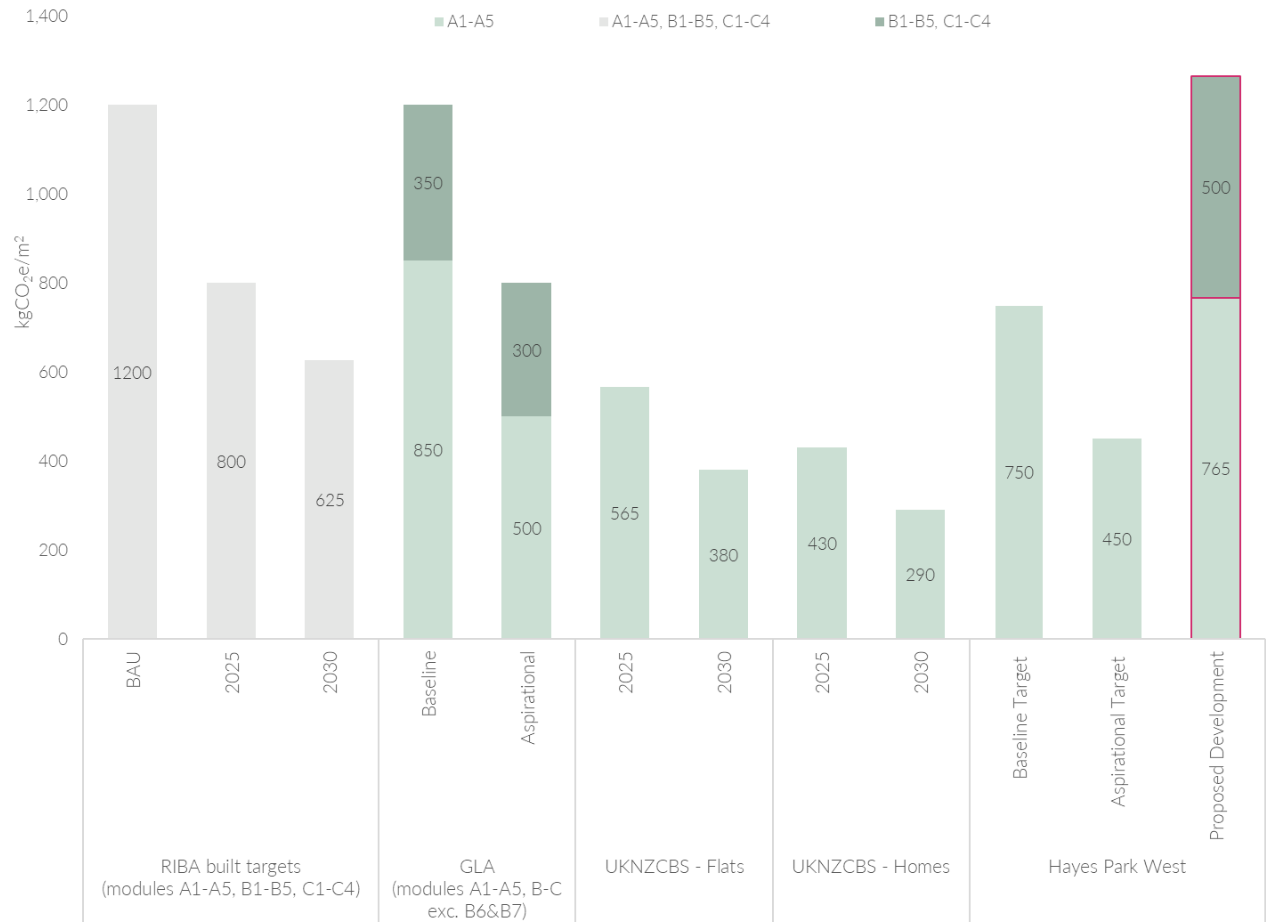


Figure 1 Results comparison with industry benchmarks

The A1-A5 upfront carbon performance for the Proposed Development is better than the GLA baseline targets of 850 $kgCO2e/m^2$ and slightly above (+2%) the proposed baseline target for the project of 750 $kgCO2e/m^2$. The major contributor to upfront carbon impact of the Proposed Development is the large volume of concrete and steel proposed in the structural design.

The module A-C embodied carbon performance is slightly above the GLA baseline target for the Proposed Development. The B1-B5 In-use and C1-C4 End-of-life impacts are higher than the GLA baseline targets, due to services and finish materials with shorter service lives and high waste processing emissions from recycling at end of life in line with RICS Whole Life carbon assessment guidance.

Further reduction opportunities.
An assessment of WLC reduction opportunities was performed on multiple building materials as part of this assessment following a carbon hotspot analysis.

- Since a large volume of concrete is associated with the building, there is an opportunity to increase the cement replacement to reduce the embodied carbon of the building. In addition, structural design optimisation would reduce material quantities, waste and emissions.
- Similarly, the use of reinforcement should be optimised, and the use of 100% recycled content rebar can be explored.
- Steel production using Electric Arc Furnace (EAF), compared to traditional blast furnace production, reduces A1-A3 carbon impacts by utilising recycled materials improving energy efficiency, and enables renewable energy use.

- The specification of durable materials and designing for longevity can reduce the in-use embodied carbon impacts by minimising replacements required.
- Use of low carbon materials and materials with high recycled content should be explored at further design and procurement stages.

The Proposed Development will seek to reduce the embodied carbon emissions further throughout the design and procurement phases.

1. Introduction.

1.1 Purpose of report.

The aim of this assessment is to assess the WLC for the Proposed Development. WLC is defined as 'those carbon emissions resulting from the construction and the use of a building over its entire life, including its demolition and disposal.' This assessment captures the operational carbon emissions for the Proposed Development from both regulated and unregulated energy use, as well as its upfront and embodied carbon emissions, i.e. those associated with raw material extraction, manufacture and transport of building materials, construction and the emissions associated with maintenance, repair and replacement as well as dismantling, demolition and eventual material disposal. The study also includes an assessment of the potential carbon emissions 'benefits' from the reuse or recycling of components after the end of a building's useful life.

The report presents the upfront and WLC performance of the Proposed Development at RIBA Stage 2 in working towards the project targets for upfront and WLC.

1.2 The Proposed Development.

This report has been prepared in support of the detailed planning application being submitted by Shall Do Hayes Developments Ltd ('the Applicant') to the London Borough of Hillingdon ('the Council') for the proposed residential development at Hayes Park West, Hayes Park, Uxbridge, UB4 8FE ('the site').

"Partial demolition and redevelopment of the existing multi storey car park to provide new homes (Use Class C3), landscaping, car and cycle parking, and other associated works." The Proposed Development has evolved through an extensive pre-application and wider stakeholder consultation process, which has included collaborative discussions with the Council, GLA, Historic England ('HE'), and a number of other key stakeholders.

The Proposed Development provides the opportunity to make sustainable use of a redundant, disused car park, and deliver a high-quality residential development that can enhance the setting of the adjacent listed buildings. The Proposed Development includes the provision of a high proportion of family homes, which is a significant planning benefit that directly addresses the Council's priority housing need.

From the outset, the Applicant has taken a carefully informed design approach, proposing a new building of outstanding architectural quality. The objective has been to enhance the setting of the adjacent listed buildings, providing a contextual architectural response and significantly improving the landscape setting.

The Proposed Development will deliver a range of planning benefits, completing the wider transformation of the Hayes Park estate and this unique new community.

Table 2 Proposed GIA

Use Class	Proposed GIA (m^2)
C3 – Residential	7,386

Table 3 Proposed housing mix

Bedrooms	Total
1 bed	16
3 bed	36
TOTAL	52

Figure 2 Proposed Development lower ground floor plan.

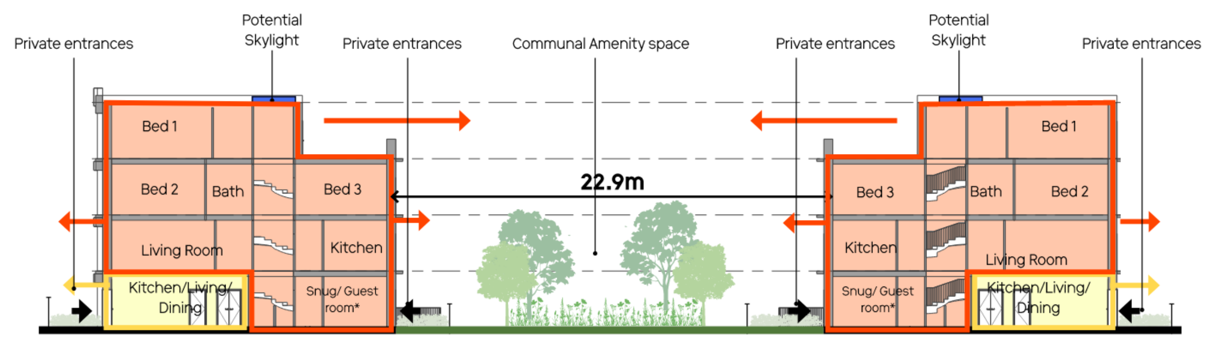


Figure 3 Proposed section.

1.3 Existing site description.

Hayes Park West ('the site') is located within the Charville Ward of the London Borough of Hillingdon ('the Council'), who will be the relevant Local Planning Authority for the application. The site sits within a wider former business park known as 'Hayes Park'.

The Hayes Park estate comprises a historically significant office campus in West London, situated in Hayes, and bounded by a structured, pastoral landscape. The estate is framed by the buildings known as Hayes Park North ('HPN'), Hayes Park Central ('HPC'), and Hayes Park South ('HPS'), both positioned within a broader landscape setting originally envisaged by architect Gordon Bunshaft as a modernist business park set in parkland. HPC and HPS are Grade II* listed due to their architectural and historic interest.

In recent years, the character and context of Hayes Park estate has undergone a fundamental shift from office use to residential, which following a series of planning applications is delivering 188 new homes. The relevant applications are as follows:

- Hayes Park North ('HPN') – a three-storey, early 2000s office building, was granted Prior Approval in 2022 for conversion to 64 homes (Ref: 12853/APP/2021/2202), followed by permission for external enhancements to the building (Ref: 12853/APP/2023/3720). These works are now on-site and being delivered.
- Hayes Park Central ('HPC') and Hayes Park South ('HPS') – both mid-century, listed office buildings, were granted full planning permission and listed building consent in early 2024 for conversion into 124 homes, with associated landscape enhancements (Ref: 12853/APP/2023/1492).

Hayes Park West is bound to the north and west by dense trees planting and open parkland, which is private land owned by the Church Commissioners. To the east the site is bound by HPN, and to the south by the listed HPC and HPS.

The entirety of the site and much of the surrounding land is located within the Green Belt. Beyond that, there are large areas of low-density terraced housing. There is a wide selection of parks and leisure facilities in the area, including the Hayes End Recreation Ground, Park Road Green and the Belmore Playing Fields. The nearest town centres are located at Hillingdon Heath Local Centre, 1.6km to the southwest, and at Uxbridge Road Hayes Minor Centre, 3.3km to the southeast.

The flood risk map for planning identifies that the site is located in Flood Zone 1, and as such has a low probability of flooding.

Figure 4 Existing site and structure.

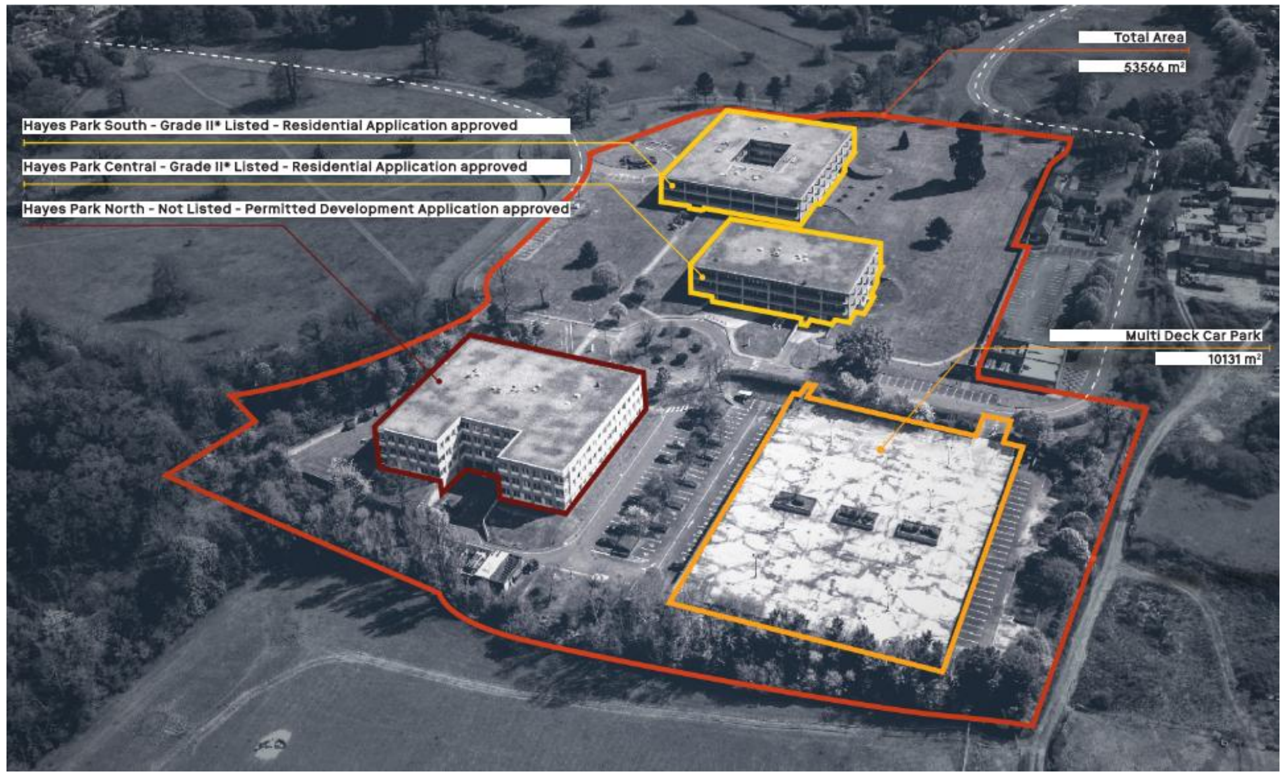


Figure 5 Ariel view of the existing site and approved planning applications.

2. Industry guidance and benchmarks.

2.1 WLC assessment modules.

In order to standardise WLC Assessments, they are reported against a number of stages as defined in EN 15978; 7.4. These life cycle stages begin with raw material extraction, moving through product manufacture, transportation, and installation within a development, this continues into maintenance and use of a site during operation, and eventual material disposal at the end-of-life stage. These stages are grouped into three modules, A, B, and C, representing upfront, operational, and end-of-life carbon, respectively, as set out in Error! Reference source not found.. Module D represents the circularity of products which are reused or recycled.

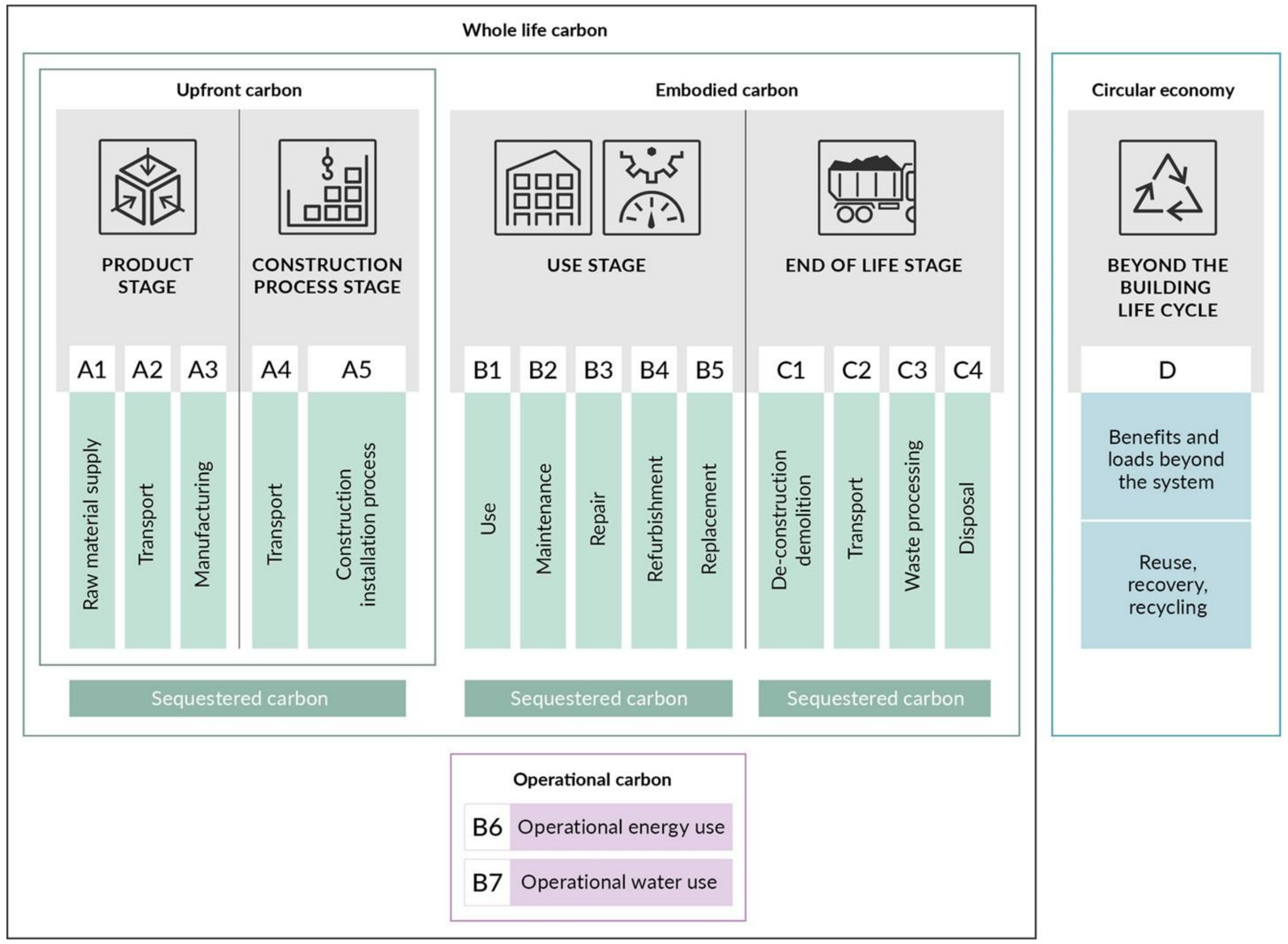


Figure 6 WLC Modules and Stages as defined by EN 15978; 7.4

2.2 RICS Whole Life Carbon.

The Royal Institute of Chartered Surveyors (RICS) professional statement: Whole Life Carbon Assessment (WLC) for the Built Environment Version 1, released in 2017, (RICS PS: WLCA V1) seeks to standardise WLC assessment and enhance consistency in outputs by providing guidance on implementing the broad appraisal methodology set out in EN 15978: Sustainability of Construction Works. This is in line with the GLA London Plan requirements.

2.3 London Borough of Hillingdon – Local plan.

Policy DMEI 2: Reducing carbon emissions.

- All developments are required to make the fullest contribution to minimising carbon dioxide emissions in accordance with London Plan targets.
- All major development proposals must be accompanied by an energy assessment showing how these reductions will be achieved.
- Proposals that fail to take reasonable steps to achieve the required savings will be resisted. However, where it is clearly demonstrated that the targets for carbon emissions cannot be met onsite, the Council may approve the application and seek an off-site contribution to make up for the shortfall.

Policy DMHB 11: Design of new development.

Design to the highest standards and incorporate principles of good design, including:

- Harmonising with local context;
- Using high quality materials and finishes;
- Ensuring internal design and layout maximises sustainability and is adaptable;
- Protecting positive value features, including safeguarding of heritage assets;
- Landscaping to protect and enhance amenity, biodiversity, and green infrastructure.

Must not adversely impact on the amenity, daylight and sunlight of adjacent properties and open space and safeguard the redevelopment of any adjoining sites with development potentials. Sufficient provision of well-designed waste storage space that avoids nuisance and visual impacts from bins. Integrate development with the surrounding area, taking account of area quality, including location-suited landscaping, use good quality materials and install public art where appropriate. Development should be accessible with improved legibility, promoted routes and wayfinding, provide pedestrian and cycle movement and incorporating inclusive design.

As the project is referable to the GLA, the London Plan policies are applicable the Proposed Development.

2.4 GLA WLC requirements.

The new London Plan came into effect on 2 March 2021. It mandates WLCA in a bid to meet net zero carbon commitments for referrable applications (150 Residential units, buildings over 30m in height or commercial buildings over 2,500sqm).

- Policy SI2: Minimising greenhouse gas emissions
  WLC emissions should be calculated for each project via a life

  cycle assessment (LCA) and the actions taken to reduce WLC emissions should be demonstrated. This is mandatory for referable applications, but it should be noted that GLA guidance on WLC encourages LCA to be done for all projects in London.

The GLA defines WLC as including operational carbon (heating, lighting and appliances), as well as embodied carbon from manufacture, maintenance and end-of-life.

The GLA guidance on WLC assessments follows EN 15978 (the European standard for measuring building performance) and the RICS PS: WLCA V1 (which has also been adopted by RIBA, the Royal Institute of British Architects). The GLA have adopted the RICS WLC methodology in their guidance methodology for WLCA of referable planning applications

Whilst the GLA does not provide specific targets for WLC, it provides "benchmarks" based on previous project assessments and have been cross referenced with data provided by WLC tools including OneClick LCA. The WLC benchmarks should be used as a guide by all applicants. The benchmarks provide a range rather than a set value and are broken down into building components. Projects with higher WLC emissions than the benchmarks should carefully examine how they can reduce WLC emissions.

2.5 Upfront and embodied carbon targets for residences.

Industry standards have been defined for embodied carbon, produced by LETI, RIBA, the GLA and the UK Net Zero Carbon Building Standard (UKNZCBS). Figure 7 provides a comparison of these embodied carbon targets.

- LETI targets relate to upfront carbon, i.e., building life cycle modules A1-A5.
- RIBA targets are the full building life cycle, i.e., building life cycle embodied carbon modules A1-A5, B1-B5, C1-C4.
- LETI targets related to the year of design.
- RIBA targets are performance based calculated over the 60-year expected operational period of the building.
- Both GLA and RIBA targets for embodied carbon (A1-C4, excluding B6 and B7) are reported including biogenic carbon sequestration.
- UK Net Zero Carbon Building Standard upfront targets for Homes and Flats.

Note: UKGBC Net Zero in Construction relates to upfront carbon impacts only, albeit whole life carbon analysis must also be considered.

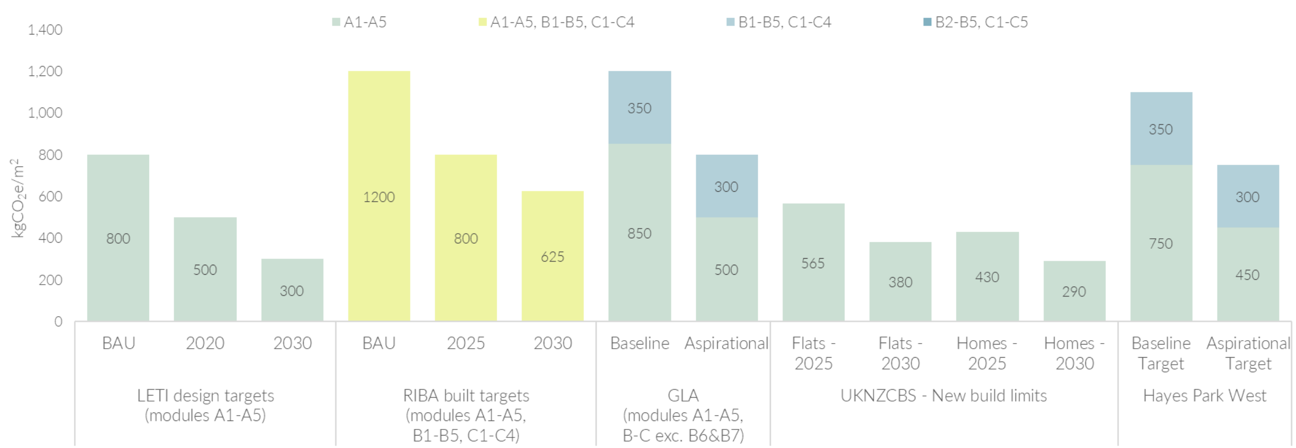


Figure 7: Embodied carbon targets for residences from LETI, RIBA, GLA and UK Net Zero Carbon Building Standard (Source: RIBA Climate Challenge 2020 v2, LETI embodied carbon primer, GLA Whole Life Cycle Carbon Assessments guidance 2022, UK Net Zero Carbon Building Standard 2024).

2.6 Life cycle assessment impacts.

A building LCA considers a range of environmental indicators that assess the relevant overall impacts of the materials selections. Whilst ideally an LCA assessment would consider all environmental factors relevant to the product or material, due to lack of information in some cases, and lack of consensus in how to calculate Key Performance Indicators (KPIs) within the industry, not all environmental impacts can be considered.

Standard ratios are used to convert the various greenhouse gases into equivalent amounts of CO_2. These ratios are based on the global warming potential (GWP) of each gas. GWP is a relative measure of how much a given mass of greenhouse gas is estimated to contribute to global warming over a given time interval – usually 100 years. It is expressed relative to carbon dioxide which is set as the baseline which other emitters are compared against, and which therefore has a GWP of 1.

This assessment thus reports on the embodied carbon of the development as 'global warming potential' with the annotation 'CO_2 equivalent (CO_2e)'.

3. Methodology and inputs.

3.1 Assessment scope.

The assessment of WLC emissions consists of the following sections: total operational carbon emissions (regulated plus unregulated); embodied carbon emissions; and any future potential carbon emission 'benefits', post end-of-life, including benefits from reuse and recycling of building structure and materials.

This assessment has been undertaken in line with the GLA guidance for undertaking WLCA and therefore in line with the RICS PS: WLCA V1.

3.1.1 Operational carbon emissions.

The operational carbon emissions for residential buildings are calculated based on Part L modelling. This encompasses carbon emissions related to energy use, accumulated over a 60-year study period.

3.1.2 Embodied carbon assessment and End-of-Life emissions.

To assess the embodied carbon for the project, an LCA tool – One Click LCA – has been used to make allocations for the anticipated material quantities in an inventory analysis. The materials are represented within the model by using materials with associated Environmental Product Declarations (EPDs). EPDs are produced by manufacturers and identify the carbon emissions of a product. By scheduling the materials proposed for the Proposed Development, the overall carbon emissions can be approximated.

It should be noted here that the LCA tool has a limited database of materials. In the scenario where a specified material isn't included in the database, the most similar material in terms of material composition is selected instead. In accordance with standard UK practice, the LCA process and results included by this report have been assessed in line with BS 15978:2011 and the RICS PS: WLCA V1. All EPDs used have been produced in line with the requirements of BS EN 15804:2012.

3.2 Inputs.

Table 4 lists the building elements covered by the assessment, in line with the RICS PS: WLCA V1.

Table 4 Data used in the embodied carbon assessment.

Building element group	Building element (NRM level 2)	Basis for information
0 Demolition	0.1 Toxic/hazardous/contaminated material treatment	An allowance for contaminated land removal and treatment has not been included at this stage of the design as it is not currently anticipated any treatment will be required. This can be considered further as the scheme progresses.
	0.2 Major demolition works	An allowance for demolition has been included based on the GLA assumption of 50kgCO2e/m².
0 Facilitating works	0.3 & 0.5 Temporary/enabling works	Material types and quantities are drawn from Stage 2 cost plan, with specification gaps informed by RICS guidance.
	0.4 Specialist groundworks	No specialist ground works were included.
1 Substructure	1.1 Substructure	Materials have been estimated in line with the Stage 2 cost plan provided by the cost consultant with material specification gaps informed by RICS guidance
2 Superstructure	2.1 Frame	Materials have been estimated in line with the Stage 2 cost plan provided by the cost consultant (Hennessy Godden), with
	2.2 Upper floors incl. balconies	
	2.3 Roof	

Building element group	Building element (NRM level 2)	Basis for information
	2.4 Stairs and ramps	material specification gaps informed by architectural layouts, RICS guidance and OneClick database.
	2.5 External walls	
	2.6 Windows and external doors	
	2.7 Internal walls and partitions	
	2.8 Internal doors	
3 Finishes	3.1 Wall finishes	Materials have been estimated in line with the Stage 2 cost plan provided by the cost consultant (Hennessy Godden), with material specification gaps informed by RICS guidance and OneClick database.
	3.2 Floor finishes	
	3.3 Ceiling finishes	
4 Fittings, furnishings and equipment (FF&E)	4.1 Fittings, furnishings & equipment incl. building-related* and non-building-related**	An allowance for FF&E has been provided using GLA guidance on % of FF&E.
5 Building services/MEP	5.1–5.14 Services incl. building-related* and nonbuilding-related**	Building services data has been provided by initial estimates from the MEP team (Hoare Lea) and benchmarking based off the GIA using in-built EPD within OneClick LCA.
6 Prefabricated Buildings and Building Units	6.1 Prefabricated buildings and building units	No prefabricated elements are applicable.
7 Work to Existing Building	7.1 Minor demolition and alteration works	Included in 0.2.
8 External works	8.1 Site preparation works	Included in within overall site construction impacts.
	8.2 Roads, paths, paving and surfacing	Materials have been estimated in line with the Stage 2 cost plan provided by the cost consultant (Hennessy Godden), with material specification gaps informed by RICS guidance and OneClick database.
	8.3 Soft landscaping, planting and irrigation systems	No allowance was considered for soft landscaping, planting and irrigation systems at this stage. This will be considered further as the scheme progresses.
	8.4 Fencing, railings and walls	These materials have been estimated in line with the Stage 2 cost plan provided by the cost consultant (Hennessy Godden).
	8.5 External fixtures	No external fixtures have been included in the WLCA at this stage.
	8.6 External drainage	External drainage was incorporated for within the build ups of the external paving and soft landscaping and the inclusion of the attenuation and stormwater tanks have been incorporated sitewide.
	8.7 External services	External services were excluded from the assessment due to lack of available data. This can be considered further as the scheme progresses
	8.8 Minor building works and ancillary buildings	No allowance was considered for minor building works and ancillary buildings. This can be considered further as the scheme progresses.

3.2.1 Life cycle modules.
Table 5 gives a description of each life cycle stage, and a commentary on the source of information used for each stage.

Table 5 The Life Cycle Modules included in the assessment and commentary on the data source.

Module	Description	Commentary on Data Source
A1-A3 Construction Materials	Raw material supply (A1) includes emissions generated when raw materials are taken from nature, transported to industrial units for processing and processed. Loss of raw material and energy are also taken into account. Transport impacts (A2) include exhaust emissions resulting from the transport of all raw materials from suppliers to the manufacturer's production plant as well as impacts of production of fuels. Production impacts (A3) cover the manufacturing of the production materials and fuels used by machines, as well as handling of waste formed in the production processes at the manufacturer's production plants until end-of-waste state.	Calculated using EPD's which align with the most applicable similar product. (See Appendix A for standard specifications).
A4 Transportation to site	A4 includes exhaust emissions resulting from the transport of building products from manufacturer's production plant to building site as well as the environmental impacts of production of the used fuel.	Transport distances were estimated based on typical average transport distances based on material type & project location, in line with RICS standard assumptions, (See Appendix A).
A5 Construction/ installation process	A5 covers the exhaust emissions resulting from using energy during the site operations, the environmental impacts of production processes of fuel and energy and water as well as handling of waste until the end-of-waste state.	A5 assumptions have been estimated based on an assumption of 50kgCO2e/m2 of GIA.
B1 In-Use Emissions	The in-use module B1 captures the in-use emissions arising from the life of a building from its components. It is expected that the	The refrigerant leakage rates are taken in line with CIBSE TM65.

Module	Description	Commentary on Data Source
	primary contributor to this will be the fugitive emissions stemming from refrigerant leakage.	
B2 & B3 Maintenance and Repair	Module B2 accounts from the carbon emissions arising from any activity relating to maintenance and cleaning. Module B3 accounts or any of the carbon emissions relating to repair.	Following GLA WLC Guidance: B2 has been assumed to be the greater of either 10 $kgCO_2e/m^2$ or 1% of the emissions produced in modules A1-A5. B3 has been assumed to be 25% of B2.
B4 & B5 Material Replacement/Refurbishment	The emissions B4 and B5 cover impacts from raw material supply, transportation, and production of any replaced new material as well as the impacts from manufacturing the replaced material and handling of waste until the end-of-waste state.	Modules B4/B5 has been determined with reference to the 'indicative component lifespans' contained within the RICS PS: WLCA V1. (See Appendix A for lifespan)
B6 Energy use	The considered use phase energy consumption (B6) impacts include exhaust emissions from any building level energy production as well as the environmental impacts of production processes of fuel and externally produced energy. Energy transmission losses are also taken into account.	Energy consumption has been estimated using Part L modelling results for the building.
B7 Water use	The considered use phase water consumption (B7) impacts include the environmental impacts of production processes of fresh water and the impacts from wastewater treatment.	The annual water consumption figure has been estimated using the BSRIA guidance in line with the RICS PS: WLCA V1.
C1-C4 Deconstruction	The impacts of deconstruction include impacts for processing recyclable construction waste flows for recycling (C3) until the end-of-waste stage or the impacts of pre-processing and landfilling for waste streams that cannot be recycled (C4) based on type of material. Additionally, deconstruction impacts include emissions caused by waste energy recovery.	C1 Deconstruction/demolition) and C2 (Transport) are based on default values. C3 (Waste Processing) and C4 (Disposal) use OneClick LCA's default end of life scenarios, please refer to the Appendix A for further detail.
D External impacts/end-of-life benefits	External benefits for re-used or recycled material types include the positive impact of replacing virgin-based material with recycled material and the benefits of the energy which can be recovered from the materials.	D (End of Life) use OneClick LCA's default end of life scenarios, please refer to the Appendix for further detail.

3.3 Data sources.

There are a number of approaches to complete a building specific LCA. In particular, a flexible approach is needed when utilising a dataset of product specific EPDs and more generic data calculated within the LCA tool.

Table 6 Types of data required for a WLC assessment.

Data Source	Comments
Cost Plan	Cost plans can be useful for calculation of uncertain quantities which are not product specific, however often an allowance is made at early design stages which may reduce accuracy.
Operational Energy	Part L energy modelling results encompassing predicted annual regulated energy use and SAP used to calculate unregulated energy use.
Operational water	Estimates provided by MEP consultant (Hoare Lea).
MEP service equipment and refrigerant	Estimates provided by MEP consultant (Hoare Lea).

The assessment has utilised multiple data sources described above and is based on the level of detail available at the current stage of design.

3.4 SAP 10.

The WLC assessments have been undertaken based on SAP10.2 emissions factors. The figures are based on the current status of the electricity grid and provides a point-in-time assessment. For materials manufactured in the UK, SAP 10 emission factors are used in line with the GLA's Energy Assessment Guidance. Products sourced from outside the UK use data appropriate to the local energy grid at that location.

3.5 Carbon reduction in current design.

During workshops with the design team, it was recognised that some carbon reduction opportunities had already been embedded into the scheme design. These measures include:

- Partial retention of the existing car park level.
- Lightweight steel structure proposed reducing the quantity of concrete proposed in the structure.
- Pad foundations from the existing structure to be reused.
- High performance GRC is being proposed in the façade, proving a durable finish. GRC cladding panels provide carbon savings compared to traditional precast panels.
- Concrete GGBS specified at the industry minimum standard of 20% across the structure.
- Timber framed windows are proposed across the Proposed Development.

4. Results.

4.1 Operational carbon emissions.

Operational carbon emissions are calculated based on the Part L energy modelling based on SAP methodology for the buildings. This encompasses carbon emissions related to regulated and unregulated energy uses, accumulated over a 60-year study period. Table 7 summarises the total operational carbon emissions for the Proposed Development.

Table 7 Summary of operational carbon emissions for the proposed Residential buildings.

B6 Operational energy - Regulated ($kgCO_2e/m^2$)	B6 Operational energy - Unregulated ($kgCO_2e/m^2$)	B7 Operational water use	Total ($kgCO_2e/m^2$)
187	191	2	380

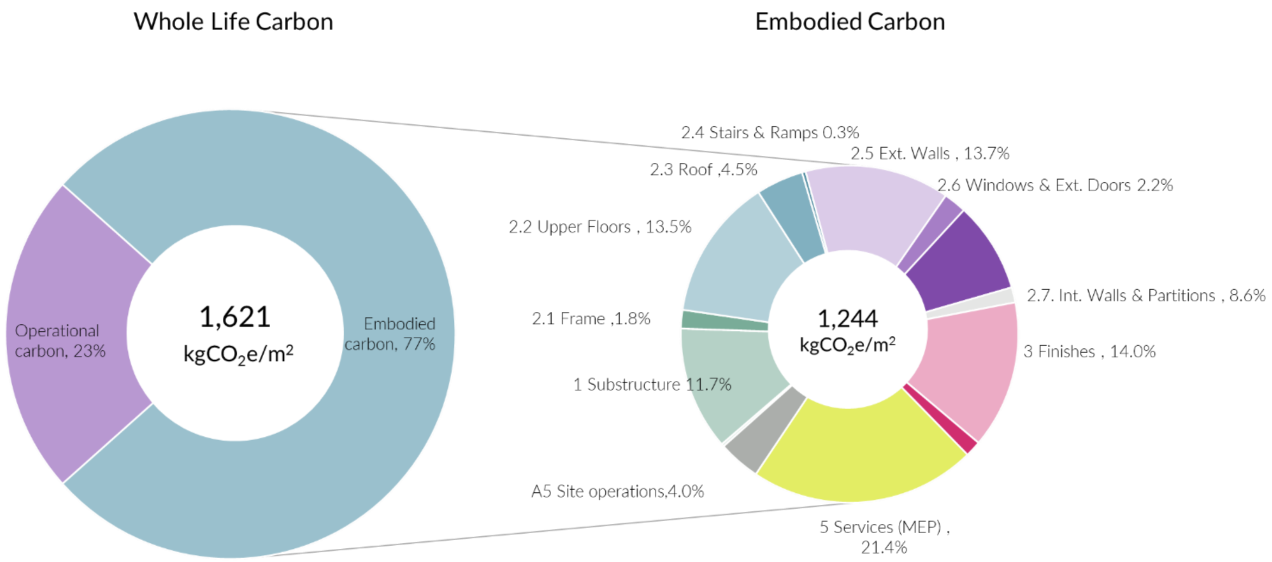


Figure 8 Whole life carbon results breakdown, including operational and embodied carbon

Figure 8 shows a breakdown of the estimated operational and embodied carbon emissions. The operational carbon emissions include both the operational energy use (B6) and the operational water use (B7) which in total contribute 23% of the total building emissions over its 60-year lifetime.

For more detail on the operational energy, please refer to the Energy Strategy (*5500043-HLE-XX-XX-RP-ST-402026*).

4.2 Upfront, embodied and WLC.

Upfront carbon, embodied carbon and WLC results for the Proposed Development are presented in Table 8.

Table 8 Upfront, embodied, and WLC targets.

	Results ($kgCO_2e/m^2$)
Upfront carbon (A1-A5)	765
Embodied carbon (A1-A5, B1-B5, C1-C4, incl. sequestration)	1,244
Embodied carbon (A1-A5, B1-B5, C1-C4, excl. sequestration)	1,264
WLC -SAP 10 (A1-A5, B1-B5, B6, B7, C1-C4, incl. sequestration)	1,621
WLC -SAP 10 (A1-A5, B1-B5, B6, B7, C1-C4, excl. sequestration)	1,642

Figure 9 shows estimated upfront carbon impact broken down by RICS building element categories.

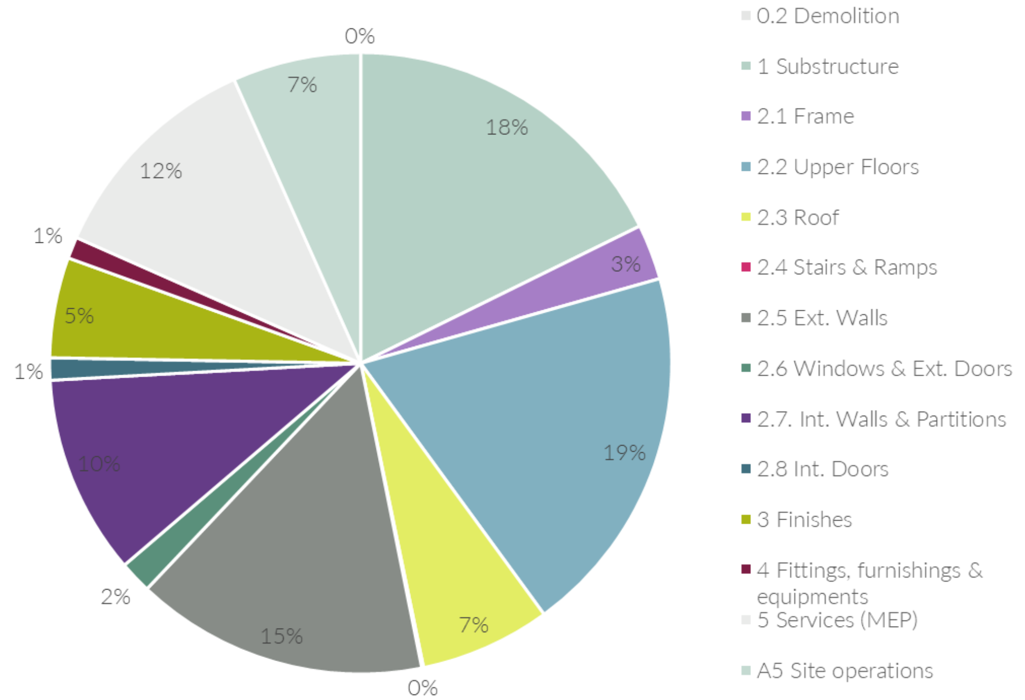


Figure 9 Upfront carbon broken down by building element

Figure 9 demonstrates that the main elements contributing to the upfront carbon emissions include: the Upper Floors accounting for 19% of the total upfront carbon impact. Similarly, the Substructure contributes 18%, followed by the External walls (15%) and Internal walls & partitions (10%). Given the volume of new materials such as concrete and steel in these elements, this is expected for a new building of this scale.

A breakdown of the embodied carbon is shown in Figure 10.

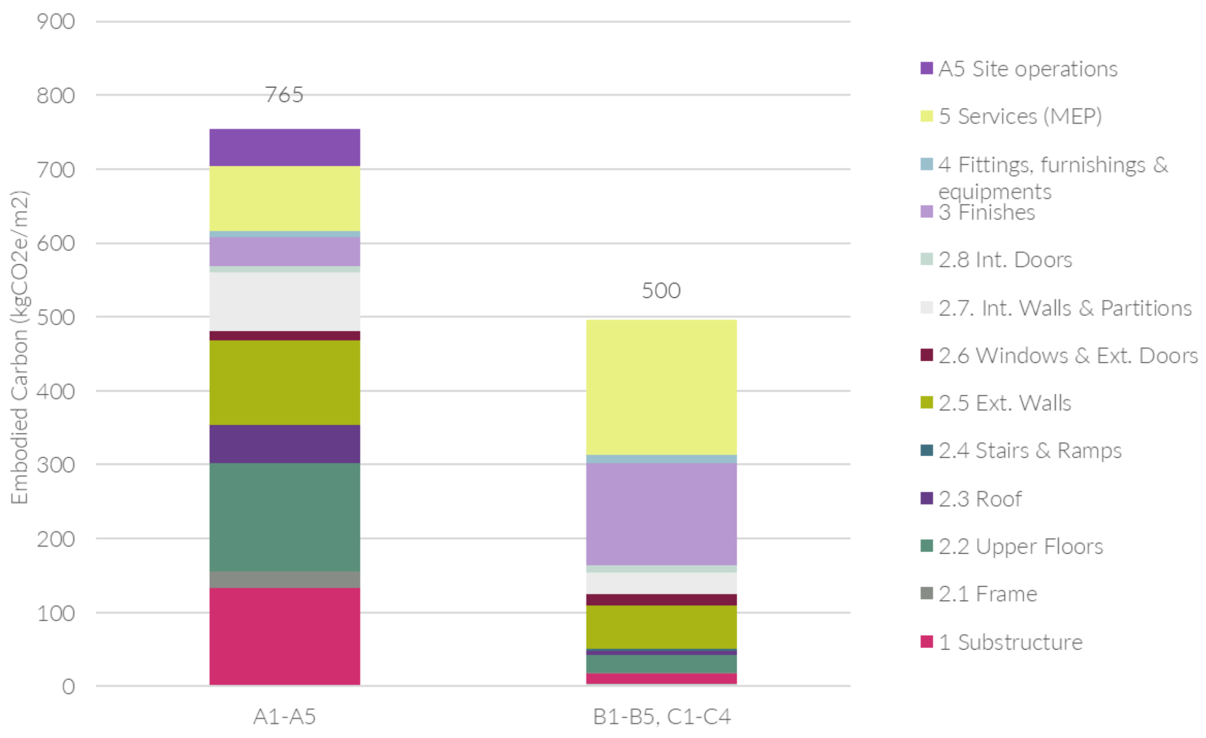


Figure 10: Breakdown of the embodied carbon by building element category.

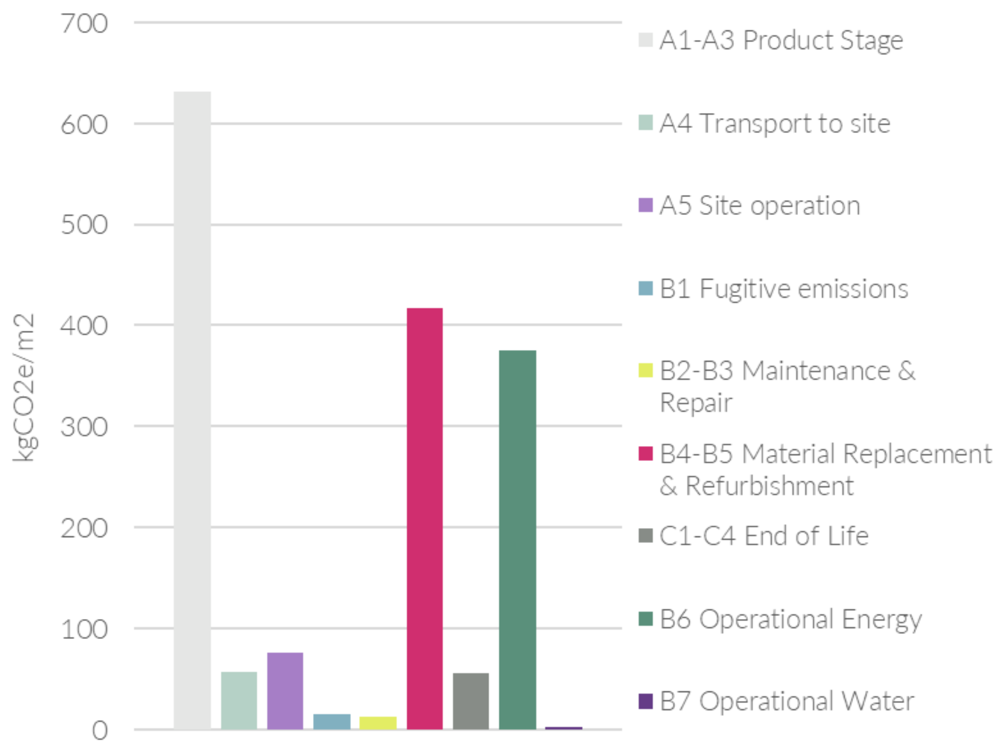


Figure 11: WLC results breakdown by Life Cycle Module

The majority of the impacts are from the upfront carbon module A1-A5, due to the quantity of new materials and construction processes required to construct the building. For modules B-C, impacts come from the services and finishes, as it is expected that there will be material replacements over the expected life of the building.

MEP equipment typically have lower expected service life than that of the whole building, which is typically designed for a standard 60 year expected life. The in-use (Module B) impacts of these elements is therefore due to the consideration of the added carbon impact of replacement and refurbishment (life cycle modules B4 & B5) of materials and components during the in-use phase of the building. In addition, there are relatively high impacts associated with end of life (Module C) due to the processing of materials during recycling. It is anticipated that best practice end-of-life scenarios will be delivered during demolition of the building, which involves maximising recycling of materials.

Figure 11 gives a breakdown of the WLC results by life cycle module.

4.3 Comparison with benchmarks.

A comparison of the upfront and embodied carbon results with industry benchmarks is shown in Figure 12.

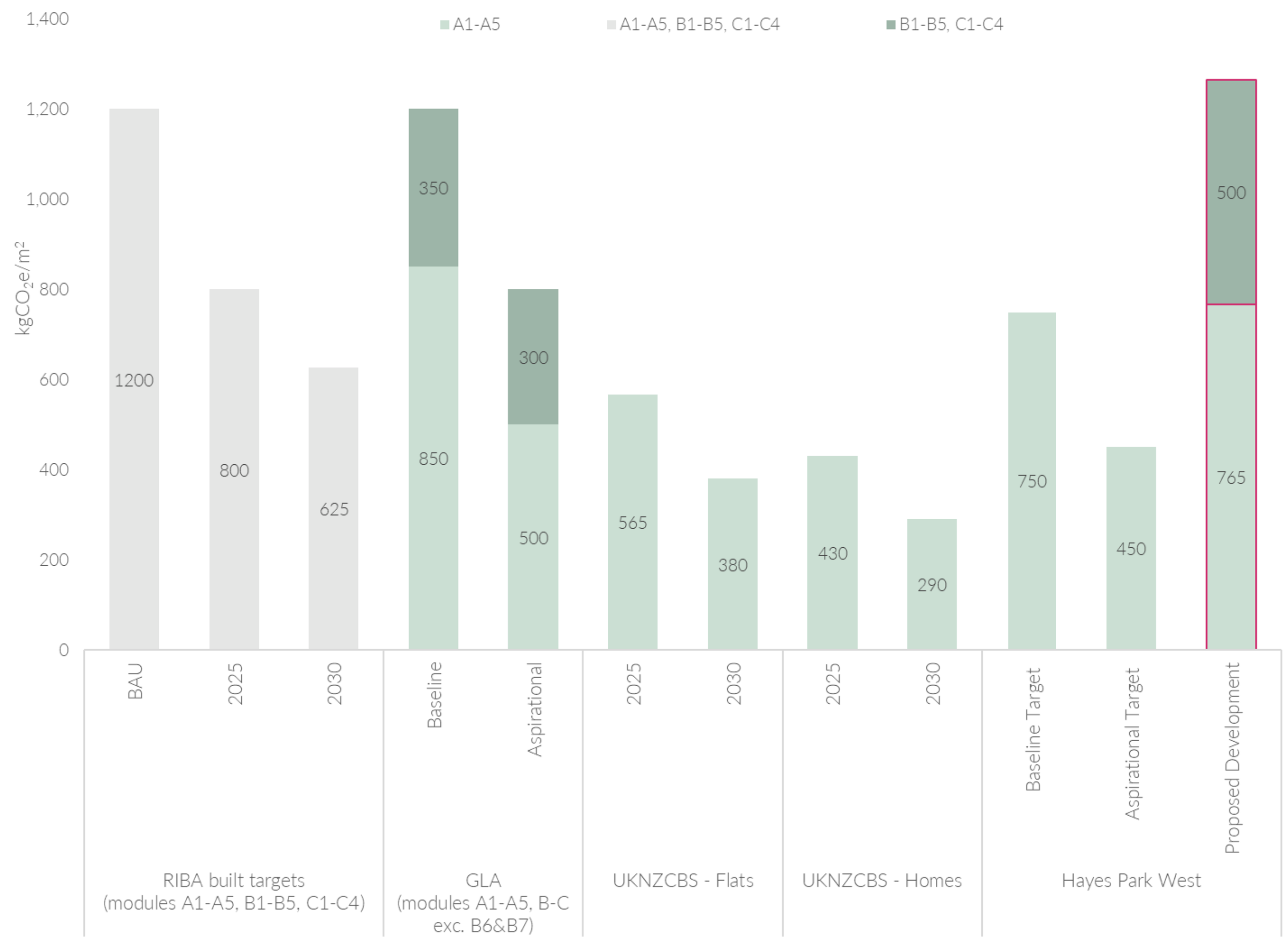


Figure 12: Results comparison with industry benchmark targets.

The A1-A5 upfront carbon performance is better than the GLA baseline targets of 850 $kgCO2e/m^2$. When compared with the project targets, the building exceeds the aspirational target and is slightly above the baseline target.

The Proposed Development's embodied carbon (A1-C4, excld. B6 & B7) performance is higher than the GLA baseline and the GLA aspirational target for residential buildings.

The B1-B5 In-use and C1-C4 End-of-life impacts exceed than the GLA baseline targets, due to short service lives of services and finishes, and high recycling rates anticipated at end of life in line with RICS Whole Life carbon assessment guidance.

A comparison of the upfront carbon per building element, and the GLA benchmarks elemental breakdown, is shown in Figure 13.

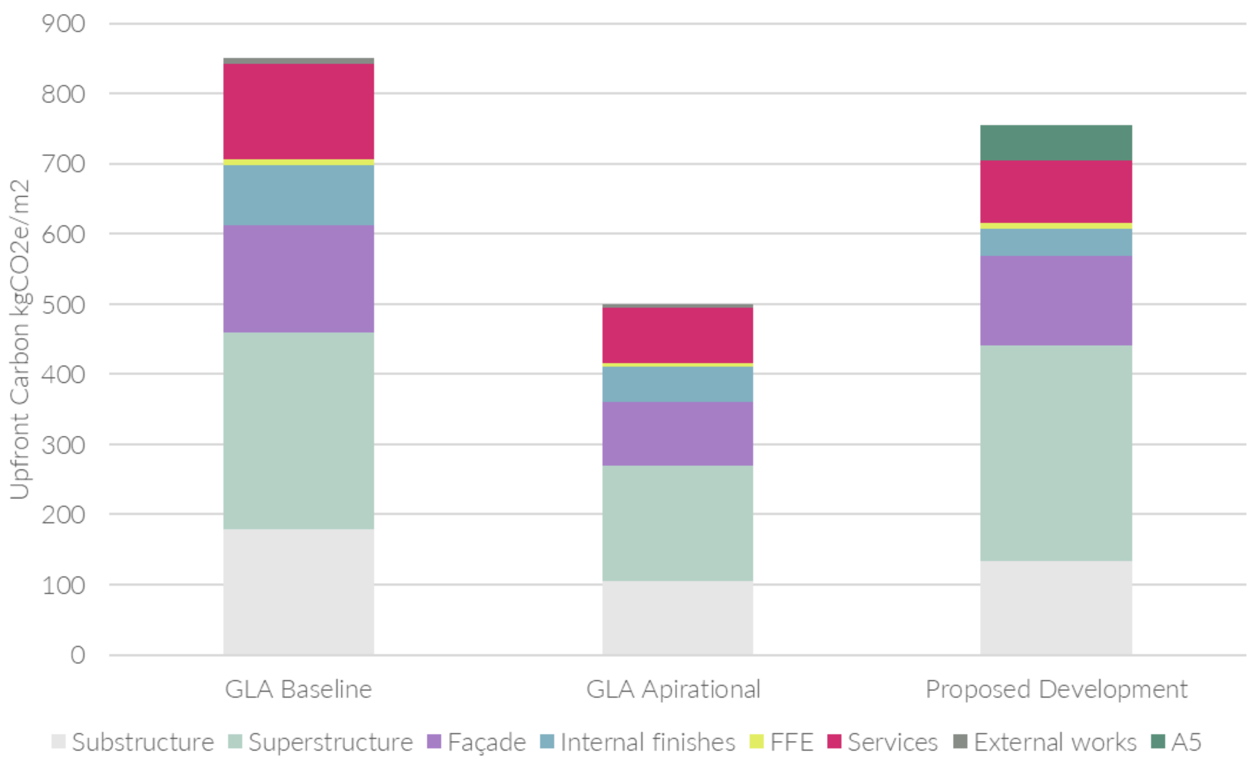


Figure 13: Upfront carbon breakdown (A1-A5) per building element- GLA benchmarks vs Proposed Development (including A5 impacts)

The upfront carbon impacts for the Substructure, Façade, Finishes and Services is similar to the GLA benchmarks for these elements (Figure 13), whereas the Superstructure exceeds the GLA baseline benchmark due to the buildings form and new upper floor structure proposed. External works impacts perform better than expected, however there were limited EPD's available for external works in the design. Soft landscaping is generally excluded in LCA. Internal finishes also perform slightly better than the baseline for upfront carbon. The materials in this layer of the building have most impacts during the in-use stage of embodied carbon as a result of replacements and refurbishments.

Overall, the building performs similar to the building element breakdown for the GLA residential baseline target.

4.4 Carbon hotspots.

The most contributing materials identified are listed in Table 9 below.

Table 9 Most contributing materials (A1-A3)

Resource	Cradle to gate impact (A1-A3 (tCO2e))
Ready-mix concrete	1,487
Steel framing	365
Steel rebar	283
Insulation	236
Steel deck	231

4.5 Carbon reduction opportunities.

Following the analysis of the carbon hotspots for the Proposed Development, a number of carbon reduction opportunities have been identified. An assessment of WLC reduction opportunities was performed on multiple building materials as part of this assessment. Table 10 provides the list of carbon reduction opportunities explored and their individual carbon reduction potential modelled to calculate the carbon impact.

Table 10 Summary of carbon reduction opportunities

No.	Reduction opportunity	Embodied Carbon reduction potential ($kgCO_2e/m^2$)
0	Baseline	1,244
1	Concrete GGBS increased from 20% to 50%	-58
2	GRC panels replaced with Fiber concrete cladding panels	-14
3	100% recycled steel rebar	-13
4	Rockwool insulation in walls & foamglass in floor	-13
	Embodied carbon total following reduction opportunities	1,146 $kgCO_2e/m^2$

The cumulative impact of all the carbon reduction opportunities explored shows that the embodied carbon impact of the Proposed Development can be reduced by about 98kg $CO2e/m^2$ by incorporating these design measures. The resultant embodied carbon impact would be estimated to be 1,146 $kgCO2e/m^2$. This represents approx. 8% saving in embodied carbon impact as compared to the current baseline design for the Proposed Development.

Following the modelling of potential carbon reduction opportunities, the embodied carbon emissions are estimated as 1,146 $kgCO2e/m^2$. While this still exceeds the GLA's aspirational target of 800 kg $CO2e/m^2$, the embodied carbon impact is approx. 5% lower than the GLA baseline target of 1,200 kg $CO2e/m^2$.

Based on the carbon hotspot analysis of the design, further carbon reduction opportunities have been identified:

- Ready-mix concrete with 20% GGBS was assumed for structural concrete in line with RICS. Since a large volume of concrete is associated with the building, there is an opportunity to increase the cement replacement to reduce the embodied carbon of the building.
- Similarly, reinforcement design should be optimised, and use of 100% recycled content rebar can be explored.
- Structural framing is also identified as the second most contributing material. Typically, 20% recycled content is assumed as per the RICS guidance. Steel production using Electric Arc Furnace (EAF), compared to traditional blast furnace production, reduces A1-A3 carbon impacts by utilising recycled materials improving energy efficiency, and enables renewable energy use.

- Module B4 - Material replacement is one of the highest contributing modules across the life cycle assessment. The specification of durable materials and designing for longevity can reduce the in-use embodied carbon impacts by minimising replacements required.
- C2 Waste transport and C3 Waste processing are also relatively high modules. The end-of-life scenario for materials assumes best practice which typically involves recycling of materials and processing. Although transporting and processing waste require energy and generate emissions, these activities are essential to divert materials from landfill, which has far greater environmental consequences. Maximising value of materials ultimately supports the transition to low-carbon, circular construction.
- Use of low carbon materials and materials with high recycled content should be explored at further design and procurement stages.

4.6 Limitations.

The following limitations have been identified for this assessment:

- This WLCA) has been prepared using an early-stage cost plan and reflects the design information available at this stage.
- Due to lack of available data at this stage in the project, an assumption for FFE materials has been included based on GLA benchmarks. It is assumed external furniture will be included in the FFE assumption.
- There is a general lack of data pertaining to the availability of carbon impact or EPDs for MEP equipment and external works. Where feasible EPDs based on GIA have been selected in OneClick LCA tool to cover the complete scope of MEP services.
- RICS early-stage assumptions have been used to fill data gaps where relevant. While this is an acceptable industry practice, this likely to impact the accuracy of the WLCA at this stage. As the design progresses, it is expected that the accuracy of the WLCA will increase with the availability of further detailed design information.
- Studies have shown that carbon performance of materials and components can vary significantly as per manufacturer as well as with change in specifications. It is recommended for the design team to liaise with the manufacturers and suppliers to provide EPDs for materials and components being considered for the project.

5. Conclusion.

This report has summarised the WLC impacts for the Proposed Development, with the results analysed for the following scopes, commonly referred to in industry:

- Upfront carbon (modules A1-A5 excluding sequestration).
- Embodied carbon (modules A1-A5, B1-B5, C1-C4 including sequestration).
- Operational energy (module B6).
- Whole Life Carbon (modules A-C, module D reported separately).

This WLC has been prepared in line with the RICS PS: WLCA V1. A summary of the results can be found in Table 11.

Table 11: Upfront, embodied and WLC results.

	Proposed Development ($kgCO_2e/m^2$)
Upfront carbon (A1-A5)	765
Embodied carbon (A1-A5, B1-B5, C1-C4, incl. sequestration)	1,244
Embodied carbon (A1-A5, B1-B5, C1-C4, excl sequestration)	1,264
WLC (A1-A5, B1-B5, B6,B7, C1-C4, incl. sequestration)	1,621
WLC (A1-A5, B1-B5, B6,B7, C1-C4, excl. sequestration)	1,642

The primary contributors to embodied carbon emissions were concrete and steel, which accounted for a substantial portion of the total. The project demonstrates strong performance relative to the GLA baseline benchmarks. Nevertheless, additional opportunities for impact reduction have been identified. These include the adoption of low-carbon materials—such as those with recycled content or composed of recycled materials—and the optimisation of material use to further decrease the embodied carbon associated with key construction materials.

Further design development will continue to prioritise low-carbon materials, enhance energy efficiency measures, and material optimisation to further reduce the overall carbon impact of the Proposed Development.

5.1 Further carbon reduction opportunities.

An assessment of WLC reduction opportunities was performed on multiple building materials as part of this assessment. Additional opportunities were identified based on the carbon hotspots from the assessment:

- Ready-mix concrete with 20% GGBS was assumed for structural concrete in line with RICS. Since a large volume of concrete is associated with the building, there is an opportunity to increase the cement replacement to reduce the embodied carbon of the building. In addition, structural design optimisation would reduce material quantities, waste and emissions.
- Similarly, reinforcement design should be optimised, and use of 100% recycled content rebar can be explored.
- Structural steel framing is also identified as the second most contributing material. Typically, 20% is assumed as per the RICS guidance. Steel production using Electric Arc Furnace (EAF), compared to traditional blast furnace production, reduces A1-A3 carbon impacts by utilising recycled materials improving energy efficiency, and enables renewable energy use.
- Module B4 - Material replacement is one of the highest contributing modules across the life cycle assessment. The specification of durable materials and designing for longevity can reduce the in-use embodied carbon impacts by minimising replacements required.
- C2 Waste transport and C3 Waste processing are also relatively high modules. The end-of-life scenario for materials assumes best practice which typically involves recycling of materials and processing. Although transporting and processing waste require energy and generate emissions, these activities are essential to divert materials from landfill, which has far greater environmental consequences. Maximising value of materials ultimately supports the transition to low-carbon, circular construction.
- Use of low carbon materials and materials with high recycled content should be explored at further design and procurement stages.

The Proposed Development will seek to reduce the embodied carbon emissions further throughout the design and procurement phases

Appendix A – WLC assumptions.

Table 12 Default Material Specification for UK Projects, used in the absence of detailed information (RICS 2017)

Material	Details	Specification
Concrete	Piling	C32/40, 20% cement replacement
	Substructure	C32/40, 20% cement replacement
	Superstructure	C32/40, 20% cement replacement
	Generic Concrete	C16/20, 0% cement replacement
Steel	Reinforcement bars	97% Recycled Content
	Structural Steel sections	20% Recycled Content
	Studwork/Support frames	Galvanised Steel, 15% Recycled Content
Blockwork	Precast Concrete blocks	Lightweight blocks for building envelope
		Dense blocks for other uses
Timber	Manufactured Structural Timber (CLT, Glulam etc.)	100% FSC/PEFC
	Formwork	Plywood
	Studwork/Framing/Flooring	Softwood
Aluminium	Cladding Panels	Aluminium sheet, 35% Recycled Content
	Glazing Frames	Aluminium extrusions, 35% Recycled Content
Plasterboard	Partitioning/Ceilings	Min. 60% Recycled Content

Table 13 Refrigerant leakage rates as of CIBSE TM65

Product	Annual leakage rate	End of life recovery rate
Package heat pump or chiller, where no refrigerant is managed on site	2%	99%
Heat pump or chiller where some works to refrigerant pipework are carried out on site	4%	98%
VRF systems where a large amount of refrigerant pipework is installed and filled on site.	6%	97%

Table 14 Default Transport Distances for UK Projects (RICS 2017)

Transport Scenario	km by road	km by sea
Locally manufactured e.g. concrete, aggregate	50	-
Nationally manufactured e.g. plasterboard, blockwork, insulation	300	-
European manufactured e.g. CLT, façade modules, carpet	1,500	-
Globally manufactured e.g. specialist stone cladding	200	10,000

Table 15 Default component lifespans (RICS, 2017)

Building part	Building element	Expected lifespan
Roof	Roof covering	30
Superstructure	Internal partitions and linings	30
Finishes	Wall finishes: Render/Paint	30/10
	Floor finishes: Raised Access Floor/Finish layers	30/10
	Ceiling finishes: Substrate/paint	20/10
FF&E	Furniture and fittings	10
Services/MEP	Heat source	20
	Space heating/ air treatment	20
	Ductwork	20
	Electrical installations	30
	Lighting fittings	15
	Communications installations/ controls	15
	Water and disposal installations	25
	Sanitaryware	20
	Lift and conveyor installations	20
Façade	Opaque modular cladding, e.g. rainscreen, timber panels	30
	Glazed cladding/ curtain walling	35
	Windows and external doors	30

Table 16 Default End-of-Life Scenarios (OneClick LCA)

Material group	End of life scenario	Materials included	C3 – C4, waste processing and landfilling	D, recycling benefits
Mineral building materials	Recycling for ground works	Concrete*, Cement*, Bricks, Porcelain, Plaster, Clay products, Stone, Ceramics, Asphalt	C3: Construction waste preparation for recycling	Recycling benefit from replacing the primary gravel
Metals	Metal preparation and recycling**	Aluminium, Steel, Stainless steel, Galvanized steel, Copper coated, Copper uncoated, Brass, Zinc, Lead	C3: Metal waste preparation	Recycling benefits for replacing virgin metal
Biobased materials with heating value	Incineration and energy recovery	Wood, Wood products	C3: Construction waste incineration for energy recovery	Recovered energy

Material group	End of life scenario	Materials included	C3 – C4, waste processing and landfilling	D, recycling benefits
Other materials with heating value	Incineration and energy recovery	Plastics	C3: Construction waste incineration for energy recovery	Recovered energy
Other materials that can be landfilled in construction waste site	Disposal / landfilling of inert material	Coatings, Synthetic materials, Panels and boards***, Insulating materials***, Glass, Window and façade components***	Disposal of inert construction waste	-

Appendix B – Terminology.

The following note provides a summary of key terminology commonly used when discussing life cycle assessments and accompanying works, and the definitions associated with each term.

Life Cycle Assessment (LCA)
A life cycle assessment is an overarching term used for assessing the environmental aspects associated with a product or asset over its life cycle. Common LCA scopes include embodied carbon, upfront carbon, and whole life carbon assessments.

Greenhouse gases (GHG)
'Greenhouse Gases' are constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of infrared radiation emitted by the Earth's surface, the atmosphere, and clouds. They are also referred to as 'carbon emissions' in general usage, carbon being the most common of the greenhouse gases.

Carbon dioxide equivalent (CO_{2e})
Greenhouse Gas emissions are often expressed as CO_2 equivalent (CO_2e or CO_2eq), a unit of measurement based on the relative impact of a given gas on global warming over a given time period. For example, over 100 years methane has a global warming potential of 28, or 1kg of methane has the same impact on climate change as 28kg of carbon dioxide and thus 1kg of methane would count as 28kg of CO_2e.

Building lifecycle modules
Building lifecycle modules are defined by BS EN 15978:2011 and determine the system boundaries of an assessment. The modules cover the whole life cycle of a building, from product stage (A1-A3) construction and transport (A4-A5) in-use (B1-B7), end of life (C1-C4) and benefits and loads beyond the system boundary (D).

Whole Life Carbon (WLC)
'Whole Life Carbon' emissions are the sum total of all asset related GHG emissions and removals, both operational and embodied over the life cycle of an asset including its disposal (Modules: A1-A5; B1-B7 (plus B8 and B9 for Infrastructure only); C1-C4). Whole Life Carbon asset performance includes separately reporting the potential benefit from future energy recovery, reuse, and recycling (Module D).

Embodied carbon
The 'Embodied Carbon' emissions of an asset are the total GHG emissions and removals associated with materials and construction processes throughout the whole life cycle of an asset (Modules A1-A5, B1-B5, C1-C4).

Upfront carbon
'Upfront Carbon' emissions are the GHG emissions associated with materials and construction processes up to practical completion (Modules A1-A5). Upfront carbon excludes the biogenic carbon sequestered in the installed products at practical completion.

Operational carbon
Operational carbon is the GHG emissions arising from all the energy consumed (Module B6), water supply and wastewater treatment (Module B7) by the asset in-use, over its life cycle.

Carbon sequestration
Carbon sequestration is the process by which carbon dioxide is removed from the atmosphere and incorporated as biogenic carbon in biomass, through photosynthesis and other processes associated with the carbon cycle. In LCAs we typically consider sequestration when incorporating timber in buildings.

Environmental Product Declarations (EPDs)
An Environmental Product Declaration is a document which transparently communicates the environmental performance or impact of any product or material over its lifetime. EPDs are generated based on data obtained through a product level LCA in line with EN 15804, ISO 14025, or other related international standards.

EPDs support carbon emission reduction by making it possible to compare the impacts of different materials and products in order to select the most sustainable option and are used when undertaking asset level LCAs to illustrate carbon performance.

Net zero carbon – construction
When the amount of carbon emissions associated with a building's product and construction stages up to practical completion (Modules A1-A5) equals zero.

Net zero carbon – embodied
When the amount of carbon emissions associated with a building's product and construction stages throughout the whole life cycle of the asset (Modules A1-A5, B1-B5, C1-C4) equals zero.

Net zero carbon – operational energy
When the amount of carbon emissions associated with the building's operational energy (Module B6) on an annual basis is equals zero. A net zero carbon building is highly energy efficient and powered from on-site and/or off-site renewable energy sources, with any residual emissions offset.

Net zero carbon – whole life
When the sum total of all asset related GHG emissions, both operational and embodied, over an asset's life cycle (Modules A1-A5, B1-B7, C1-C4) are minimized, meet local carbon, energy and water targets, and with residual emissions 'offset', equals zero.

Appendix C – Whole life carbon context.

Background to Life Cycle Assessment and embodied carbon.
Global climate change is widely considered to be one of the most pressing challenges at a regional, national and international level. Industrialisation has resulted in the use of refined and unrefined fossil fuels as an energy source and since the start of the industrial revolution, use of fossil fuels and their resultant release of carbon dioxide into the atmosphere has caused an exponential increase in the concentration of carbon dioxide and other pollutants that are generally agreed to result in increasing global average surface temperature.

Given the wide-ranging impacts of climate change urgent action is required to limit carbon dioxide and limit the impacts of climate change.

Carbon emissions from operational use of buildings has been the subject of regulation for some time and has historically been the primary focus of reducing the impact of built environment projects. More recently, this focus has been expanded to also include carbon emission associated with the building materials themselves.

Some studies have historically suggested that 40-50% of the total carbon emissions for buildings over their lifetime are due to embodied carbon. With increasing energy efficiency within buildings and an increasingly decarbonised electricity supply, building operational carbon emission are being acknowledged to be rapidly reducing. With this the measurement and reduction of embodied carbon has increasingly become significant. and there is greater need for reducing the overall carbon emissions of buildings through innovative design, structural design choice and material selection.

IPCC Sixth Assessment Report 2023.
The Intergovernmental Panel on Climate Change (IPCC) is a body of the United Nations, tasked with advancing scientific knowledge related to anthropological climate change. The IPCC provide to policymakers and the general public regular assessments of the scientific basis of climate change, its impacts, future risks, and options for adaption and mitigation.

In their Sixth Synthesis Report (AR6), the IPCC warn that human activities, principally through emissions of greenhouse gases, have unequivocally caused global warming, with global surface temperature reaching 1.1°C above 1850–1900 levels in 2011–2020. Global greenhouse gas emissions have continued to increase due to unequal historical and ongoing contributions arising from unsustainable energy use, land use and land-use change, lifestyles and patterns of consumptions and production across regions, between and within countries, and among individuals. Furthermore, approximately 79% of global Greenhouse Gas (GHG) Emissions came from Energy, Industry, Transport and Buildings.

AR6 states that continued greenhouse gas emissions will lead to increasing global warming, with the best estimate of reaching 1.5°C in the near term in considered scenarios and modelled pathways. Every increment of global warming will intensify multiple and concurrent hazards; however, deep, rapid, and sustained reductions in greenhouse gas emissions would lead to a discernible slowdown in global warming within around two decades, and also to discernible changes in atmospheric composition within a few years.

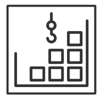
Limiting human-caused global warming requires net zero CO_2 emissions. Cumulative carbon emissions until the time of reaching net-zero CO2 emissions and the level of greenhouse gas emission reductions this decade largely determine whether warming can be limited to 1.5°C or 2°C. Projected CO2 emissions from existing fossil fuel infrastructure without additional abatement would exceed the remaining carbon budget for 1.5°C.

UKGBC Net Zero Carbon framework
The UK Green Building Council released a framework definition in April 2019, setting out the proposed method on how the UK built environment can achieve zero carbon. It sets out two pathways: net zero carbon in construction (embodied) and operation.

Importantly, the framework definition defines the 'net zero carbon in operation' pathway based on annual total metered energy consumption and associated emissions, rather than using the Part L methodology. 'Net zero carbon in construction' requires the quantification of upfront carbon impacts at the point of completion based on as-built data and is offset via a verified offsetting scheme.

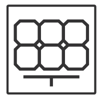
Net zero carbon for both construction and operation represent the greatest level of commitment to the framework.

The framework suggests the following approach to delivering net zero development:

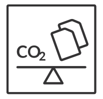


- Reduce Construction Impacts
  - A WLCA should be undertaken and disclosed for all construction projects to drive carbon reductions.
  - The embodied carbon impacts from the product and construction stages should be measured and offset at practical completion.

- Reduce Operational Energy Use
  - Reductions in energy demand and consumption should be prioritised over all other measures.
  - In-use energy consumption should be calculated and publicly disclosed on an annual basis.



- Increase Renewable Energy Supply
  - On-site renewable energy source should be prioritised.
  - Off-site renewables should demonstrate additionality.



- Offset Any Remaining Carbon
  - Any remaining carbon should be offset using a recognised offsetting framework.
  - The amount of offsets used should be publicly disclosed.

The definitions from the UKGBC framework for construction and operation area as follows:

Net zero in construction – "when the amount of carbon emissions associated with the building's product and construction stages up to practical completion is zero or negative, through the use of offsets or the net export of on-site renewable energy".

Net zero in operation – "when the amount of carbon emissions associated with the buildings operational energy on an annual basis is zero or negative. A net zero carbon building is highly energy efficient and power from on-site and/or off-site renewable energy sources, with any remaining carbon balance offset".

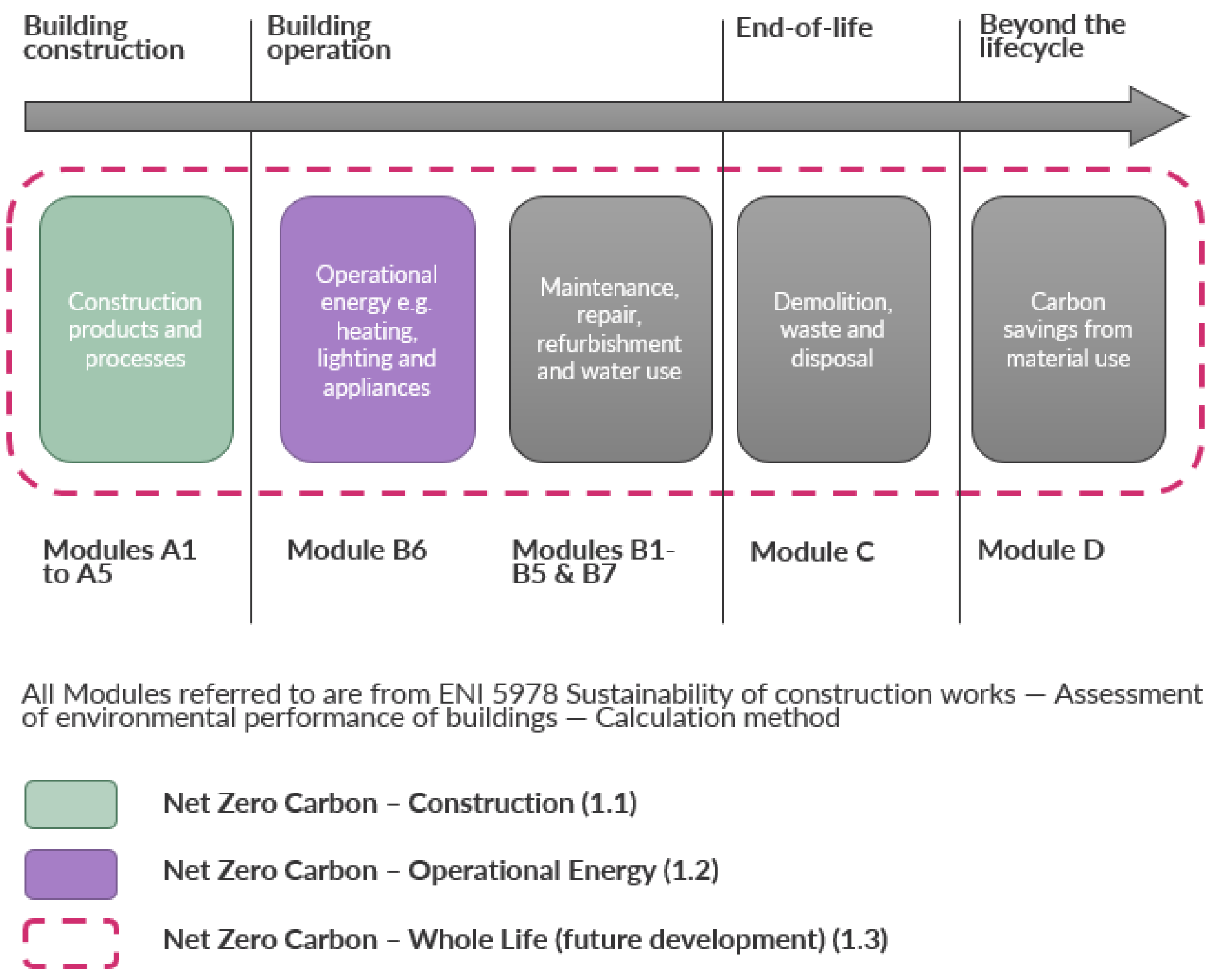


Figure 14: UKGBC Advancing Net Zero Carbon framework approach.

Net Zero Carbon Buildings Standard (2024).
The UK Green Building Council (UKGBC) released the Net Zero Carbon Building Standard (NZCBS) pilot in 2024. This standard enables developments to be certified as Net Zero Carbon, providing a framework aligned with science-based carbon targets. It offers a structured approach for verifying and certifying net-zero achievements across both construction and operation phases, building upon previous UKGBC frameworks and sector-specific targets.

To establish these targets, 14 sector tasks groups were set up to define appropriate upfront/embodied carbon and operational energy targets for different building types. To achieve Net Zero certification in construction, meeting the upfront 'science based' carbon targets will be mandatory. Net Zero Carbon in Construction can be claimed once an as-built assessment has been verified. Net Zero Carbon in Operation can only be claimed after a year's operation based on metered data and energy procurement. Net Zero Carbon in Operation will have to be recertified every 1 to 2 years.

With regards to verification, third party/parties will take on the role of verifier and it will therefore be at their discretion to charge a preferred fee. There is currently no information available regarding registration and/or certification costs associated with the Standard, so this cannot be advised at this point.

Renewable Energy Procurement & Carbon Offsetting Guidance for Net Zero Carbon Buildings.

In March 2021, UKGBC released guidance on renewables procurement and offsetting. This guidance report was developed to align with the UKGBC framework for net zero carbon buildings. The offsetting and procurement guidance is intended to be relevant to all building types, sizes, and ownership scopes where annual public disclosure of energy use, generation and carbon offsets is possible.

An updated version of the guidance was released in August 2023 (Renewable Energy Procurement summary report)[1] . The new guidance recognises that *"The current energy crisis has reduced the already low availability of options which meet the principles defined by v1 guidance. There are, in fact, a broad range of routes for procuring renewable electricity available. This guidance aims to present this spectrum of options in a way that enables built environment stakeholders to determine which route is best for them."*

The new guidance also recognises the binary and limited nature of the previous recommendations, is more nuanced and flexible, and provides a beta scoring matrix for energy suppliers based on a number of factors. Key principles outlined in this guidance relating to the carbon associated with the supply are renewable, additionality, and time matched.
Any building wishing to claim alignment with the Net Zero Carbon buildings framework definition, either for construction or operation, must comply with the renewable procurement and offsetting guidance.

LETI & RIBA Energy Intensity Targets
RIBA and LETI have established targets for operational energy performance in residences. RIBA provide benchmarks and targets covering a Business as Usual (BAU) case, 2025 target and 2030 target. These are based on Gross Internal Area (GIA). Energy demand reduction and energy efficiency must lead all approaches irrespective of geographic location. As the targets are for performance outcomes of buildings in operation, the RIBA advocates that buildings in design today should, as a minimum, adopt the 2025 targets.

LETI have suggested targets for 2030 of 35 kWh/m^2/yr GIA.

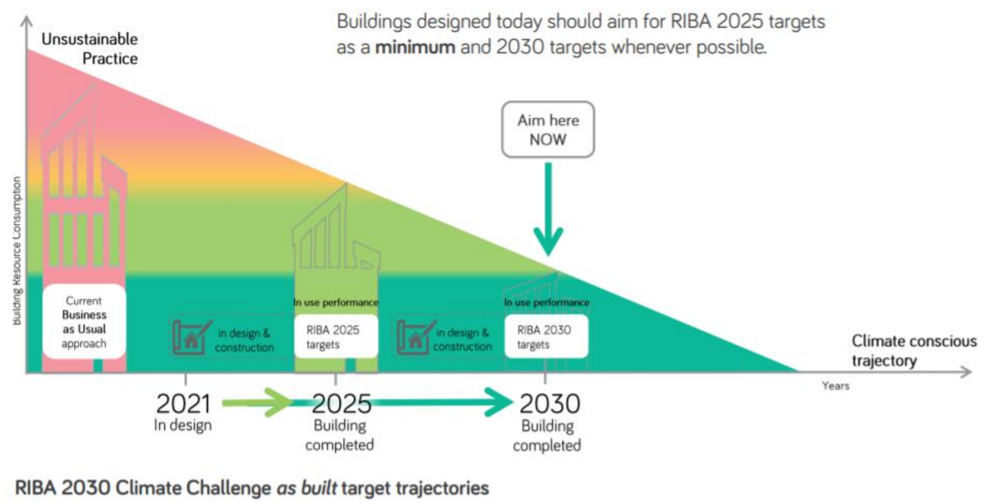


Figure 15: RIBA as built targets (Source: RIBA 2030 Climate Challenge version 2).

[1] Renewable-Energy-Procurement-Summary-Report.pdf (ukgbc.org)

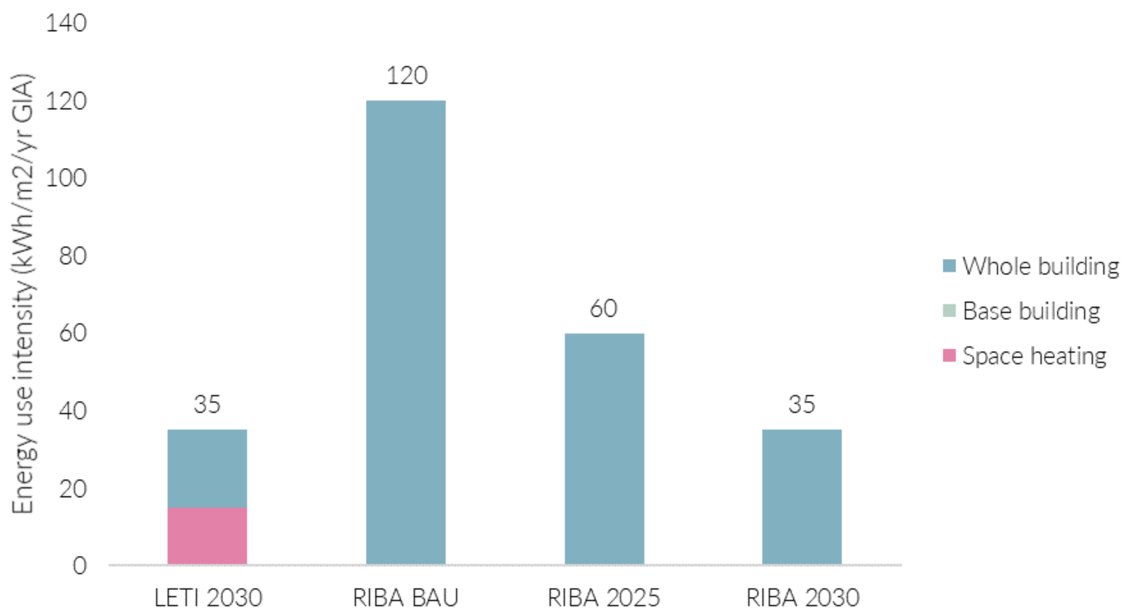


Figure 16: Operational energy intensity for residences from RIBA and LETI.

LETI Embodied Carbon Target Alignment
LETI have launched upfront and embodied carbon guidance that sought to align the various embodied carbon targets suggested by LETI and RIBA. Key points:

- Current average buildings performance equates to an E rating.
- Current good building design is equivalent to a C rating (LETI 2020 target).
- LETI 2030 design target achieves an A rating.
- A rating of B and above is considered a robust stretch target.

The RIBA 2030 Climate Challenge built performance achieves a B rating, this is with practical completion in 2030 with design being earlier. Figure 17 shows, based on the LETI design targets and the RIBA 2030 built target, the equivalent letter banding. The image to the right is a potential scorecard for buildings showing the upfront and whole life embodied carbon reporting separately.

Figure 18 provides a summary of the proposed letter bandings by LETI for both upfront carbon only and embodied carbon. Both LETI design targets and RIBA as built targets are shown.

Please note that LETI require projects to disclose full results, methodology and assumptions on a publicly accessible website before projects are able to market meeting or targeting a certain letter banding.

Building Target	Equivalent letter banding
LETI **Design** 2020 Target	C
LETI **Design** 2030 Target	A
RIBA **Built** 2030 Target	B

Figure 17: LETI targets and letter bandings (left). LETI potential badge ratings reporting up front embodied carbon separately (right) (Source: LETI Embodied Carbon Alignment).

Upfront Embodied Carbon, A1-5 (exc. sequestration)

	Band	Office	Residential (6+ storeys)	Education	Retail
	A++	<100	<100	<100	<100
	A+	<225	<200	<200	<200
LETI 2030 Design Target	A	<350	<300	<300	<300
	B	<475	<400	<400	<425
LETI 2020 Design Target	C	<600	<500	<500	<550
	D	<775	<675	<625	<700
	E	<950	<850	<750	<850
	F	<1100	<1000	<875	<1000
	G	<1300	<1200	<1100	<1200

Life Cycle Embodied Carbon, A1-5, B1-5, C1-4

	Band	Office	Residential (6+ storeys)	Education	Retail
	A++	<150	<150	<125	<125
	A+	<345	<300	<260	<250
	A	<530	<450	<400	<380
RIBA 2030 Design Target	B	<750	<625	<540	<535
	C	<970	<800	<675	<690
	D	<1180	<1000	<835	<870
	E	<1400	<1200	<1000	<1050
	F	<1625	<1400	<1175	<1250
	G	<1900	<1600	<1350	<1450

Figure 18: LETI letter banding for different typologies (Source: LETI Embodied Carbon Alignment).

Appendix D – Results.

Estimated WLC emissions.

Table 17 WLC emissions for each lifecycle module, using SAP 10.2 carbon factor for module B6 (operational energy use)

Result category	Biogenic carbon	A1-A3 Product Stage	A4 Transportation to site	A5 Site operations	B1 Use Phase	B2 -B3 Maintenance & repair	B4/B5 Material replacement / refurbishment	B6 Operational Energy use (regulated and unregulated)	B7 Operational Water use	C1-C4 End of Life Stage	TOTAL (excluding Biogenic and D)
0 Major demolition	0	0	0	0	0	0	0	0	0	25	25
1 Substructure	0	882	52	54	0	17	0	0	0	89	1,094
2.1 Frame	0	153	6	2	0	3	0	0	0	1	165
2.2 Upper Floors	0	977	56	47	0	19	95	0	0	63	1,257
2.3 Roof	0	334	25	20	0	7	9	0	0	25	419
2.4 Stairs & Ramps	-26	3	3	0	0	0	0	0	0	27	32
2.5 Ext. Walls	0	711	114	23	0	14	408	0	0	9	1,279
2.6 Windows & Ext. Doors	-18	82	12	0	0	2	88	0	0	18	202
2.7. Int. Walls & Partitions	0	546	21	12	0	11	201	0	0	11	802
2.8 Int. Doors	0	47	18	0	0	1	66	0	0	2	134
3 Finishes	-108	221	53	17	0	4	902	0	0	112	1,309
4 Fittings, furnishings & equipment	0	59	3	0	0	1	73	0	0	4	141
5 Services (MEP)	0	611	32	9	109	12	1,228	2774	14	2	4,791
8 Ext. works	0	37	30	4	0	1	7	0	0	24	103
A5 Site operations	0	0	0	370	0	0	0	0	0	0	370
TOTAL (tonnes)	-152	4,663	425	559	109	92	3,079	2,774	14	412	12,126

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