LOVE DES/GN STUD\O

160 Malden Road

Whole Life-Cycle Carbon Assessment

July 2024

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01 Executive Summary

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Executive Summary

This Whole Life-Cycle Carbon Assessment (WLCA) has been prepared by Love Design Studio in support of an application for full planning permission for the Proposed Development at 160 Malden Road, Camden, London, NW5 4BS.

The Proposed Development consists of the erection of a 4-storey building to provide 15 self-contained flats at ground, first, second, and third floor levels and office use at ground floor level, following demolition of existing MOT repair garage and hand car wash.

The purpose of this report is to set out how the Proposed Development seeks to comply with the London Plan 2021 Policy SI 2 (f) 'Minimising greenhouse gas emissions' and to provide an estimate of the total carbon emissions emanating from the development over its lifetime. This includes the emissions resulting from the materials used, the building's construction, the use of the building, and its demolition and disposal.

The WLCA examines the carbon associated with the proposed design using targets to benchmark the results against standard or aspirational practice, drawing targets from the GLA, as well as other organisations, such as LETI and RIBA.

Embodied Carbon: At the current Stage 2 design, the Proposed Development's embodied carbon is measured at 717 kgCO2e/m2, equivalent to 924 tCO2e.

Operational Carbon: The Proposed Development's operational carbon associated to energy consumption amounts to 771 kgCO2e/m2 equivalent to 994 tCO2e.

Whole Life-Cycle Carbon: The overall WLCA has calculated an estimated 1,900 tCO2e over the buildings assumed lifetime of 60 years**.**

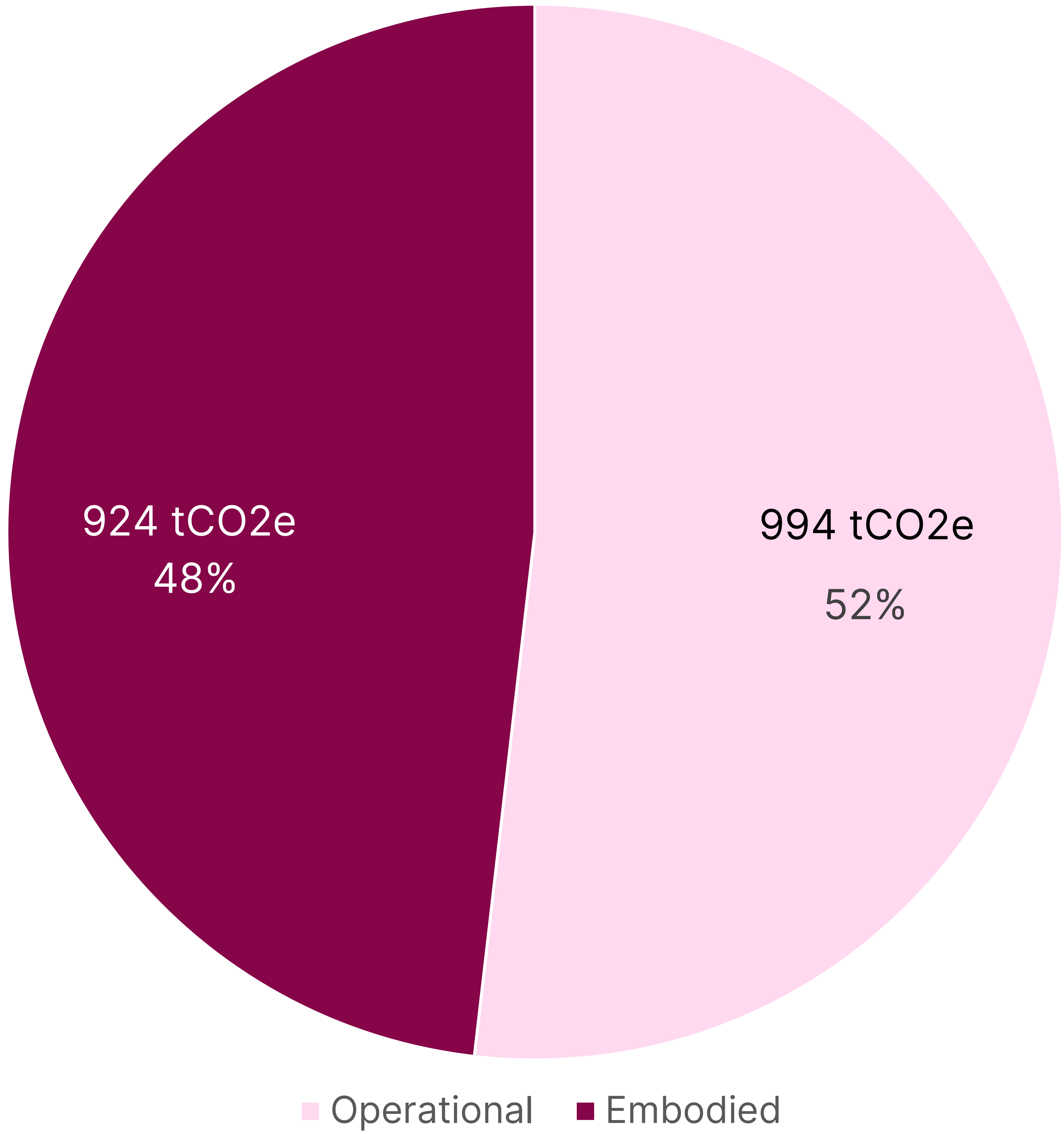
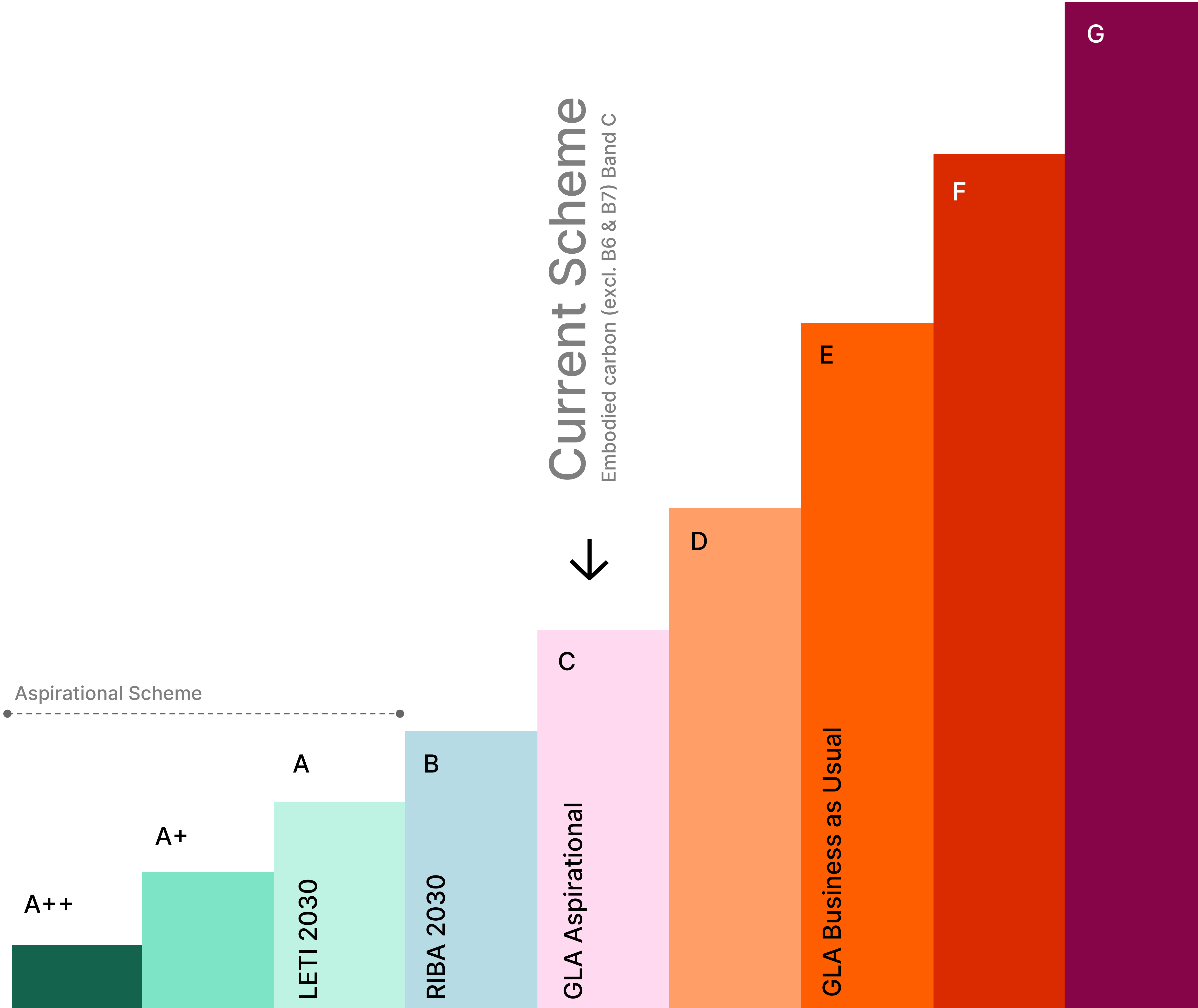


Figure 1: *WLC summary result for the Proposed Development at 160 Malden Road*

Executive Summary



The scheme's embodied carbon results are currently in line with the GLA's aspirational benchmark for WLCA. Once the design is developed further, including material specifications and in line with Circular Economy principles, the project has a good opportunity of meeting the ambitious RIBA and LETI 2030 targets.

Introduction

02

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Introduction

This WLCA has been prepared by Love Design Studio in support of an application for full planning permission for the Proposed Development at 160 Malden Road, Camden, London, NW5 4BS.

The Proposed Development consists of the erection of a 4-storey building to provide 15 self-contained flats at ground, first, second, and third floor levels and office use at ground floor level, following demolition of existing MOT repair garage and hand car wash.

Given the nature of the Proposed Development involving demolition and new construction, this assessment highlights the approach taken to minimise embodied carbon emissions from waste materials in line with regional and local policy.

The Proposed Development implements two fundamental principles aimed at reducing embodied carbon emissions associated with demolition and construction:

- Retaining the existing value of the site.
- Maximising the proposed value of the site.

These principles are integral to a circular economy, which is further explored in Section 8 of this report.

Figure 2: *CGI of the Proposed Development*

Site Overview

The existing site comprises of a one-storey MOT repair garage and car wash located on Malden road. The site is adjacent to a three-storey care home on Wellesley Road.

The immediate surrounding area is characterised by a mix of residential and commercial buildings, featuring both Victorian and Edwardian architecture, as well as modern apartment buildings.

The site is not subject to any statutory heritage asset designations.

The application site has good public transport links (PTAL rating of 3) with the nearest stations Gospel Oak and Kentish Town West, located north and south to the site, respectively.

Figure 3: *Site Location (Red)*

03

Policy & Methodology

Guidance and Policy

National Planning Policy Framework (NPPF)

The National Planning Policy Framework (NPPF) sets out the Government's planning policies for England and how these should be applied. The National Planning Policy Framework must be considered in preparing the development plan and is a material consideration in planning decisions. Planning policies and decisions must also reflect relevant international obligations and statutory requirements.

The purpose of the planning system is to contribute to the achievement of sustainable development. In summary the framework advises:

"*Plans should take a proactive approach to mitigating and adapting to climate change, taking into account the long-term implications for flood risk, coastal change, water supply, biodiversity and landscapes, and the risk of overheating from rising temperatures. Policies should support appropriate measures to ensure the future resilience of communities and infrastructure to climate change impacts, such as providing space for physical protection measures, or making provision for the possible future location of vulnerable development and infrastructure.*

New development should be planned for in ways that:

- *Avoid increased vulnerability to the range of impacts arising from climate change. When new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through the planning of green infrastructure; and*
- *Can help to reduce greenhouse gas emissions, such as through its location, orientation, and design. Any local requirements for the sustainability of buildings should reflect the government's policy for national technical standards.*

To help increase the use and supply of renewable and low carbon energy and heat, plans should:

- *Provide a positive strategy for energy from these sources, that maximises the potential for suitable development, while ensuring that adverse impacts are addressed satisfactorily (including cumulative landscape and visual impacts);*
- *Consider identifying suitable areas for renewable and low carbon energy sources, and supporting infrastructure, where this would help secure their development; and*
- *Identify opportunities for development to draw its energy supply from decentralised, renewable or low carbon energy supply systems and for co-locating potential heat customers and suppliers."*

- Section 14, paragraphs 158-160 of the National Planning Policy Framework December 2023

"Achieving sustainable development means that the planning system has three overarching objectives, which are interdependent and need to be pursued in mutually supportive ways (so that opportunities can be taken to secure net gains across each of the different objectives):

- *an economic objective – to help build a strong, responsive and competitive economy, by ensuring that sufficient land of the right types is available in the right places and at the right time to support growth, innovation and improved productivity; and by identifying and coordinating the provision of infrastructure;*
- *a social objective – to support strong, vibrant and healthy communities, by ensuring that a sufficient number and range of homes can be provided to meet the needs of present and future generations; and by fostering well-designed beautiful and safe places, with accessible services and open spaces that reflect current and future needs and support communities' health, social and cultural well-being; and*
- *an environmental objective – to protect and enhance our natural, built and historic environment; including making effective use of land, improving biodiversity, using natural resources prudently, minimising waste and pollution, and mitigating and adapting to climate change, including moving to a low carbon economy.*

- Section 2, paragraph 8 of the National Planning Policy Framework December 2023

Policy and Guidance

Regional Policy

Regional Policy is governed by the London Plan (March 2021). Policy SI 2 Minimising greenhouse gas emissions (f) of the London Plan mandates that major development proposals should produce a Whole Life Cycle Carbon Assessment (WLCA).

Policy SI 7 requires referable applicants to demonstrate circular economy outcomes and aims in a CES and the following principles:

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

Assessment Guidance

The guidance for the methodology in this assessment is set out in the London Plan Guidance on Whole Life-Cycle Carbon Assessments (March 2022) and Circular Economy Statements (March 2022). Both document set out the required scope of a GLA compliant assessment.

Local Policy

The Local Planning Authority, Camden Borough Council, have a statutory guide to development within the borough and use policies and guides to do so. The Local Plan documents include a variety of overarching spatial policies to guide future development and land use in the Borough and have full weight in the determination of planning applications.

The Camden Council Local Plan sets out the Council's planning policies and replaces the prior Core Strategy and Development Policies planning documents (adopted in 2010). Additionally, Camden's Local Plan comprises the Camden Site Allocations Plan (2013), the North London Waste Plan (2022) and supplementary Camden Planning Guidance (CPG) documents.

The Borough of Camden declared a climate and ecological emergency in 2019 and pledge to achieve net zero by 2030. The Council is therefore committed to mitigating carbon emissions throughout the borough. The policies and requirements of new development which relate to this proposal, contained in the Camden Local Plan (2017), are set out below.

Camden Local Plan (2017-2031)

The Core Strategy produced by Camden Borough Council is a key document in Camden's development plan, which sets out the Council's vision and strategy for the Borough for the following fifteen years. It includes a variety of overarching spatial policies to guide future development and land use in the Borough.

Policy extract that is deemed relevant to whole life-cycle carbon assessment is set out below for reference:

Policy CC1 – Climate Change Mitigation

Requires all development to minimise the effects of climate change and encourage all developments to meet the highest feasible environmental standards that are financially viable during construction and occupation.

The council will:

- *Promote zero carbon development and require all developments to reduce carbon emissions by following the steps in the energy hierarchy.*
- *Require all major development to demonstrate how London Plan targets for carbon dioxide emissions have been met.*
- *Support and encourage sensitive energy efficiency improvements to existing buildings.*
- *Require all proposals that involve substantial demolition to demonstrate that it is not possible to retain and improve the existing building*
- *Expect all developments to optimise resource efficiency.*

Policy CC5 – Waste

The Council will seek to make Camden a low waste borough by:

- *Reducing waste production and increasing recycling and reuse of materials to meet the London Plan targets of 60% of household waste recycled/composted by 2031.*
- *Collaborate with other North London Boroughs on a unified North London Waste Plan strategy.*
- *Safeguard Camden's existing waste site unless a suitable compensatory waste is provided.*
- *Ensure that developments include facilities for the storage and collection of waste and recycling.*

Policy and Guidance

Supplementary Policy Documents

The North London Waste Plan (NLWP) (2022) comprises the seven North London Boroughs, including Camden; as a complementary detailed framework for waste development and management to 'Policy CC5 – waste' within Camden's Local Plan.

The NLWP encourages an understanding of waste as a resource rather than a nuisance, promoting the principles of the waste hierarchy:

- Prevention – use less material in design and manufacture and ensure longevity and re-use.
- Preparing for re-use – checking, cleaning, repairing, refurbishing whole items or spare parts.
- Recycling – turning waste into useful materials or products.
- Other recovery – including energy-producing processes.
- Disposal – landfill and incineration without energy recovery.

Relevant to the CES for new constructions, the NLWP encourages usage of excavated material within the development, in habitat creation, or flood defense. Preference should be given to using the materials on-site or within local projects where feasible.

Methodology

Whole Life-Cycle Assessment

This WLCA is comprised of the following sections:

- Total operational carbon emissions (regulated and unregulated) based on SAP10.2 carbon factors.
- Total embodied carbon emissions including all building layers (substructure, superstructure, skin/facade and internal spaces including fixed furniture only).
- Opportunities for embodied carbon reduction and end-of-life scenarios.

The methodology for the assessment follows BS EN 15978, as interpreted by the RICS Professional Statement: Whole Life-Cycle Carbon assessment (2017), later amended by The London Plan Guidance on WLCA's (2022). The methodology set out by the London Plan Guidance document is almost identical to the RICS guidance, save for the alterations explained in Box 1 of the London Plan Guidance document.

The London Plan Guidance document is the underpinning guidance used in the production of this report.

The assessment has been prepared on the assumption that the building will have a lifespan of 60 years, in coherence with paragraph 2.5.3 of GLA guidance and RICS guidance.

Embodied Assessment

Love Design Studio have utilised One Click LCA to calculate the embodied carbon associated with the Proposed Development, which is a policy compliant Life-Cycle Assessment (LCA) tool in accordance with Appendix 1 of the GLA's guidance note.

In accordance with GLA guidance, EPDs utilised within this assessment should be produced in accordance with European Standard for the generation of EPD for construction products (EN15804) or certified by other EPD standards as established in table 3.3.1 of RICS Whole Life-Cycle guidance (November 2017). The EPDs used also comply with the more recent requirements which came into effect July 2022, with alterations to EN15804+A2.

Table 6 of the RICS Whole Life-Cycle guidance (2017) has been used as the default specification for main building materials as per GLA guidance.

The environmental impact of building materials will be reported across life-cycle modules A-D as set out in BS EN 15978. The RICS NRM Classification system has been used to specify the building elements that will be included within this WLCA, as follows:

- Demolition (0.1, 0.2)
- Facilitating works (0.3 - 0.5)
- Substructure (1)
- Superstructure (2.1-2.8)
- Finishes (3.1-3.3)
- Fittings, Furnishes and equipment (4.1)
- Building Services (5.1 - 5.14)
- Prefabricated buildings and building units (6.1)
- Minor demolition and alteration works (7.1)
- External works (8.1-8.8)

Operational Assessment

As stipulated within GLA guidance, operational carbon emissions have been calculated based on a CIBSE TM54 assessment. The figures may differ from the submitted Energy and Sustainability Statement as the GLA Guidance on Energy Assessments does not state the requirement for utilising CIBSE TM54.

Both regulated and unregulated carbon emissions are included within this assessment.

Most recent GLA guidance acknowledges that although the UK's electricity grid is decarbonising, the data presently available is not reliable to utilise when reviewing WLCA emissions. Therefore, this assessment does not take into account future grid decarbonisation.

Methodology

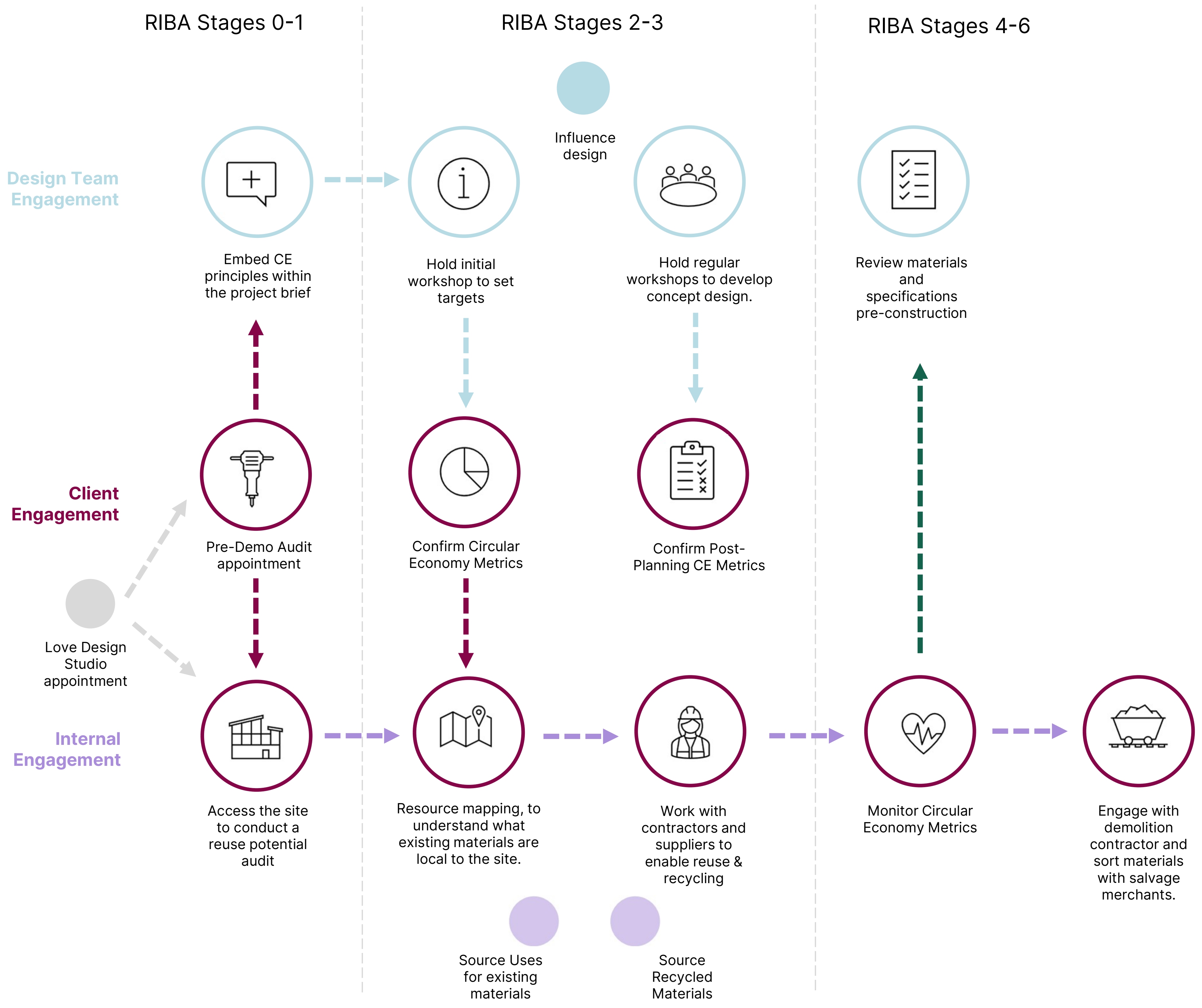


Figure 4: *Steps to integrate circular economy principles into the project throughout the RIBA stages*

The Love Design Studio approach establishes circular economy as a fundamental principle of the project and encourages all team members and the supply chain to work together towards achieving circular economy goals.

The figure illustrates the necessary steps for integrating circular economy from the outset of a project. Our involvement is critical to not only guide the design team but also to monitor and document the progress across all RIBA stages. A significant amount of groundwork is required to actualise circular economy in a project, so Love Design Studio engages with suppliers and local communities at the earliest stage to optimise reuse and recycling of existing materials on-site.

The strategy implements all circular design principles outlined by the GLA to meet the following targets:

- Min. of 95% diverted from landfill for reuse, recycling or recovery.
- Min. of 20% of the building materials and elements to be comprised of recycled and reused content.

In its simplest form, the strategic objectives for the development are to:

- Retain the value of the existing building as much as possible through prioritising reuse of the existing building materials.
- Maximise the value of the new development throughout its lifetime, focusing on the longevity and adaptability of the design.

Embodied Carbon Benchmarking

Embodied carbon targets provided in the GLA and LETI guidance documents have been utilised to benchmark and compare the carbon of this project. These targets cover specific modules set out below.

Embodied Carbon: Modules A-C (excluding B6 & B7, including sequestration), accounting for the whole life carbon of materials but excluding operational carbon.

Upfront Carbon: Modules A1-A5 (excluding sequestration) encompassing material production, transportation, and site operation.

These targets cover shell & core only and CAT A finishes. This assessment will therefore only include materials associated to substructure, superstructure, façade, services, internal spaces, and fixed furniture.

The GLA does not currently refer to or state any benchmarking guidance for operational carbon; therefore, this report uses the Embodied Carbon GLA Benchmarks only.

Benchmarks (kgCO2/m2)

Band	Residential **Embodied Carbon** (A-C excl. B6 & 7)	Residential **Upfront Carbon** (A1-A5 excl. Sequestration)	Target Benchmarks
A++	<150	<100	
A+	<300	<200	
A	<450	<300	**LETI 2030 Design Target**
B	<625	<400	**RIBA 2030 Built Target**
C	<800	<500	**GLA Aspirational**
D	<1000	<675	
E	<1200	<850	**GLA Business As Usual**
F	<1400	<1000	
G	<1600	<1200	

Figure 5: *Summary of benchmarks represented as bands ranging from A++ to G, following the LETI embodied carbon guidance for residential developments. The benchmarks exclude external works, loose furniture, and renewable on-site energy generation.*

Operational Carbon Benchmarking

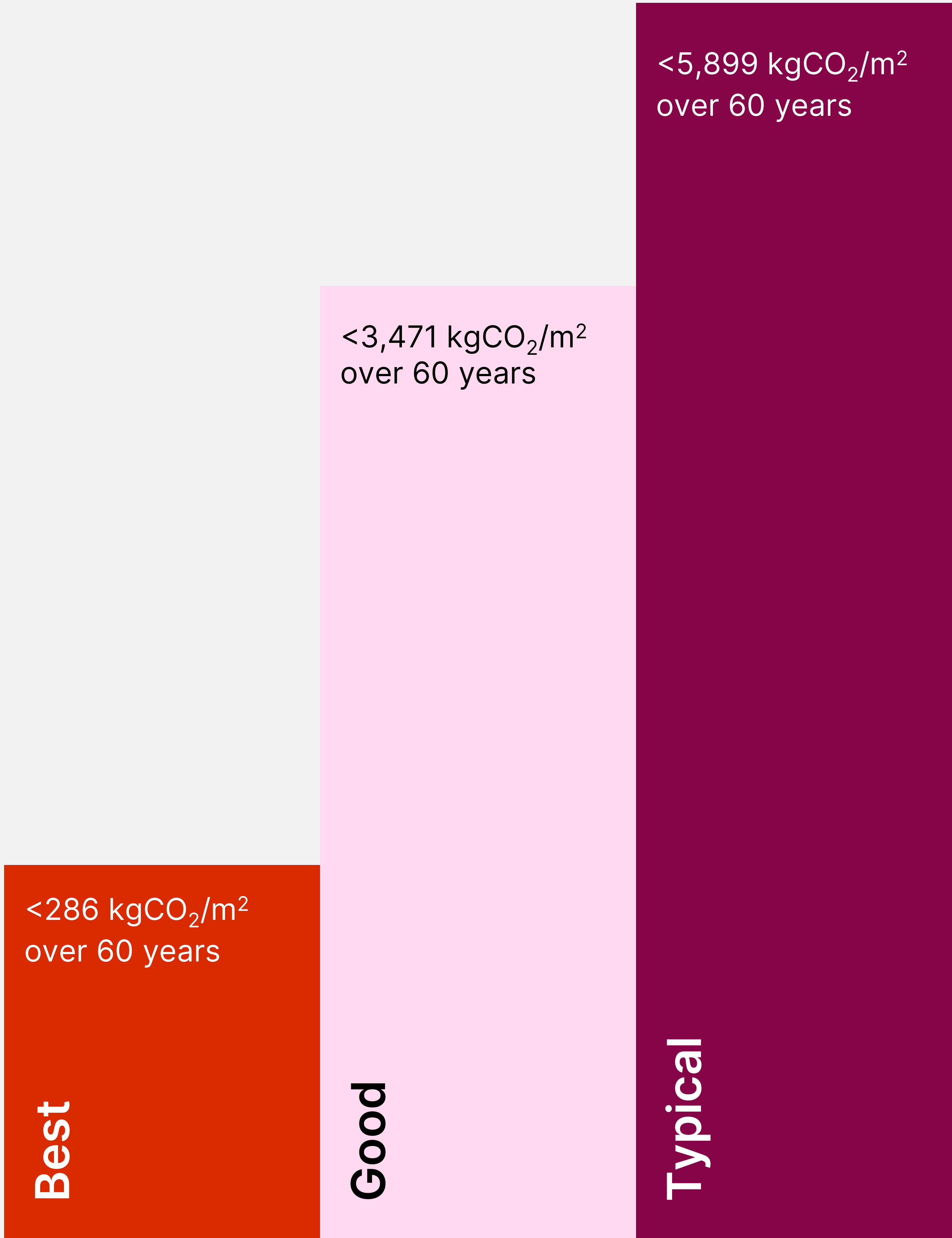
As there are no target benchmarks for operational carbon provided by the GLA, it is possible to utilise CIBSE Guide F for operational energy benchmarks tailored for existing buildings in the UK. This provides insights into the likely energy consumption of typical buildings based on their use type and presents data indicating average energy consumption in kWh/m2 per year for both regulated and unregulated energy.

For WLCAs, we can extract and convert the kWh figures for residential buildings into kgCO2/m2 per year using SAP 10.2 factors. This benchmark allows us to evaluate the project's energy consumption, and whether it is the energy efficiency objectives.

To establish an ambitious ‘best' target, we used comparative targets from LETI to estimate low energy consumption for a residential building.

This enables us to assess the project's position relative to both existing building stock and high energy efficiency targets.

Figure 6: *Summary of operational benchmarks represented as Best, Good and Typical using CIBSE Guide F and LETI guidance.*



04

Whole Life-Cycle Carbon

Whole Life-Cycle Carbon Inputs

The WLC model constructed in OneClick LCA achieved an 'B' rating within the RICS sense checker, which indicates that building elements and quantities included are in accordance with RICS guidance and estimations. This tool provides a high-level sense check to ensure nothing has been omitted from the assessment.

The RICS WLCA guidance (2017) for the built environment states that the assessment must encompass all building elements that are relevant to the project as shown in Table 1 overleaf. As per paragraph 2.6.3 of the GLA guidance, more than 95% of the capital cost allocated to each building element category has been accounted for within this WLCA.

Operational energy use has been calculated using the CIBSE TM54 methodology. Outputs from the BRUKL and SAP outputs were used within the TM54 calculation carried out by Love Design Studio.

In line with paragraph 3.2 of the RICS WLCA guidance, as the development involves the demolition of an existing structure, the impact has been accounted for in the WLCA sub-module C1. The specification of reused and repurposed materials can improve the emission figures in the product stage (A1–A3); however, the specification of these have not yet been established at RIBA Stage 2. Module D, focusing on circular economy, is calculated separately to highlight the advantages of specified materials that have the potential to be reused and recycled beyond the building's lifespan.

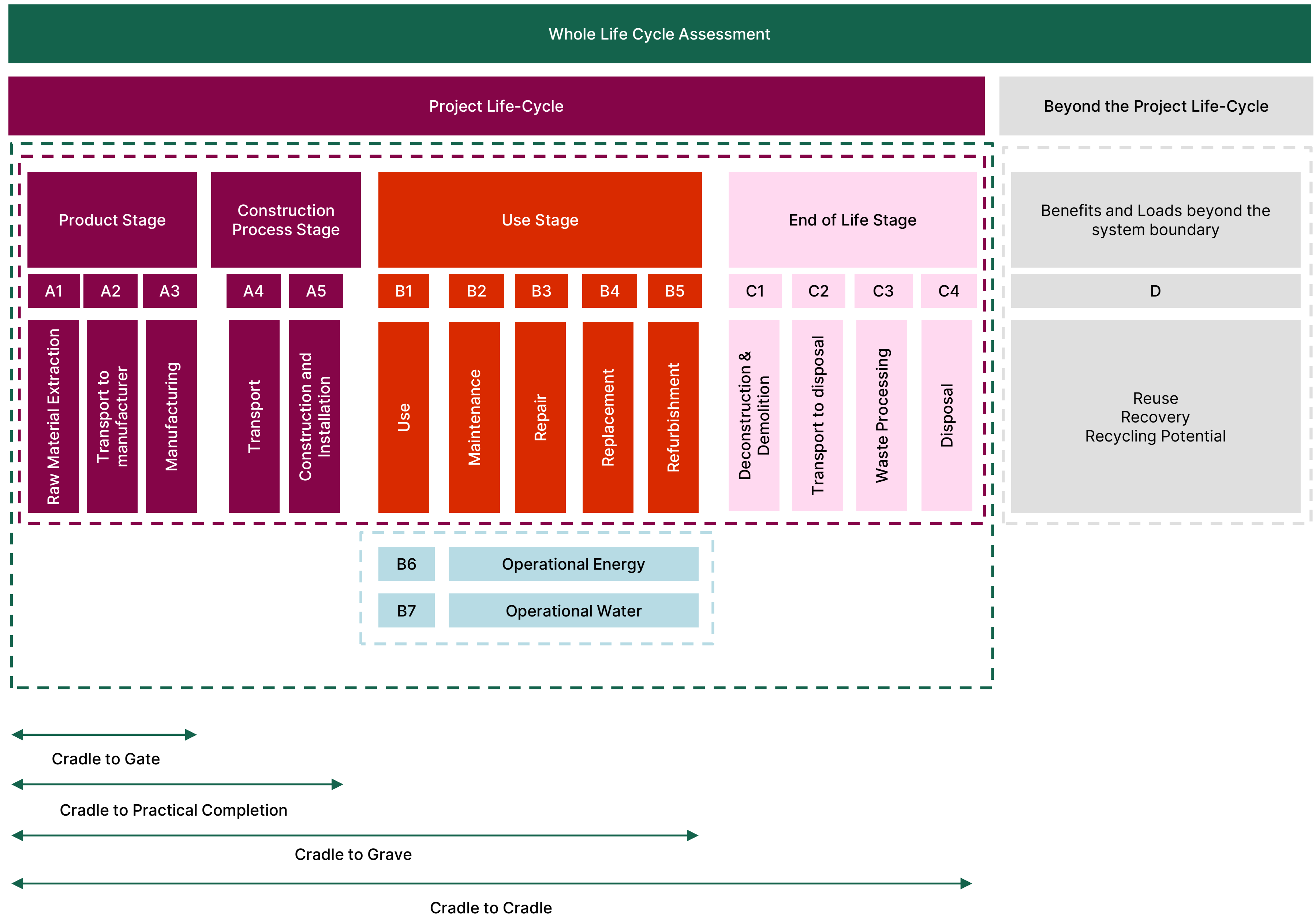


Figure 7: *Modular information for the assessment as per EN 15978 including typical system boundaries*

Whole Life-Cycle Carbon Inputs

Building element Group	Building Element	Materials/Items	Origin of information
0 Demolition and Facilitating Works	0.1 Toxic/ hazardous / contaminated material treatment	Site investigations are on-going and the design will be reviewed as it progresses.	n/a
	0.2 Major demolition works	Carbon associated to the demolition of a 136m2 MOT car wash and garage is included.	Information extracted from drawings and Design & Access Statement by Architect.
	0.3 and 0.5 Temporary enabling works	No temporary enabling works are envisioned at this stage.	n/a
	0.4 Specialist groundworks	No specialist groundworks were specified. All groundworks are accounted for in the substructure section.	n/a
1 Substructure	1.1 Substructure	Excavation and concrete piled foundations, including provisions for one lift pit.	Information extracted from drawings and Design & Access Statement by Architect.
2 Superstructure	2.1 Frame	A reinforced in-situ concrete frame. Potential to use Ground granulated blast-furnace slag (GGBS) replacement in concrete at a minimum of 30% to reduce the carbon footprint of the scheme.	Information extracted from drawings and Design & Access Statement by Architect.
	2.2 Upper floors including balconies	Reinforced concrete upper floors. Potential to use cement replacement to reduce embodied carbon.	Information extracted from drawings and Design & Access Statement by Architect.
	2.3 Roof	Flat roof with a bitumen finish incorporating green roof elements.	Information extracted from drawings and Design & Access Statement by Architect.
	2.4 Stairs and ramps	Core stairs including metal balustrade and handrail. Balustrading to balconies/terraces.	Information extracted from drawings and Design & Access Statement by Architect.
	2.5 External walls	Cavity wall consisting of facing brick, insulation and internal skin of SFS.	Information extracted from the cost plan by Johnson Associates
	2.6 Windows and external doors	Aluminium framed windows and external doors, including metal shading elements.	Information extracted from drawings and Design & Access Statement by Architect.

Table 1*: Illustrating the origin of information enabling embodied carbon analysis to be undertaken in accordance with RICS NRM 2 components.*

Whole Life-Cycle Carbon Inputs

Building element Group	Building Element	Materials/Items	Origin of information
2 Superstructure	2.7 Internal walls and partitions	Metal frames internal stud partitions with acoustic insulation and plywood strengthening	Information extracted from drawings and Design & Access Statement by Architect.
	2.8 Internal doors	Timber board fire doors with associated ironmongery	Information extracted from drawings and Design & Access Statement by Architect.
3 Finishes	3.1 Wall finishes	All internal partitions are finished with gypsum plasterboard and emulsion paint.	Information extracted from drawings and Design & Access Statement by Architect.
	3.2 Floor finishes	The flooring throughout comprises a combination of vinyl flooring and ceramic tiling.	Information extracted from drawings and Design & Access Statement by Architect.
	3.3 Ceiling finishes	All ceilings are metal framed and suspended with a plasterboard and paint finish	Information extracted from drawings and Design & Access Statement by Architect.
4 Fittings, furnishings and equipment (FFE)	4.1 Fittings, furnishings and equipment, incl. Building related and non-building related	Fixed furniture and kitchen equipment have been estimated based on the drawings, assuming materials, such as particleboard and plywood with laminates. Loose furniture is not included in the assessment.	Information extracted from drawings and Design & Access Statement by Architect.
5 Building Services / MEP	5.1 - 5.14 Services	Services associated to electricity distribution, lighting, fire safety, communications, HVAC, and ventilation has been included to cover a total Gross Internal Area (GIA) of 1,289 sqm.	Information extracted from drawings and Design & Access Statement by Architect.
6 Prefabricated buildings and building units	6.1 Prefabricated buildings and building units	There are no prefabricated elements within the scheme, therefore this has been excluded from the assessment.	Information extracted from drawings and Design & Access Statement by Architect.
7 Works to existing building	7.1 Minor demolition and alteration works	Not included	n/a
8 External Works	8.1 - 8.8 External works	Not included	n/a

Table 1*: (Cont) Illustrating the origin of information enabling embodied carbon analysis to be undertaken in accordance with RICS NRM 2 components.*

Limitations

This WLCA has been completed using the most up to date information available pertaining to the project, as at the date of this report. Information pertaining to the operational and embodied carbon footprints may change as the design progresses.

Limited information was available for materials and quantities and therefore certain assumptions were made. This should be reassessed at a later design stage, once as-built drawings and specifications are available.

As acknowledged in the GLA guidance, during the design stages, module B can be challenging to estimate. On this basis, modules B2 and B3 have been calculated in accordance with paragraph 2.5.12 of the GLA WLCA guidance.

Other assumptions that have been made relating to quantities are listed below. These may change once detailed design information is available at the technical design stage:

- Transportation, waste factors and material lifespans are presently unknown, and therefore are temporarily listed as per default figures associated to EPDs within One Click LCA.
- The quantities of recycled content and recycling rates for modules C-D are set in accordance with RICS default values as per the RICS PS assumption document. Calculations also take into account that all reinforcement steel required will be from at least a >97% recycled source.

EPD data provided by One Click LCA for building services has been used, which are based on GIA, as unit specific EPDs are not available and final specification of equipment may change prior to completion. This enabled the calculation of embodied carbon emissions associated with building services in conjunction with TM65. All EPDs pertaining to building services comply with EN15804+A2 standards. At the later design stages once M&E has been frozen, the assessment should be updated to reflect more accurate information.

Operational Carbon Inputs

CIBSE TM54 modelling utilises a building energy model to calculate energy consumption associated with space heating, cooling (if any), and fans & pumps, with the remaining energy consumption figures calculated using engineering calculations as stipulated within the CIBSE TM54 guidance.

The building fabric parameters used for assessment are illustrated to the right. The assessment of operational carbon emissions is compliant with paragraph 2.5.14 of the GLA WLCA guidance.

The overall energy strategy capitalises on passive design measures to maximise the fabric energy efficiency via an insulated building fabric and incorporation of Mechanical Ventilation with Heat Recovery to reduce the demand for heating and cooling.

The scheme will provide space heating and domestic hot water via Air Source Heat Pumps for the residential portion of the scheme. A VRF system will provide space heating and cooling to the commercial space. To maximise the on-site CO2 reduction in line with Merton's Net Zero target, solar photovoltaic panels have also been integrated alongside the scheme's proposed blue/green roof.

Further details of the assumptions used in the CIBSE TM54 assessment are available on request, while additional information on the BRUKL and SAP outputs can be found in the appendices to the submitted Energy and Sustainability Statement.

Building Fabric/Energy Efficiency Measure	**Input**	**Unit/Comment**
External wall U-value	0.14	W/m2.K
Ground floor U-value	0.10	W/m2.K
Roof U-value	0.10	W/m2.K
Door U-value	1.0	W/m2.K
Window U-value	1.2	W/m2.K
Window g-value	0.4	-
Air permeability	3	@50Pa (m3/h.m2)
Other Technical Information		
Ventilation method	Mechanical Ventilation with Heat Recovery	
Cooling	Cooling via ASHPs to ground floor commercial only.	

Table 2: *Building fabric inputs to the Proposed Development energy model*

05

Embodied Carbon Results

Embodied Carbon Results

Summary

Based on the RIBA Stage 2 design, the results for the upfront and embodied carbon are illustrated to the right, comparing the results against benchmarks from the GLA, RIBA, and LETI, creating bands A to G.

The results show that the embodied carbon is **717 kg CO_2/m^2**, placing it in a **band C**. While this aligns with the GLA aspirational benchmark, it falls short of meeting the LETI and RIBA 2030 targets. Similarly, the upfront carbon is **490 kg CO_2/m^2**, also meeting a **band C** and the GLA aspirational benchmark.

Embodied Carbon Benchmarks (kgCO2/m2)
For shell & core, CAT A finishes only

Band	Residential Benchmark	Result	Residential Benchmark	Result	
	Upfront (A1-A5)		Embodied (A-C excl. B6 & B7)		
A++	<100		<150		
A+	<200		<300		
A	<300		<450		LETI 2030 Design Target
B	<400		<625		RIBA 2030 Built Target
C	<500	**C 490**	<800	**C 717**	GLA Aspirational Target
D	<675		<1000		
E	<850		<1200		GLA Business As Usual
F	<1000		<1400		
G	<1200		<1600		

Figure 8: *Embodied carbon results against benchmarks represented as bands ranging from A++ to G, following the LETI embodied carbon guidance for Residential developments*

Embodied Carbon Analysis

Embodied Carbon by Life-Cycle Stage

The figure to the right provides an overview of the various life cycle stages and highlights where the majority of the embodied carbon is attributed. It is evident that A1-A3 (63%) and B2-B4 (30%) have the highest contributions.

The concrete structure and foundations contribute significantly to modules A1-A3, alongside the external masonry walls. The internal partitions are also major contributors to these modules, primarily due to the carbon-intensive metal frame studworks. Reducing the impact of the A modules can be achieved by increasing the use of reused and recycled content in the specifications and opting for timber components over metal.

The primary contributors to the B modules are the fixed furniture and kitchen equipment, along with services such as lighting, HVAC, and lifts. Since the B4 module pertains to carbon impacts from material replacement over 60 years, these impacts can be reduced by choosing more durable materials with longer lifespans and materials that are reusable at the end of their life cycle.

Embodied Carbon by Building Element

The figure to the right illustrates the main building elements contributing to the embodied carbon of the Proposed Development. The highest contributors are the services (29%), fittings, furnishings & equipment (13%), and external walls (14%). When combining the substructure (8%), frame (7%), floors (11%), and roof (3%), the concrete structure accounts for 29% of total carbon emissions. This demonstrates that the structure as a whole, alongside the services, are the largest contributors. This highlights the materials for which low-carbon alternatives could be sought to reduce overall embodied carbon and exceed the GLA's aspirational targets at the following design stages.

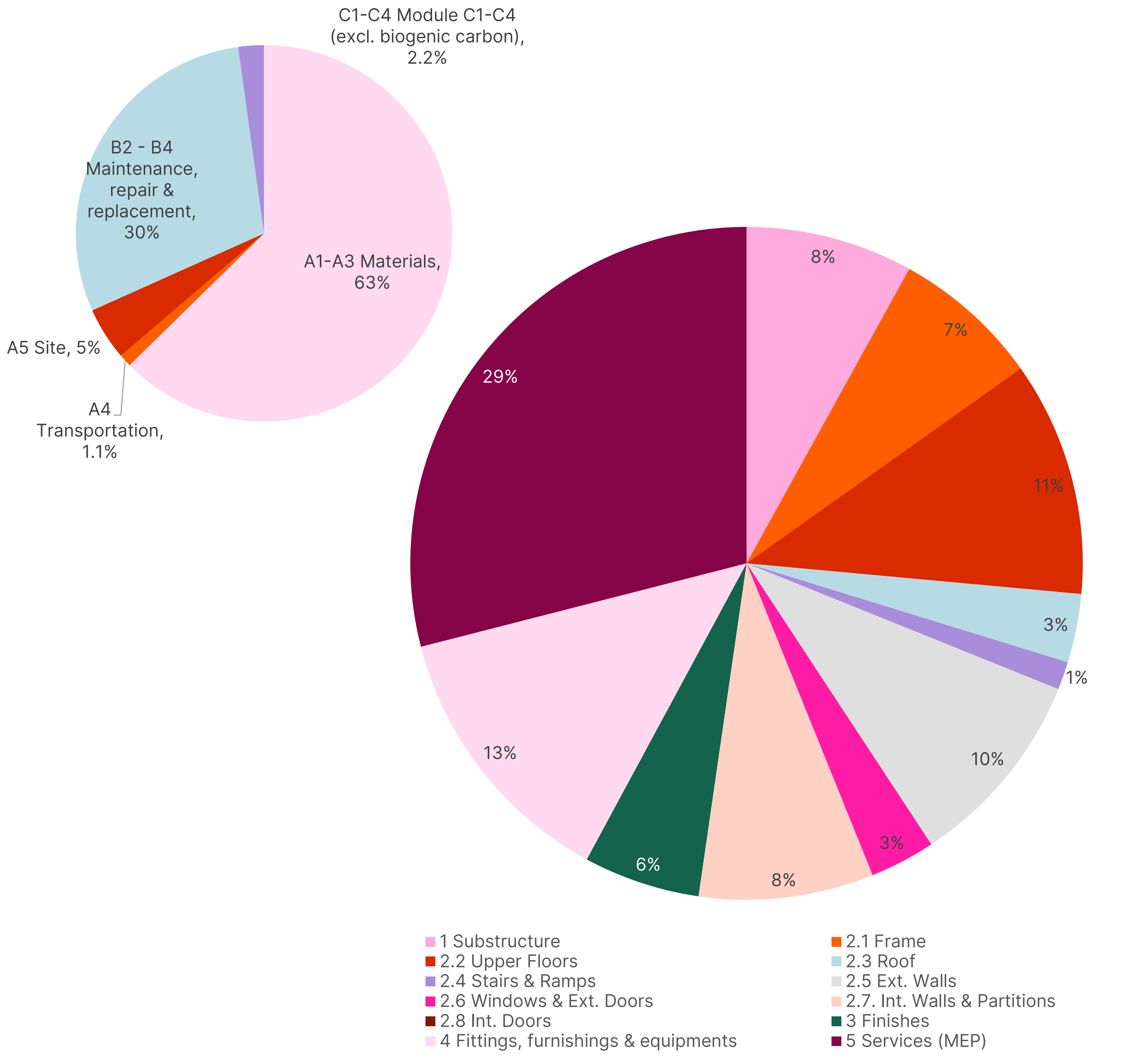


Figure 9: *Embodied carbon results for the Proposed Development based on building component (right) and life-cycle stage (left)*

Embodied Carbon Analysis

The following table illustrates the most carbon intensive materials for the Proposed Development.

12 most contributing materials to the Upfront Carbon footprint	Upfront Carbon (A1-A3) (tCO2e)	% of total Upfront Carbon
Ready-mix concrete for the structure	98	18%
Hollow core concrete slabs including reinforcement	65	11.3%
Lift	40	6.8%
Reinforcement steel (rebar) with 90% recycled content	38	6.5%
Heating unit	33	5.6%
Lightweight concrete blockwork for external walls	28	4.9%
Electricity distribution system	28	4.8%
Aluminium frame windows with double glazing	26	4.6%
Stone wool insulation panels	20	3.5%
Red brick	19	3.3%
Self levelling mortar for floors	18	3.1%
Kitchen units & cabinets	18	3.1%

Table 3: *Summary of the building's 12 most contributing materials to the Upfront Carbon footprint*

Operational Carbon Results

06

LOVE
DES/GN
STUD\O

Operational Carbon Results

TM54 analysis indicates that the total operational emissions for the Proposed Development over a period of 60 years are to 771 kgCO2e/m2 equivalent to 994 tCO2e.

The graph to the right indicates that the highest contributors are small power, domestic hot water, and space heating, which is to be expected for a building of this use type. The assessment uses a conservative approach regarding occupancy, assuming full occupancy year-round of both the guest rooms and employment spaces.

The analysis assumes each residential unit will include provision of a fridge, microwave, and a hob and other electrical appliances; this significantly increases the emissions associated with small power.

The consumption associated with heating and cooling is limited due to the high efficiency systems and equipment proposed, as well as the high U-values and air permeability of the Proposed Development.

Further information on how energy demand has been reduced in design can be found in the Energy and Sustainability Statement.

Please note that these calculations do not take into account future grid decarbonisation and are based on SAP 10.2 carbon factors.

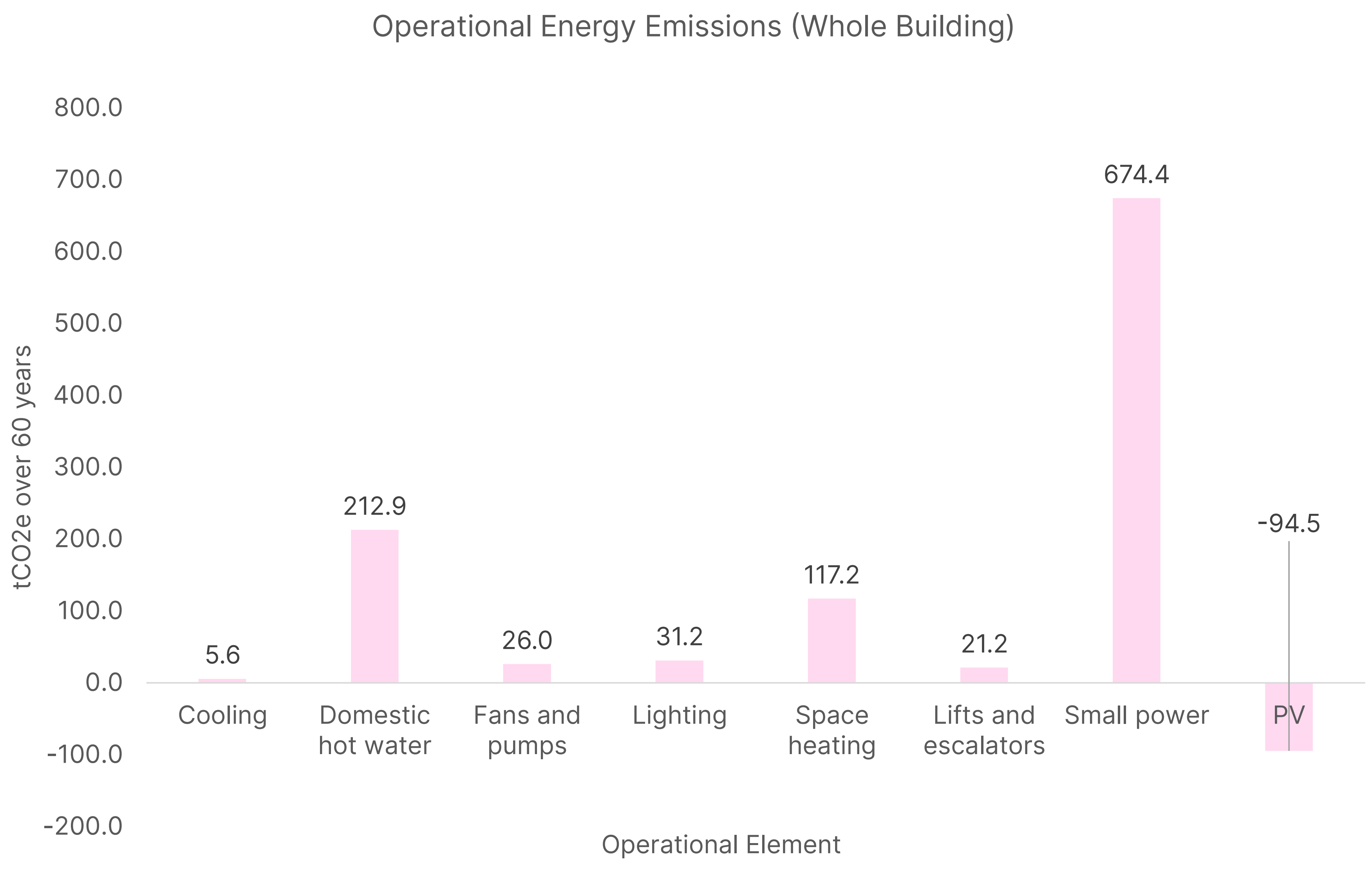


Figure 10: *Operational carbon results calculated using TM54 analysis*

Operational Carbon Benchmarks

The total operational carbon emissions (estimated regulated and unregulated) for this project are as follows:

- **994** tCO_2/60-years
- **771** $kgCO_2/m^2$·60-years
- **17** tCO_2/year
- **13** $kgCO_2/m^2$.year

The combined energy consumption of both regulated and unregulated energy is compared to the operational benchmarks for residential buildings outlined in CIBSE Guide-F.

This indicates that the Proposed Development has far surpassed the good practice benchmark. This reduction is attributable to the high U-value specification of the new fabric, as well as an efficient heating and cooling system.

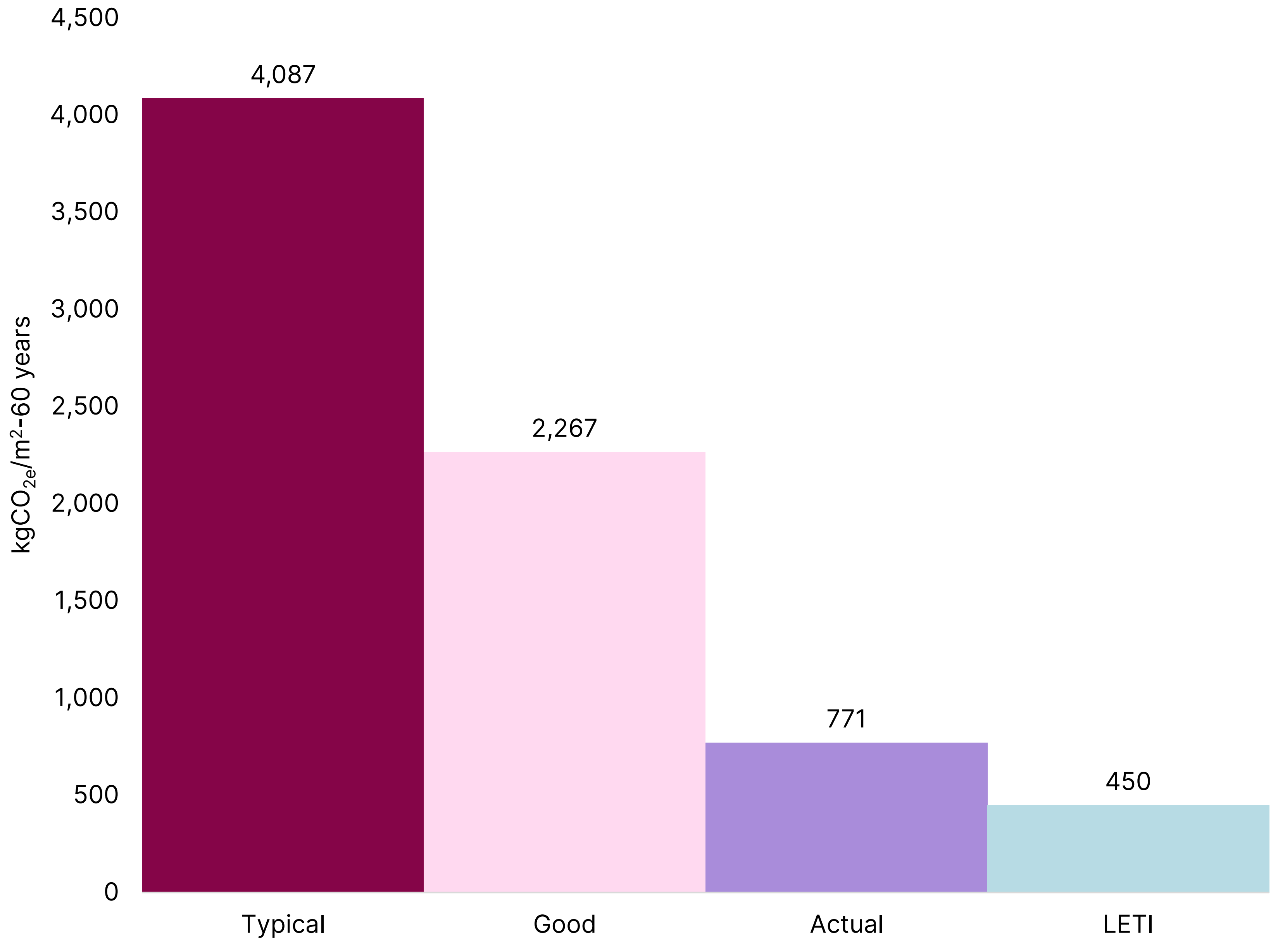


Figure 11: *Operational carbon results calculated using TM54 analysis*

07 Summary Results

Whole Life-Cycle Carbon Results

Whole Life-Cycle Carbon

The overall Whole Life-Cycle Carbon Assessment has calculated an estimated 1900 tCO2e over the buildings assumed lifetime of 60 years. This figure is split between the embodied carbon and the operational carbon.

Embodied Carbon

The embodied carbon figure associated to the proposed materials amounts to 924 tCO2e. This has achieved a band D when compared against the benchmark targets set out by the GLA, RIBA and LETI. Band D surpassed the GLA Business as usual benchmark but does not meet the GLA aspirational benchmark.

Operational Carbon

The operational carbon figure associated to energy consumption of the space amounts to 994 tCO2e, which is lower than benchmarks set in CIBSE Guide F for good practice in general residential buildings, indicating a good operational performance.

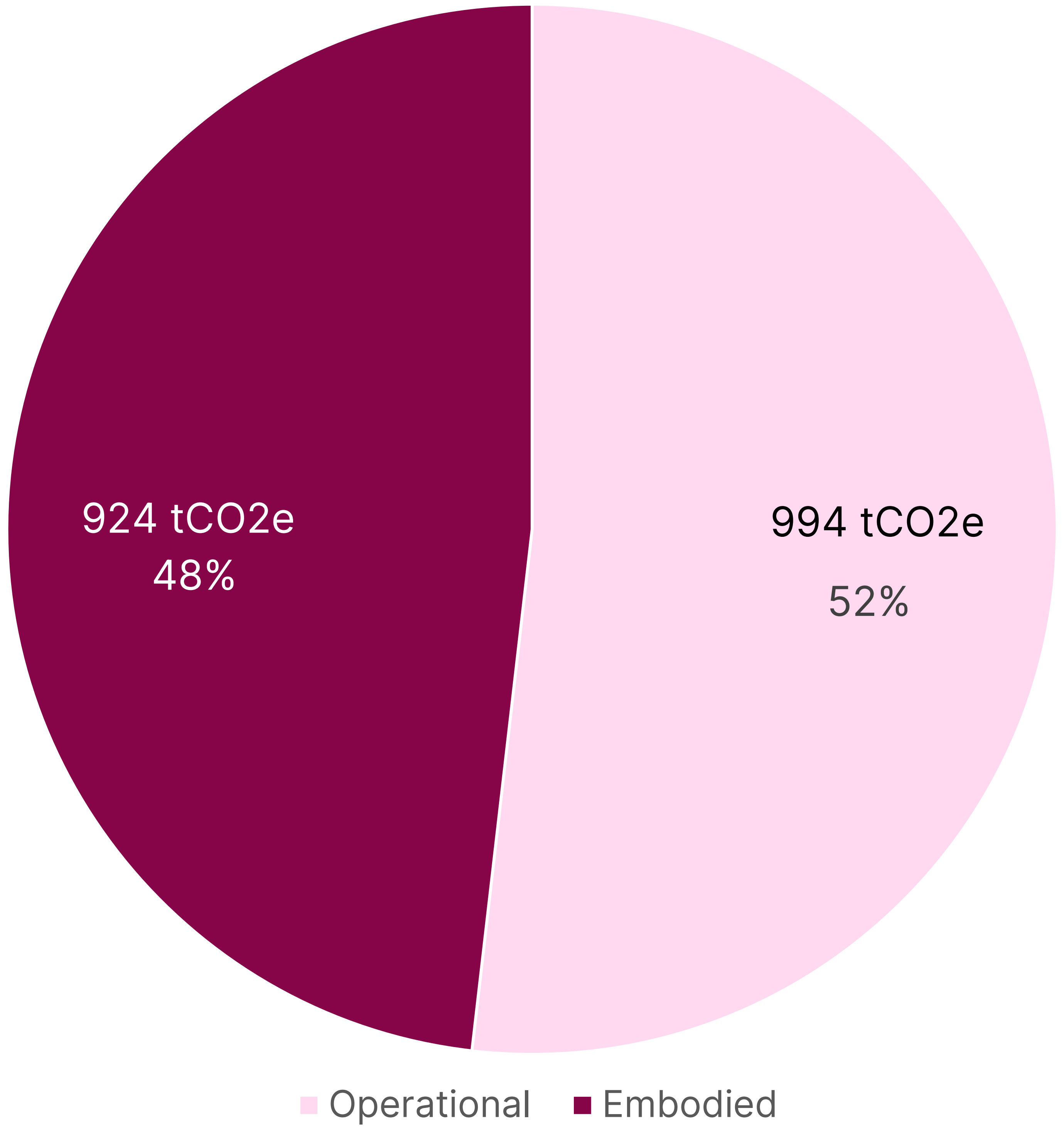


Figure 12: *WLC for 160 Malden Road*

Future Opportunities for Reductions

As the scheme progresses through the design stages, there will be several further opportunities for additional embodied carbon reductions to be made.

Source Sustainably

Efforts to source and specify local materials should be prioritised, in conjunction with the implementation of a Sustainable Procurement Plan.

Manage Waste Sustainably

Once cost plans have been finalised for the construction stage, a construction waste management plan should be implemented and managed by the construction company on-site, to avoid unnecessary waste.

Integrate Circularity

The Circular Economy principles should be followed to assist in reducing emissions across all life-cycle stages.

Cement Replacements and Recycled Steel

Within this assessment, all concrete used within the structure has no recycled binder content based on the information received. However, if the design can consider specifying recycled concrete or binder replacement at the detailed design stage, then the carbon emissions can be further reduced.

Timber Based Products

Consider using bio-based materials and timber-based products across all building elements where feasible. If the opportunity should arise, then timber should replace any feasible metal or concrete counterpart, provided that all fire safety requirements are adhered to. Additionally, specification of timber suspended ceilings and internal stud partitions in place of steel is preferable due to the embodied carbon savings and its contribution to sequestered carbon.

Design for Adaptability and Disassembly

To reduce emissions at the end-of-life cycle stages, the scheme should consider ease of disassembly and adaptability within internal layouts of all floors. Prioritise materials that are capable of reuse at end of life or closed loop recycling. This is further explored in the following section covering all circular economy principles and strategies.

08

Circular Economy

GLA Principles & Targets

The GLA have outlined six key principles to be integrated into every scheme to promote circularity and meet specific targets to reduce waste in the design, construction, and in-use phases. These core principles are detailed on the right.

The project's approach involves evaluating and integrating each principle into the proposal to achieve specific targets outlined by the GLA. These targets serve as benchmarks for monitoring progress and minimising waste. They include:

- Divert a minimum of 95% **Demolition Waste** from landfill for reuse, recycling or recovery
- Divert a minimum of 95% **Excavation Waste** from landfill for beneficial use
- Divert a minimum of 95% **Construction Waste** from landfill for reuse, recycling or recovery
- Minimum 20% of the building material elements to be comprised of **recycled or reused content.**
- Minimum 65% **recycling rate** by 2030

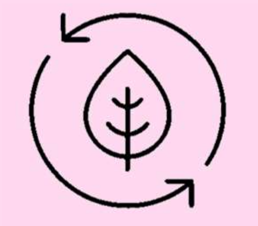
1		**Building in layers** Create a design framework that emphasises the autonomy of individual layers, adapting each one based on its function and lifespan. Embrace a design methodology to ensure ease of accessibility and disassembly for all building layers and elements. This approach streamlines maintenance, reducing disruptions and potential waste.
2		**Designing out waste** From project inception to completion, prioritise waste reduction. Incorporate standardised components, modular and pre-fabricated construction techniques, and explore opportunities for reusing reclaimed products and recycled materials. When the building is operational, encourage reuse and recycling initiatives.
3		**Design for longevity** Opt for durable and long-lasting materials and construction methods. Buildings designed for longevity require fewer resources for maintenance and repairs, reducing their overall environmental impact.
4		**Design for adaptability** Embrace flexibility in design to accommodate changing needs and functions over time. This approach extends the building's useful life and minimises premature obsolescence.
5		**Design for disassembly** Anticipate the end-of-life phase during the design process. Create structures that can be easily disassembled, enabling the separation of materials for recycling and reducing waste.
6		**Using reusable and recyclable materials** Prioritise materials that can be repurposed or recycled after use. This contributes to resource conservation and may extend to working with suppliers who offer take back schemes or product as a service models.

Table 4: *Summary of the core GLA circular design principles*

Retaining the Existing Value

To retain the existing value of the site and its materials, the design team have used the GLA's 'Circular Economy Decision Tree' to determine the most suitable strategic approach for the project. This tool prompts designers and developers to first consider ways to reuse existing buildings, materials, or elements on the site, before exploring strategies to maximise the proposed value of the development over time.

Strategic approach:

Based on the decision tree, the design team determined that the plan would be to prioritise material deconstruction and reuse and then explore demolition and recycling of elements that are not easily reusable. This decision was made due the poor construction, low value, and likely contamination of the existing structure, which made the building technically unsuitable for retrofitting. The current arrangement and layout do not maximise the site's potential, making it inefficient to incorporate it into the new design. However, materials from the structure may be considered for recycling off-site if deemed safe following an intrusive investigation.

For further details on the existing site, please see the Contamination Report submitted with this application.

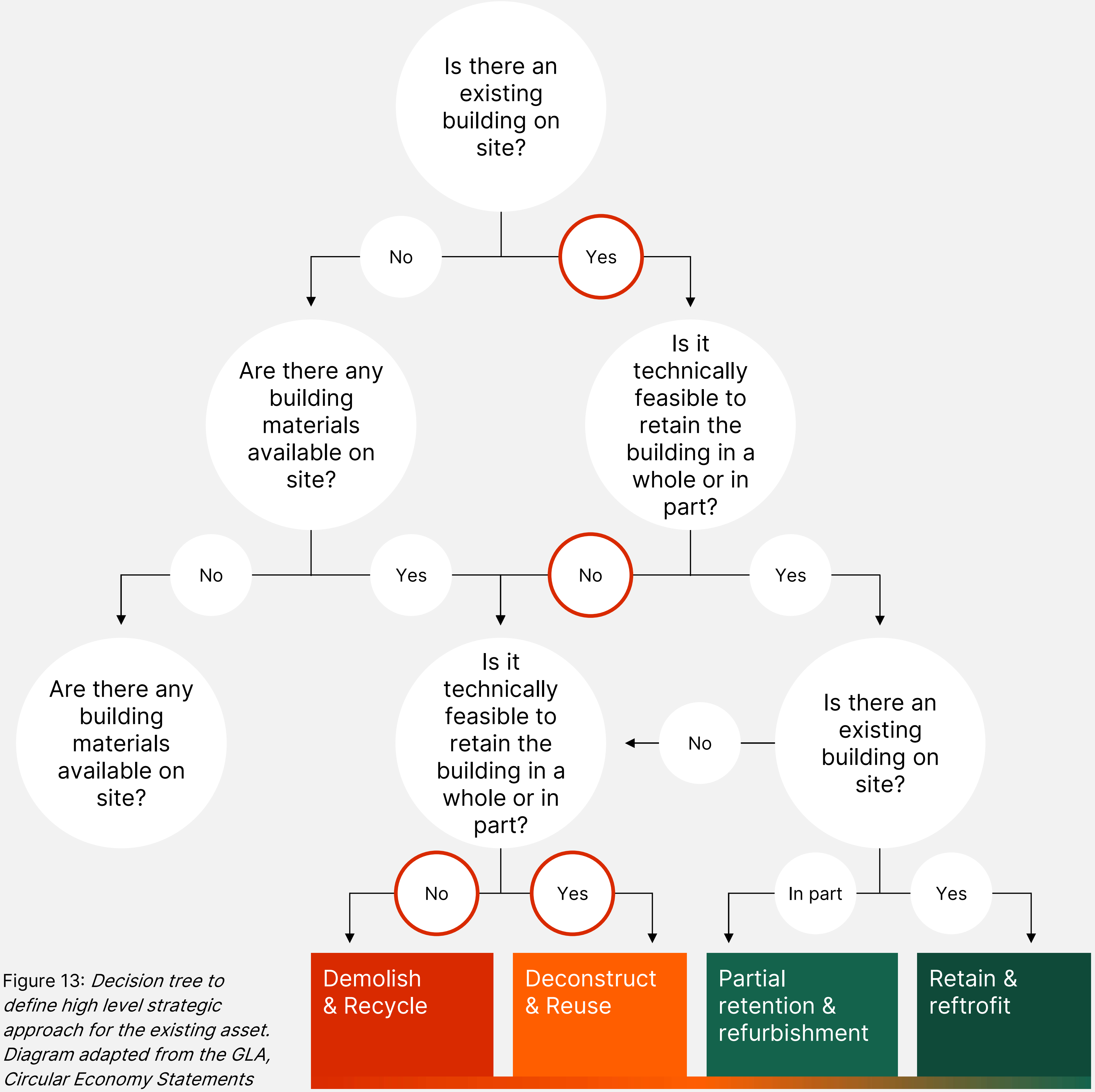


Figure 13: *Decision tree to define high level strategic approach for the existing asset. Diagram adapted from the GLA, Circular Economy Statements Guidance.*

Figure 14: *Existing materials on-site*

Retaining the Existing Value

Consistent with the decision tree approach, the core strategy focuses on the deconstruction-to-reuse and the demolish-to-recycle approaches to the existing building. All the materials planned for removal should first prioritise deconstruction for off-site reuse, if feasible. The materials that are deemed unsuitable for reuse, recycling should be considered over landfill disposal. This strategy, not only retains the value of the existing materials but helps to meet the key GLA target to reuse, recycle, and recover 95% of on-site waste.

Reusing and recycling on-site waste aligns with the GLA Principle 2, 'Designing out Waste,' which focuses on the concept of Urban Mining. Urban Mining treats buildings as material banks, enabling the extraction of valuable resources during deconstruction rather than treating them as demolition and landfill waste.

As a result, it is important to understand what materials are available on-site for reuse and recycling. For this project, Love Design Studio have carried out approximate calculations of the existing material types and quantities.

This information has been incorporated in the accompanying GLA spreadsheet template for Circular Economy Statements.

Principle 02 - Designing out waste

Key Strategies:

Reclamation
- Identify existing materials and their quantities on-site.
- To reuse and recycle existing materials found on-site
- To conduct a reuse potential audit to identify materials with reuse potential. Materials should be graded based on their visual and technical qualities to aid designers in placing these materials within their specifications.
- When selecting materials for recycling, explore options with manufacturers that can transform the materials into new products, instead of sending them directly to a recycling facility. If a recycling center is preferred, prioritise local facilities.
- Consult with demolition contractors and deconstruction experts to understand the feasibility of disassembly as early as possible
- Determine suitable storage locations for materials during the deconstruction and development of the building to facilitate efficient salvage of materials.
- A structural engineer to investigate and assess the strength of the retained structure or elements.

Construction
- Allocate convenient space for segregating and storing construction waste to encourage reuse and recycling.
- Ensure contractors are part of the Considerate Contractors Scheme.
- Educate contractors about salvaging practices.
- Implement a robust contract to enforce salvage of materials, preventing disposal and disputes.

Target:

Minimum of 95% of demolition and construction waste diverted from landfill for reuse, recycling or recovery, and the beneficial use of at least 95% of excavation waste.

Table 5: *Designing out of waste*

Maximising the Proposed Value

Another GLA Circular Economy Decision Tree was used to determine the most suitable approach for the Proposed Development regarding how it can be designed to maximise the proposed value for the site.

Strategic approach

The Proposed Development will be designed for a long-life expectancy and use durable materials to ensure its longevity.

However, adaptability is also crucial here to allow the development to cater for multiple functions and/or allow the addition of stories and extensions in the future.

Internally, the space must also be designed for adaptability and disassembly, accommodating for changing occupancy, functions, and climate without the need for demolition or future strip-outs. Opting for responsible manufacturers with product-as-a-service, long warranties, or take-back schemes are essential to extend the life span of the building and the materials.

All aspects of the building should be designed for disassembly, avoiding permanent fixtures and adhesives wherever possible. While the building as a whole is designed for longevity, individual layers and components within the building should incorporate measures of flexibility and adaptability to accommodate changing needs over time.

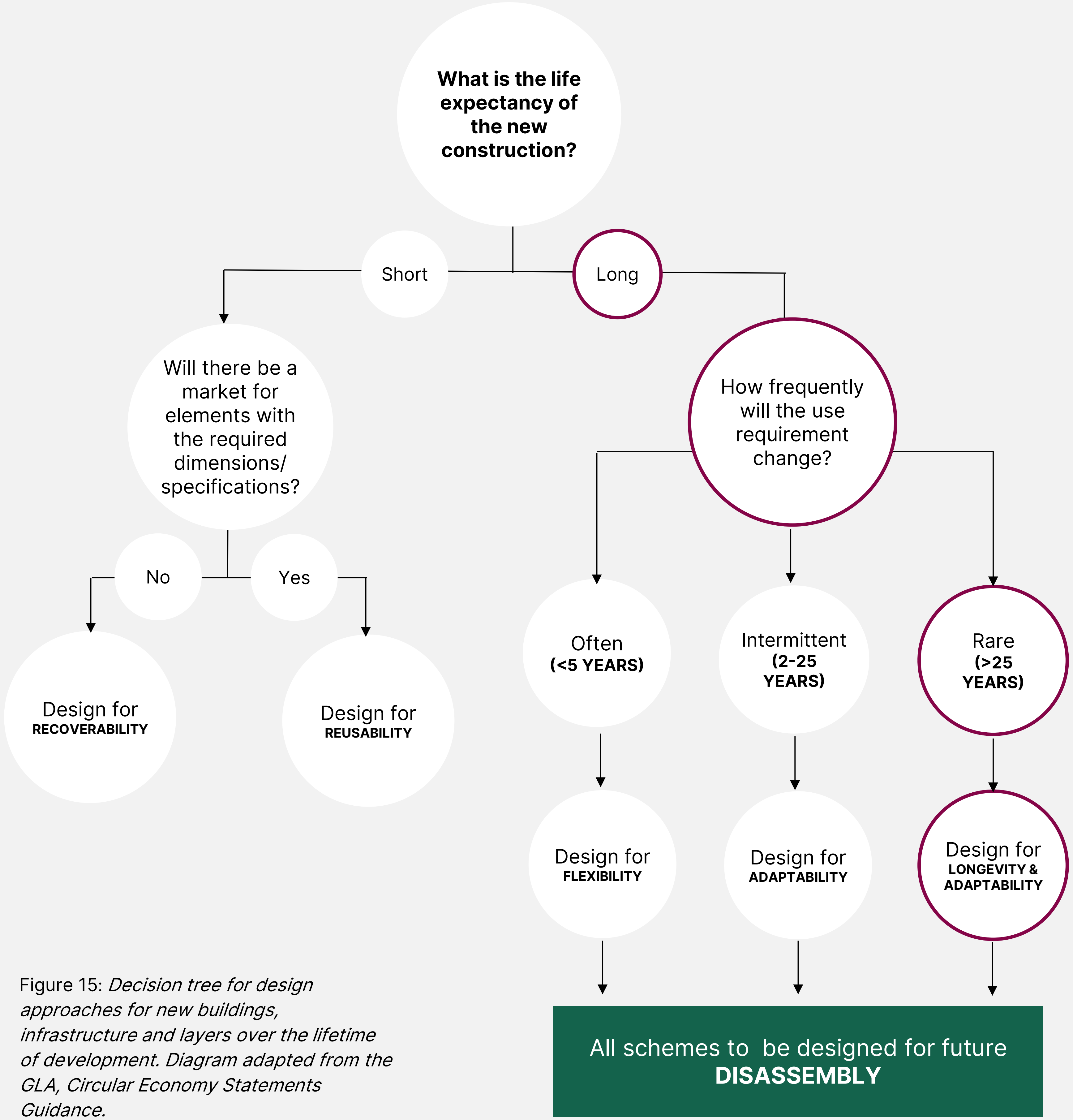


Figure 15: *Decision tree for design approaches for new buildings, infrastructure and layers over the lifetime of development. Diagram adapted from the GLA, Circular Economy Statements Guidance.*

Maximising the Proposed Value

The Proposed Development will look to embody all six GLA principles detailed in the table to the right.

Design Response:

The primary structure will be a durable concrete frame designed for a long lifespan. The exterior walls will be constructed using high-quality, reusable brick using lime-based mortar, combined with metal cladding that can be easily dismantled and recycled. Aluminum frame windows will be specified for their durability and recyclability, with a design that facilitates easy removal and replacement.

Materials with high recycled content will be prioritised and those that are easily recyclable at the end of their life. On-site waste will be carefully sorted and recycled, with a target of diverting at least 95% of construction waste from landfill. When operational, a comprehensive recycling program will look to be implemented within both residential and commercial spaces to ensure high recycling rates.

The services will be designed for easy access and maintenance, ensuring longevity and reducing the need for complete system replacements. The building's components will be designed for disassembly, facilitating the reuse and recycling of materials. By treating the building as a material bank, the proposed design will ensure that valuable resources can be extracted and reused at the end of the building's life, aligning with the principles of Urban Mining.

Principle 01 – Building in layers	**Principle 02 – Design out waste**
Key Strategies: • Understand the lifespan, expected wear and tear, and maintenance requirements of each layer, and design accordingly. • Adopt a modular design approach to allow for the independent replacement of building components within each layer. • Plan for the end of life of each layer, ensuring materials are able to be disassembled, reused and recycled at end of life.	Key Strategies: **Design** • Increase specification of biological and compostable materials • Prioritise specification of reclaimed materials and those with a high recycled content • Utilise prefabricated and standardised components that can be disassembled and reused at end of life. **Construction** • Increase off-site construction to reduce on-site waste and disruptions. • Optimise construction processes to reduce offcuts and leftover materials. • Encourage suppliers to reduce product packaging and promote reusability, consider packaging take-back schemes. **In operation** • Integrate closed-loop systems for water, energy, and waste to reduce resource consumption. • Include on-site facilities for reuse, recycling, and composting in line with the London Plan Guidance. • Promote education on reuse and recycling to minimise operational waste during the building's life cycle.
GLA Guidance: • **Provide a realistic assessment of the lifecycle, accessibility and maintenance requirements of each layer.**	**GLA Target:** • **Achieve 65% recycling rate by 2030.** • **Minimum 20% of the building material elements to be comprised of recycled or reused content.** **Suggested additional target:** • **To specify a minimum of 10% low impact materials (define this by using certifications such as C2C)**

Table 7 : *Building layer and design out waste*

Maximising the Proposed Value

Principles 3, 4, and 5 serve as the primary design drivers for the Proposed Development, as illustrated in the decision tree.

The concrete structure will be designed for a long lifespan, ensuring structural integrity for decades. High-quality materials and construction methods will maximise durability while flexible floor plans will allow for easy reconfiguration, accommodating future changes without major structural alterations.

The building envelope will feature resilient brick along with durable metal cladding, ensuring a long-lasting facade. These elements, including the aluminum frame windows, will be designed for straightforward removal, enabling materials to be easily reclaimed and recycled.

Mechanical ventilation systems and other services will be installed in accessible areas to facilitate upgrades and maintenance with minimal disruption. Internal walls and partitions will be modular, specifically in the commercial ground floor area, allowing for simple reconfiguration of spaces. Internal finishes, such as flooring and ceilings, will avoid adhesives/wet finishes where feasible and be chosen for their ease of removal and recyclability.

Materials and components will prioritise manufacturers that offer take-back schemes and those that can guarantee end of life recyclability. For mechanical systems, product-as-a-service models will also be explored where manufacturers retain ownership and responsibility for maintenance and eventual reuse or recycling.

Principle 03/04/05 – Design for Longevity, Adaptability & Disassembly

Key Strategies:

Longevity
- Choose durable and high-quality materials that withstand wear and tear, extending the building's life.
- Opt for suppliers with long warranties to ensure product quality and durability and extend customer to manufacturer relationship
- Develop maintenance and refurbishment plans to support the durability and functionality of the building, and to extend the lifespan of existing structures. Plan for regular maintenance and provide clear guidelines on how to preserve the building's value over time.

Adaptability
- Implement flexible design solutions for each building layer that can easily adapt to future needs and functions.
- Create modular and reversible construction techniques to allow for easy disassembly and reconfiguration when required.

Disassembly
- No irreversible fixings or adhesives to allow future disassembly without damaging materials and systems.
- Design so that each layer is accessible for maintenance teams and to allow deconstruction.
- Material Passports - Label and document building components to aid in future disassembly and reuse

GLA Guidance:

- **Use decision trees and building in layers framework to find appropriate design approach for the site**
- **Create a realistic assessment of the building's adaptability to changing needs and functions**

Principle 06 – Using reusable and recyclable materials

Key Strategies:

- Collaborate with suppliers to establish closed-loop supply chains, where materials are continuously reclaimed, remanufactured, and reintegrated into new products. Prioritise manufacturers that offer take-back schemes or product as a service models for instance, explore leasing ventilation, heating, cooling, lighting, lifts, and facades.
- Specify standardised and modular construction of elements as this will increase the likelihood that the materials or component can be reused again.
- Conduct life cycle assessments (LCAs) to evaluate the environmental impact of materials and products from extraction to disposal. Consider how much of the material the material is recyclable at end of life and set a target for the project..

Target Suggestion:

- **Target a minimum of prefabricated and standardised elements.**
- **Set a target for the specification of manufacturers with take-back schemes and service models.**

Table 7: *Design for Longevity, Adaptability & Disassembly and Using reusable and recyclable materials*

Summary

The Proposed Development has considered a design strategy that minimises waste and maximises the reuse of materials.

Love Design Studio have been collaborating with the design team to encourage ongoing discussions on the implementation of circular design strategies. At RIBA stage 2, the following strategies were considered by the design team which were developed:

1. To retain the existing value through the off-site reuse and recycling of existing on-site materials, where feasible.
2. To maximise the proposed value of the site through circular design principles including design for adaptability, disassembly, and longevity.

Next steps

Post planning, the design team will play a crucial role in incorporating circular economy principles into the design. The following key considerations are encouraged:

- To conduct a comprehensive whole life-cycle carbon assessment of the development to monitor the impact of design decisions against targets set within this report.
- Collaboration with manufacturers and suppliers to encourage take-back schemes and reuse opportunities
- Careful selection of materials that align with the circular economy principles and promote responsible and local sourcing.
- To develop design details with manufactures for disassembly solutions including structure, internal partitions, and finishes.

09

Conclusion

Conclusion

This WLCA sets out how the Proposed Development seeks to comply with London Plan 2021 Policy SI 2 (f) ‘Minimising greenhouse gas emissions’ and to provide an estimate of the total carbon emissions emanating from the development over its lifetime. This includes the emissions resulting from the materials, the building’s construction, the use of the building, and its demolition and disposal.

The carbon emissions associated to the proposed design have been examined using targets to benchmark the results against standard or aspirational practice, drawing targets from the GLA, as well as other organisations, such as LETI and RIBA. The results indicate that the scheme is currently within the GLA benchmark targets for WLCAs.

Further opportunities will be explored to continually reduce the overall carbon footprint of the project at each design stage. The report outlines key strategies aligned within the Circular Economy principles, focusing on the reuse of on-site materials and designing for disassembly.

Embodied Carbon

At the current Stage 2 design, the project's embodied carbon emissions is measured at 717 kgCO2e/m2, equivalent to 924 tCO2e.

The embodied carbon results for the Proposed Development currently meet the GLA Aspirational Benchmark but do not meet the LETI and RIBA 2030 targets. However, if the material specifications are further developed at the detailed design stage and Circular Economy principles are integrated, the project has a good opportunity to meet the more ambitious targets.

Operational Carbon

TM54 analysis indicates that the total operational emissions for the Proposed Development over a period of 60 years are 771 kgCO2e/m2 equivalent to 994 tCO2e

The scheme has been carefully designed to reduce its carbon emissions in operation, providing a site-wide CO2 reduction against a notional scheme compliant with Part L Building Regulations (2021). The scheme adopted the principles of the energy hierarchy, Be Lean, Be Clean, and Be Green to maximise on-site carbon reductions.

Please refer to the submitted Energy and Sustainability Statement for further details.

Based on a CIBSE TM54 assessment, the elements that make the highest contributions to the operational carbon footprint are small power, domestic hot water, and space heating, which are typical for a residential use

Whole Life-Cycle Carbon

The overall WLCA has calculated an estimated 1,900 tCO2e over the buildings assumed lifetime of 60 years.

Circular Economy

At RIBA Stage 2, the Proposed Development has considered all six Circular Economy principles and is progressing towards the GLA waste targets.

Incorporating circular economy strategies post-RIBA Stage Two is essential to further reduce the development's impact. For example, by specifying reclaimed and recycled materials and opting for manufacturers that lease products or offer take-back schemes, the lifespan of materials are extended and ensure the life-cycle carbon impact of the development and its materials remain low.

A comprehensive whole life-cycle carbon assessment is encouraged to be conducted at RIBA Stage Four Technical Design and upon completion. This will monitor and improve the impact of design decisions, ensuring targets are met.

Appendices

10

Appendix A – Table of Results

Result category	Biogenic carbon (kg CO2e)	A1-A3 Product Stage	A4 Transportation to site	A5 Site operations	B1 Use Phase	B2 Maintenance	B3 Repair	B4 Material replacement - materials	B5 Material refurbishment	B6 Operational Energy use - Regulated	B6 Operational Energy use - Unregulated	B7 Operational Water use	C1 Deconstruction / demolition	C2 Waste transportation	C3 Waste processing	C4 Waste disposal	TOTAL kg CO2e	D External impacts (not included in totals)
0.1 Toxic Mat.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.2 Demolition	0	0	0	0	0	0	0	0	0	0	0	0	462	0	0	0	462	0
0.3 Supports	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.4 Groundworks	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.5 Diversion	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1 Substructure	0	60112	2839	3223	0	1074	269	294	0	0	0	0	0	1591	3458	0	71518	-13898
2.1 Frame	0	56005	2440	2641	0	1074	269	0	0	0	0	0	0	2184	177	0	63447	-14900
2.2 Upper Floors	0	92472	2467	3288	0	1074	269	0	0	0	0	0	0	1993	221	11	100452	-23048
2.3 Roof	0	24181	309	479	0	1074	269	389	0	0	0	0	0	390	3596	8	29351	-8312
2.4 Stairs & Ramps	0	10274	578	476	0	1074	269	254	0	0	0	0	0	328	72	0	11982	-2484
2.5 Ext. Walls	0	77074	541	6037	0	1074	269	1093	0	0	0	0	0	829	78	47	85698	-3155
2.6 Windows & Ext. Doors	0	27059	35	0	0	1074	269	583	0	0	0	0	0	268	2	4	27951	-1261
2.7. Int. Walls & Partitions	-20200	52101	243	2840	0	1074	269	17995	0	0	0	0	0	1391	20437	24	74832	-5638
2.8 Int. Doors	0	0	0	0	0	1074	269			0	0	0	0	0	0	0	0	0
3 Finishes	-16480	27902	250	3546	0	1074	269	16426	0	0	0	0	0	311	17781	45	49781	-13240
4 Fittings, furnishings & equipments	-9968	25337	83	816	0	1074	269	90392	0	0	0	0	0	96	10051	4	116812	-13997
5 Services (MEP)	-13	126624	244	854	0	1074	269	129206	0	0	0	0	0	956	98	10	257980	-99175
6 Prefabricated	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7 Existing bldg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8 Ext. works	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other or overall site construction	0	0	0	17775	0	0	0	0	0	0	0	0	0	0	0	0	17775.31	0
Unclassified / Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL kg CO2e	-46661	579142	10029	41976		12890	3223	256632	0	0			462	10336	55994	153	924155	-199109

Table 8: *Carbon results calculated using One-Click LCA for embodied carbon. Modules B6 & B7 have been calculated separately.*

EPD building information input available on request

Appendix B – Principles of WLCA guidance

No	Principle	Description	Relevant life-cycle modules
1	Reuse and retrofit of existing built structures	Retaining existing built structures for reuse and retrofit, in part or as a whole, should be prioritised before considering substantial demolition, as this is typically the lowest-carbon option. Significant retention and reuse of structures also reduces construction costs and can contribute to a smoother planning process.	A1-A5, B1-B6, C1-C4, D
2	Use recycled or repurposed materials	Using repurposed or recycled or materials, as opposed to newly sourced materials, typically reduces the carbon emissions from constructing a new building and reduces waste. This process would start by reviewing the materials already on site for their potential for inclusion into the proposed scheme. Many of the currently available standard products already include a degree of recycled content.	A1-A5, B1-B5, C1-C4, D
3	Material selection	Appropriate low-carbon material choices are key to carbon reduction. Ensuring that materials are selected with consideration of the planned life expectancy of the building reduces waste, the need for replacements, and the in-use costs. It is important to note that the overall lifetime carbon emissions of a product can be as much down to its durability as to what it is made of. For example, bricks may have high carbon emissions in terms of their manufacture, but they have an exceptionally long and durable life expectancy. The selection of reused or recycled materials and products, plus products made from renewable sources, will also help reduce the carbon emissions of a project.	A1-A5, B1-B5, C1-C4, D
4	Minimise operational energy use	A 'fabric first' approach should be prioritised to minimise the heating and cooling requirement of a building and the associated systems. Naturally ventilated buildings avoid the initial carbon and financial costs of a ventilation system installation, and the repeat carbon and financial costs of its regular replacement.	A1-A5, B1- B4, B6
5	Minimise operational water use	Carbon emissions from water use are largely due to the materials and systems used for its storage and distribution, the energy required to transfer it around the building, and the energy required to treat any wastewater. The choice of materials used and the durability of the systems, which help avoid leakage and resulting damage to building fabric, are therefore key aspects of reducing the carbon emissions of water use. On-site water collection, recycling and treatment, and storage can have additional positive environmental impacts as well as reducing in-use costs.	A1-A5, B1-B5, B7, C1-C4, D
6	Disassembly and reuse	Designing for future disassembly ensures that products do not become future waste, and that they maintain their environmental and economic value. A simple example is using lime rather than cement mortar - the former being removable at the end of a building's life, the latter not. This enables the building's components (e.g. bricks) to have a future economic value as they can be reused for their original purpose rather than becoming waste or recycled at a lower level (e.g. hardcore in foundations). Designing building systems (e.g. cladding or structure) for disassembly and dismantling has similar and even broader benefits. Ease of disassembly facilitates easy access for maintenance and replacement leading to reduced maintenance carbon emissions and reduced material waste during the in use and end-of-life phases. This leads to the potential for material and product reuse which also reduces waste and contributes to the circular economy principle.	A1-A5, B1-B5, C1-C4, D

Table 9: *Principles of WLCA guidance*

Appendix B – Principles of WLCA guidance

No	Principle	Description	Relevant life-cycle modules
7	Building shape and form	Compact efficient shapes help minimise both operational and embodied carbon emissions from repair and replacement for a given floor area. This leads to a more efficient building overall, resulting in lower construction and in-use costs. A complex building shape with a large external surface area in relation to the floor area requires a larger envelope than a more compact building. This measure of efficiency can be referred to as the 'wall to floor ratio', or the 'heat loss form factor'. This requires a greater use of materials to create the envelope, and a potentially greater heating and/or cooling load to manage the internal environment.	A1-A5, B1-B6
8	Regenerative design	Removing carbon from the atmosphere through materials and systems absorbing it makes a direct contribution to carbon reduction. Examples include unfinished concrete, some carpet products and maximising the amount of vegetation.	A1, B1, D
9	Designing for durability and flexibility	Durability means that repair and replacement is reduced which in turn helps reduce lifetime building costs. A building designed for flexibility can respond with minimum environmental impact to future changing requirements and a changing climate, thus avoiding obsolescence which also underwrites future building value. Buildings designed with this principle in mind will be less likely to be demolished at their end-of life as they lend themselves to future refurbishment. Examples include buildings being designed with 'soft spots' in floors to allow for future modification and design, as well as non structural internal partitions to allow layout change.	A1-A5, B1-B5, C1-C4, D
10	Optimisation of the relationship between operational and embodied carbon	Optimising the relationship between operational and embodied emissions contributes directly to resource efficiency and overall cost reduction. For example, the use of insulation has a clear carbon benefit whereas its fabrication will generate carbon emissions. This means that it is important to look not only at the U-value of insulation, but also the carbon emissions from the manufacture and installation of different product options. Avoiding fully glazed façades will reduce cooling demand and limits the need for high-carbon materials (glass units, metal frame, shading device etc) at both the construction and in-use stages through wholesale replacements.	A1-A5, B1-B6
11	Building life expectancy	Defining building life expectancy gives guidance to project teams as to the most efficient choices for materials and products. This aids overall resource efficiency, including cost efficiency and helps future-proof asset value.	A1-A5, B1-B5, C1-C4, D
12	Local sourcing	Sourcing local materials reduces transport distances, and therefore supply chain lengths; and has associated local social and economic benefits, e.g. employment opportunities. It also has benefits for occupiers as replacement materials are easier to source. Transport type is also highly relevant. A product transported by ship will have significantly lower carbon emissions per mile than one sent by HGV. A close understanding of the supply chain and its transport processes is therefore essential when selecting materials and products.	A1-A5, B3- B4

Table 9: *cont. Principles of WLCA guidance*

Appendix B – Principles of WLCA guidance

No	Principle	Description	Relevant life-cycle modules
13	Minimising waste	Waste represents unnecessary and avoidable carbon emissions. Buildings should be designed to minimise fabrication and construction waste, and to ease repair and replacement with minimum waste, which helps reduce initial and in-use costs. This can be achieved through the use of standard sizes of components and specification and by using modern methods of construction (MMC). Where waste is unavoidable, the designers should establish the suppliers' processes for disposal or preferably reuse or recycling of waste.	A1-A5, B1-B7, C1-C4, D
14	Efficient fabrication	Efficient construction methods (e.g. modular systems, precision manufacturing and MMC) can contribute to better build quality, reduce construction-phase waste and reduce the need for repairs in the post completion and defects period (snagging). These methods can also enable future disassembly and reuse with associated future carbon savings.	A1-A5, B1-B7, C1-C4, D
15	Lightweight construction	Lightweight construction uses less material, which reduces the emissions of the building as there is less material to source, fabricate and deliver to site. Foundations can then also be reduced with parallel savings. Lightweight construction can also be easier to design for future disassembly and reuse. The benefits of lighter construction should be seen in the context of other principles such as durability.	A1-A5, C1- C4, D
16	Circular economy	The circular economy principle focuses on a more efficient use of materials which in turn leads to financial efficiency. Optimising recycled content, reuse and retrofit of existing buildings; and designing new buildings for easy disassembly, reuse and retrofit, and recycling as equivalent components for future reuse are essential. The use of composite materials and products can make future recycling difficult. Where such products are proposed, the supplier should be asked for a method statement for future disposal and recycling.	A1-A5, B1-B5,C1-C4, D

Table 9: *cont. Principles of WLCA guidance*

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