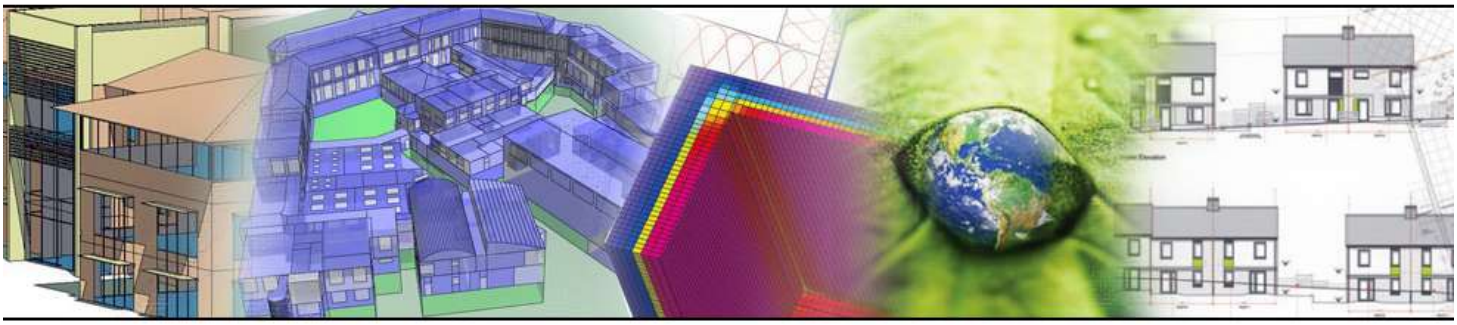

Whole Life Cycle Carbon Assessment

Harefield Grove

Stroma Reference: 089359 WLC3
Date: 13/08/2025
Prepared for: Comer Group UK

1. Executive Summary

This Whole Life-Cycle Carbon Statement has been produced on behalf Comer Homes to support the planning submission for the proposed development at Harefield Grove.

This report has been prepared in line with the guidance given in the GLA Document 'Whole Life-Cycle Carbon Assessments March 2022'.

1.1. Results Summary

Assessment Scope	Whole Life Carbon Emissions (kcCO_2e)
SAP10 Emissions	6,689,581

Table 1. LCA Results

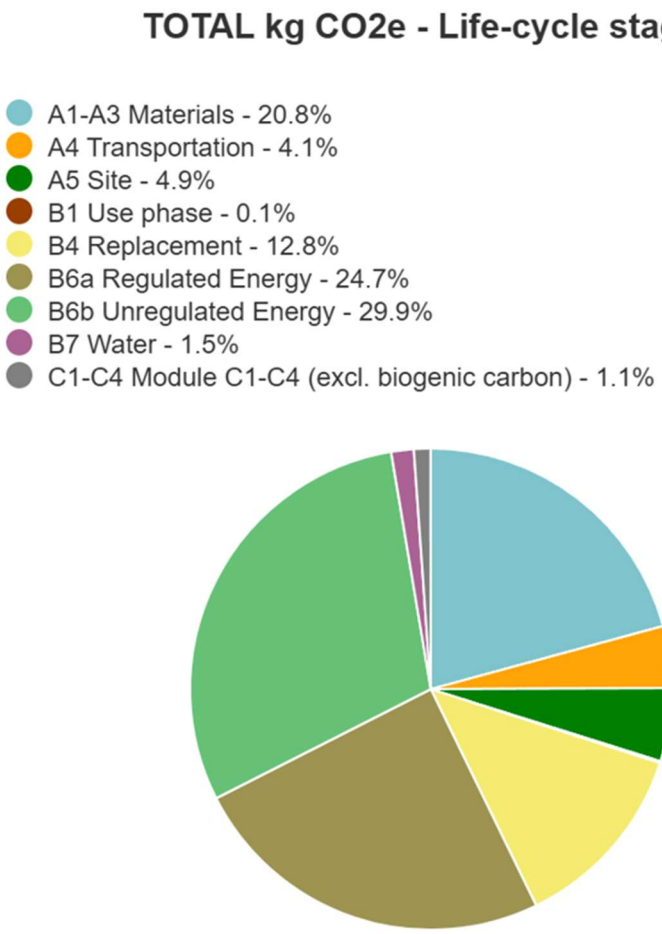

Figure 1.Pie chart showing life cycle stage embodied carbon emissions

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2. Quality Management

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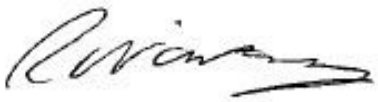	
Rob Waiting BSc (hons) MSc	Richard de Fleury BEng (hons) MSc
Principal Sustainability Consultant	Principal Sustainability Consultant
Date: 13/08/2025	**Date:** 13/08/2025
File reference:	089359 LCA1

Version	Status	Date	Change Summary
LCA1	Draft	27.04.23	
LCA2	Final Issue	01.09.23	
WLC3	Final Issue	13.08.25	Updated for revised planning application

3. Development

Stroma Built Environment has been commissioned on behalf of Comer Homes to prepare Whole Life Carbon Assessment to accompany a full planning permission application for the proposed development at Harefield Grove.

The site extends to approximately 7.8 hectares and is accessed via a long driveway from Rickmansworth Road. The site is currently vacant, although it is used sporadically for film and television sets. The site's last permanent use was for office purposes in c. 2002.

This planning application includes the subdivision and conversion of the Main House into 6no. residential units; demolition of the existing extension of the Main House and erection of a three storey 'stable block' building containing 28no. residential units; construction of a new dwellinghouse to the south-east (Orchard House); extension of Garden House to provide a new single storey dwelling; internal alterations to Cottage House to provide a new two storey dwelling; demolition of Conservatory building and replacement with a new two storey dwelling (Lake View House); and associated alterations to landscape, access and parking.

The total Gross Internal Area for the refurbished main house is 1,043 m^2 and 2,964 m^2 for the new build Stable Block. The other buildings on the site consist of a refurbished Cottage House to form a single dwelling, an extension to Garden House to provide a single dwelling, a new build Lake View House and a new build Orchard House.

Figure 2.Development site plan

4. Planning Policy

4.1. Regional Policy – Greater London

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

- a net zero-carbon target for all major developments, which has applied to major residential developments since 2016. The GLA's Energy Assessment Guidance provides information on how to comply with this target and how to produce an energy assessment.
- a requirement for all major development to 'be seen' i.e. to monitor and report its energy performance post-construction to ensure that the actual carbon performance of the development is aligned with the Mayor's net zero-carbon target. The 'Be Seen – energy monitoring guidance explains how to meet this requirement.
- a requirement for all referable planning applications to calculate and reduce whole life-cycle carbon (WLC) emissions to fully capture a development's carbon impact.

Calculating and reducing WLC emissions offers a wealth of benefits including:

- Ensuring that a significant source of emissions from the built environment are accounted for which is necessary in achieving a net zero-carbon city.
- Achieving resource efficiency and cost savings by encouraging the re-use of existing materials instead of new materials and the retrofit and retention of existing structures and fabric over new construction.
- Identifying the carbon benefits of using recycled material and the benefits of designing for future reuse and recycling to reduce waste and support the circular economy.
- Encouraging a 'fabric first' approach to building design thereby minimising mechanical plant and services in favour of natural ventilation.
- Considering operational and embodied emissions simultaneously to find the optimum solutions for the development over its lifetime.
- Identifying the impact of maintenance, repair and replacement over a building's life-cycle which improves life-time resource efficiency and reduces life-cycle costs, contributing to the future proofing of asset value.
- Encouraging local sourcing of materials and short supply chains, with resulting carbon, social and economic benefits for the local economy.
- Encouraging durable construction and flexible design, both of which contribute to greater longevity, reduced obsolescence of buildings and avoiding carbon emissions associated with demolition and new construction.

5. Assessment Methodology

5.1. Assessment Scope

The assessment of Whole Life Carbon (WLC) emissions consists of the following sections: total operational carbon emissions; embodied carbon emissions; and any future potential carbon emissions '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 WLC Assessments and therefore in line with the RICS Professional Statement: Whole Life Carbon Assessment for the Built Environment. The OneClick LCA Tool has been used to calculate the embodied carbon emissions associated with the below stages of the project.

In the assessment following life cycle stages according to EN 15804:2012 were included:

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
x			x	x	x					x	x	x				x		

A description of the life cycle stages and analysis scope are provided in the table below:

A1-A3 Materials	Construction	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.

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.
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.
B1-B5 Maintenance and material replacement	The environmental impacts of maintenance and material replacements (B1-B5) include environmental impacts from replacing building products after they reach the end of their service life. The emissions cover impacts from raw material supply, transportation and production of the replacing new material as well as the impacts from manufacturing the replacing material as well as handling of waste until the end-of-waste state.
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.
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 waste water treatment.
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 includes emissions caused by waste energy recovery.
D External impacts/end-of-life benefits	The external benefits include emission benefits from recycling recyclable building waste. Benefits for re-used or recycled material types include positive impact of replacing virgin based material with recycled material and benefits for materials that can be recovered for energy cover positive impact for replacing other energy streams based on average impacts of energy production.

5.2. Assessment Software

The calculations were performed with One Click LCA calculation tool. The software is fully compliant with EN 15978 standard. One Click LCA has been third party verified by ITB for compliancy with the following LCA standards: EN 15978, ISO 21931–1 and ISO 21929, and data requirements of ISO 14040 and EN 15804. You can find the official letters of compliancy here:

https://www.oneclicklca.com/wp-content/uploads/2016/11/360optimi-verification-ITB-Certificate-scanned-1.pdf.

ITB is a certification organization and a Notified Body (EC registration nr. 1488) to the European Commission designated for construction product certification. Polish Accreditation Board assures the independence and impartiality of ITB services (Accreditation Certificates are: AB 023, AC 020, AC 072, AP 113). ITB activities are conducted in accordance to the requirements of the following assurance standards: ISO 9001, ISO/IEC 27001, ISO/IEC 17025, EN 45011, and ISO/IEC 17021.

5.3. Operational Carbon Emissions

Predicted annual energy consumption has been determined using SAP Calculation Modelling as part of the Energy Statement produced by Stroma as part of the Planning Application. Unregulated Energy has been calculated using SAP Appendix L.

5.4. Embodied Carbon Assessment and End-of-life emissions

One Click LCA has been used to assess the embodied carbon associated with the development to produce the anticipated materials quantities in an inventory analysis. Each material specified has been matched to anticipated Environmental Product Declaration (EPD). These are produced by manufacturers and identify the carbon emissions of a product. By scheduling together all the materials specified, the overall carbon emissions can be calculated.

The One Click Tool has a limited database of materials and where a specified material is not included, the most similar material in terms of composition is selected. The LCA process and results have been assessed in line with BS 15978:2011 and the RICS Professional Statement: Whole Life Carbon Assessment for the Built Environment. All EPDS's stored within One Click have been produced in line with the requirements of BS EN 15804: 2012 and each material has been assessed against the following life cycle stages:

- A1-A3: Product stage
- A4: Material transportation to site
- B4-B5: Replacement and maintenance
- C1-C4: End of life

The Construction Phase A5 has also been included to give an estimate of the emission related to the electrical consumption and waste disposal.

In line with the draft GLA guidance, the assessment includes the following elements:

- Demolition (emissions associated with demolition and facilitating works are included in the A5 Lifecycle Phase)
- Facilitating works
- Substructure
- Superstructure (frame, upper floors, roof, stairs and ramps, external walls, windows and external doors, internal walls and partitions, internal doors)
- Finishes
- Fittings, furnishings and equipment
- Building services
- Prefabricated buildings and building units
- Work to existing building (not applicable to this development)
- External works (hard and soft landscaping, fencing, fixtures, drainage, services)

5.5. Data Sources

One Click LCA LCA EN-15978 tool was used in the assessment. The tool supports CML (2002 - November 2012 or newer) methodology and all assessed impact categories. All of the datasets in the tool follow EN 15804 standard. A complete list of data sources including all EPD's used is presented in Appendix A.

The following planning application documents have been reviewed as part of the assessment:

1. Plans, elevations and specifications
2. Landscape drawings and specifications
3. Stroma Built Environment – Energy Statement
4. Viability Statement and Cost Plan

6. Assessment Parameters

6.1. Data sources within the Assessment

The following table details the assumptions and data sources for the assessment against each of the required element groups. The assessment covers the New Build Stable Block, Garden House, Cottage House, Orchard House, Conservatory House and an assessment of the new elements introduced to the Main House as part of its refurbishment. Oneclick allocates all existing materials within the Main House as re-used materials.

Building Element Group	Building element	Data Sources
Demolition	0.1 Toxic/hazardous/contaminated material treatment	At this stage of the project, it is not yet known the extent of any contaminated land removal and treatment. This has therefore not been included in the modelling
	0.2 <major demolition works	The demolition phase emissions have been estimated from the database values within oneclick using the RICS guidance of 3.4 KGCO2e/m2 GIA for the demolition of the existing building on the site
Facilitating Works	0.3 & 0.5 Temporary/enabling works	Due to the project currently at RIBA Stage 2 this information is not yet available
	0.4 Specialist groundworks	No specialist groundworks are known at this stage and have not been included in the assessment
1 Substructure	1.1 Foundations	**New Build** The cost plan contains details of the foundations. These have been entered into the OneClick LCA Carbon Designer Tool which provides an estimate of the CO_2 associated with the construction of the substructure
		Refurbished Main House All foundations utilise reused materials with no impact on the assessment
2 Superstructure	2.1 Frame	**New Build** The cost plan contains details of the concrete frame. These have been entered into the OneClick LCA Carbon Designer Tool which provides an estimate of the CO_2 associated with the construction of the frame
		Refurbished Main House No frame applicable
	2.2 Upper Floors	**New Build** The material specification and quantity has been determined from an area calculation of the planning drawings
		Refurbished Main House No works to existing floors
	2.3 Roof	**New Build** The material specification and quantity has been determined from an area calculation of the planning drawings
		Refurbished Main House Replacement roofing and insulation has been included
	2.4 Stairs and ramps	**New Build**

		The material specification and quantities were calculated using the OneClick LCA Carbon Designer Tool
		Refurbished Main House No major structural works to existing staircase
	2.5 External Walls	**New Build** The material specification and quantity has been determined from an area calculation of the planning drawings
		Refurbished Main House New wall where office is demolished
	2.6 Windows and external doors	**New Build** The material specification and quantity has been determined from an area calculation of the planning drawings
		Refurbished Main House New double glazed windows installed
	2.7 Internal Walls and partitions	**New Build** The material specification and quantities were calculated using the OneClick LCA Carbon Designer Tool
		Refurbished Main House New internal blockwork walls
	2.8 Internal doors	The material specification and quantities were calculates using the OneClick LCA Carbon Designer Tool
3 Finishes	3.1 Wall finishes	The material specification and quantity has been provided within the project cost plan and entered into the OneClick Software
	2.3 Floor Finishes	The material specification and quantity has been provided within the project cost plan and entered into the OneClick Software
	3.3 Ceiling Finishes	The material specification and quantity has been provided within the project cost plan and entered into the OneClick Software
4 Fittings, furnishings and equipment (FF&E)	4.1 Fittings, furnishings & equipment incl. building-related* and non-building-related**	Furnishing and equipment are not known at this stage
5 Building services/MEP	5.1–5.14 Services incl. building-related* and non-building-related**	The material specification and quantity has been provided within the project cost plan and entered into the OneClick Software
6 Prefabricated Buildings and Building Units	6 Prefabricated Buildings and Building Units	There are no prefabricated elements
7 Work to Existing Building	7.1 Minor demolition and alteration works	There are no minor works to existing buildings
8 External Works	8.1 Site preparation works	This information is not yet available
	8.2 Roads, paths, paving and surfacing	The material specification and quantity has been provided within the landscape drawings
	8.3 Soft landscaping, planting and irrigation systems	This information is not yet available
	8.4 Fencing, railings and walls	This information is not yet available
	8.5 External fixtures	This information is not yet available
	8.6 External drainage	This information is not yet available
	8.7 External services	This information is not yet available

	8.8 Minor building works and ancillary buildings	There are no works classified as minor building works and ancillary buildings

Module	Description	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 from OneClick LCA which align with the exact product (where known) or the most applicable similar product.
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, provided by OneClick LCA.
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.	Due to lack of site-specific construction data, the RICS 2020 average site impacts per £1million was used and sized based upon the scale of the development.
B1-B5 Maintenance	The environmental impacts of maintenance and material replacements (B1-B5) include environmental impacts from	Use (B1) includes the impact of refrigerant leakage. The total refrigerant charge has not yet been determined and thus not reported

and material replacement	replacing building products after they reach the end of their service life. The emissions cover impacts from raw material supply, transportation and production of the replaced new material as well as the impacts from manufacturing the replaced material and handling of waste until the end-of-waste state.	Maintenance (B2) emissions - No data was available from the design team and emissions have been estimated for relevant products using the below nominal assumption from the GLA Guidance Document: • 10 kgCO2e/m2 Repair (B3) No data was available from the design team and emissions have been estimated for relevant products using the below nominal assumptions in line with the GLA Guidance Document • 25% of B2 emissions. Replacement (B4) were based on the inputted EPD's from Oneclick Refurbishment (B5) account for the technical service life of the building components "BCIS Life expectancy of building components". There is no know refurbishment strategy so these emissions are excluded
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 data for regulated and unregulated usage taken from the Energy Statement in line with the SAP10 emissions factors
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.	Water consumption based on Building Regulations Part G 'Enhanced Consumption' of 105 l/p/d and multiplied by the intended full occupancy of the development, using the EPD for Thames Water. Total occupancy is 129 persons x 105 l/p/d = 13,545 litres per day = 4,943,925 litres per annum. Equates to 4,943 m3
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)	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.

	based on type of material. Additionally, deconstruction impacts include emissions caused by waste energy recovery.	
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.

7. Results

7.1. Whole Life Carbon Emissions

A whole life carbon assessment has been undertaken for the Proposed Development. The assessment has been undertaken in line with the guidance given in the GLA document, Whole Life-Cycle Carbon Assessments Guidance Consultation, March 2022.

The results are shown in the following table using the SAP 10 Emissions Factors.

Assessment Scope	Whole Life Carbon Emissions (kcCO_2e)
SAP10 Emissions	6,689,581

Table 2. Whole Life Cycle Emissions

The full results from the GLA Reporting spreadsheet are provided within Appendix A

The overall emissions for the SAP10 emission factors are shown in the graphs below.

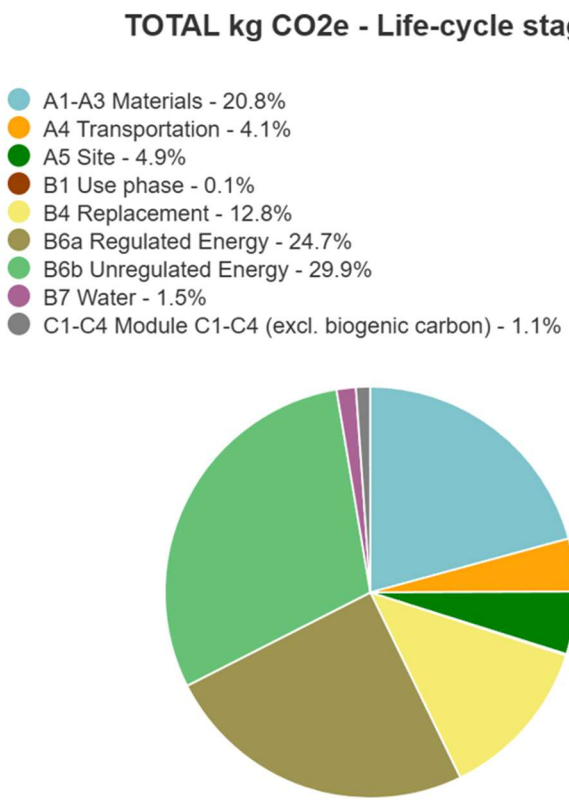

Figure 4. Pie chart of Whole Life Cycle Emissions by Life Cycle Stage SAP 10

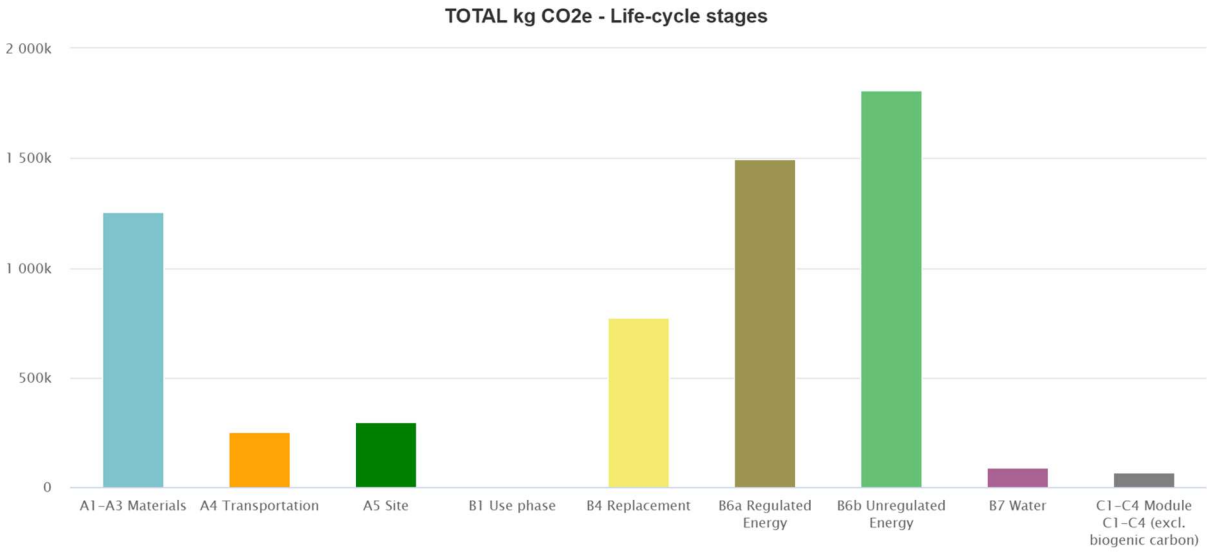

Figure 5. Bar chart of Whole Life Cycle Emissions by Life Cycle Stage SAP 10

7.2. Comparison with benchmark data and actions taken to reduce emissions

The Whole Life Cycle Carbon Emissions have been calculated for the development and compared against the benchmark data provided within the GLA guidance document. The WLC benchmarks are based on previous project assessments carried out by Cundall and Targeting Zero and have been cross referenced with data provided by Etool, One Click and Hilson Moran. These assessments followed the RICS PS in terms of the scope of assessment, and material baseline assumptions and specifications. All life-cycle modules apart from B6, B7 (operational energy and operational water) and module D are included.

For the A1-A5 modules the actual emissions are below the benchmarks. This can be explained as follows. Of the 4,664 m^2 total floor area of the development, 1,512 m^2 is made up of the refurbished Main House, Cottage House, Garden House and Lake House. These elements reuse significant quantities of materials from the sub structure, frame, upper floors, external walls and roof elements. This results in less mass of materials inputted to the assessment when compared to a newly built development requiring new sub structure and superstructure.

Within the calculated B-C WLC emissions, at this stage B1 emissions are not reported as a design for the refrigerant system has not yet been undertaken. This explains why the actual data is below the benchmark data. These emissions will be included in an updated WLC assessment undertaken during detailed design stage.

The full data from the OneClick Report is provided within Appendix B.

Module	**WLC benchmark kg $CO_2e/m2$**	**Aspirational WLC Benchmark kg $CO_2e/m2$**	**Actual WLC $kgCO_2e/m2$**
A1-A5	<850	<500	387.34
B-C (Excluding B6 ad B7)	<350	<300	248.46
Modules A-C (excl B6 & B7 including sequestered carbo)	<1200	<800	585.34

The data shows the Module A1-A5 emissions to be below the benchmark data for an Apartment Building. The emissions are lower than the typical benchmark building B-C emissions are lower than the aspirational benchmark data as B1 emissions are currently not reported due to a refrigerant design not yet undertaken by the applicant.

Options for reducing the emissions are shown in the table below as follows:

- Reusing the main existing building on site to be retained and retrofitted to form 6 apartment buildings;
- Recycled Steel within structural elements;
- Replace the district heating system in the new build stable block with individual exhaust air heat pumps to each dwelling;

- Introduce a solar photovoltaic array to all new buildings to generate 40,632 kWh of energy per annum;
- A further opportunity for reducing the whole life carbon emissions has been specified. This has been simulated using the generic EPD which replaces 50% of the cement content for the Substructure Concrete with GGBS.

The design team will explore with the Structural and Mechanical Engineer for the project if making these changes is feasible during the detailed design stage of the project.

Option for reducing	**WLC kg $CO_2e/m2$ Current**	**Reduced WLC kg $CO_2e/m2$**	**% reduction**
Recycled Steel within structural elements;	1,434	1,396	2.65
Replace the district heating system in the new build stable block with individual exhaust air heat pumps to each dwelling;	1,434	1,397	2.58
Introduce a solar photovoltaic array to all new buildings to generate 40,433 kWh of energy per annum. Assumes all energy is utilised on the development	1,434	1,341	6.49
A further opportunity for reducing the whole life carbon emissions has been specified. This has been simulated using the generic EPD which replaces 50% of the cement content for the Substructure Concrete with GGBS.	1,434	1,379	3.84

Appendix A – GLA WLC Spreadsheet Tool

Appendix B – Data Sources Used

Appendix C – Full Data Report from Oneclick