Peter Deer and Associates Sustainability ■ Environmental Consultancy

264 Belsize Road

Whole Life Carbon Assessment

September 2022

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Executive summary

This whole-life carbon assessment has been prepared to support the planning application for the redevelopment of the mixed-use commercial/community building, 264 Belsize Road, Camden, London, NW6 4BT.

London Borough of Camden (LBC) will also require developments to consider the specification of materials and construction processes with low embodied carbon content. LBC will expect all developments, whether for refurbishment or redevelopment, to optimise resource efficiency by:

- Reducing waste
- Reducing energy and water use during construction
- Minimising materials required
- Using materials with low embodied carbon content
- Enabling low energy and water demands once the building is in use

According to the London Plan 2021 (FLA of 580m² <1000m²), the development is not a major project. However, according to the Camden Local Plan, it is regarded as a medium development. LBC will expect developments to divert 85% of waste from landfills, comply with the Institute for Civil Engineer's Demolition Protocol, and either reuse materials on-site or salvage appropriate materials to enable their reuse off-site.

Embodied Carbon Emissions

This development is retaining the existing ground floor concrete slab and much of the 1st-floor slab, boundary walls and the steel frame, therefore, utilising much of the embodied carbon of the existing building in the creation of the new dwellings.

The estimated demolition volumes and the recommended reusing of the materials are listed. The One Click LCA carbon life cycle model includes the material quantities.

Whole Life Cycle (WLC) Principles

The design team reviewed and contributed to Table 4 Explanation of Life Cycle Stages. During the design development, post-planning will consider how the building can be altered or dismantled for reuse at the end of life.

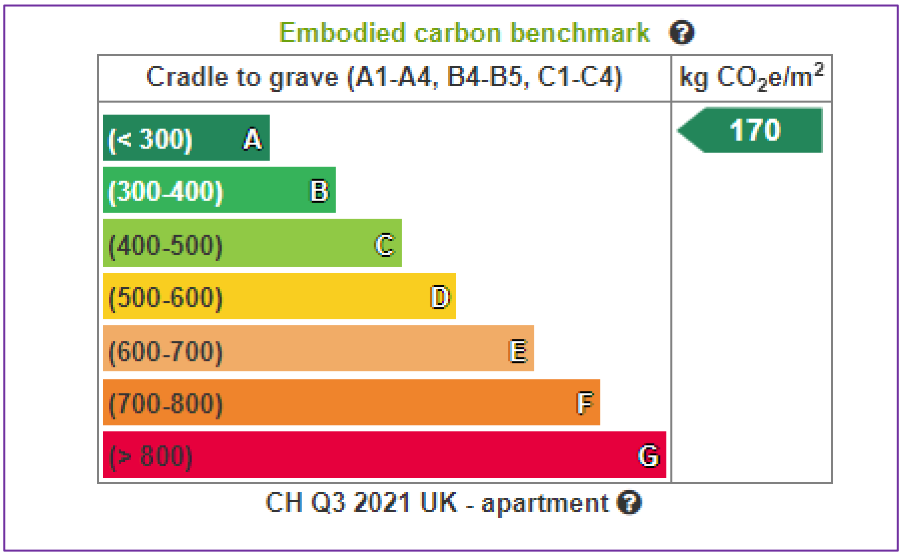
One Click LCA Software.

Life Cycle assessment is calculated using measured building data from the energy model, drawings, and generic construction materials. The assessment follows the RICS life cycle stages according to EN 15804:2012. This model is refined throughout the project as additional information is generated. The additional measured data is unavailable as the project's costs are based on the square meter rate. Many construction materials are yet to be fully defined at the planning stage.

Results

Estimated total WLC emissions (kgCO_2e) for each lifecycle module will form the development baseline and automatically populate based on the 'GWP of all lifecycle modules' table.

The proposed development achieves a grade of A with a score of 170 against Embodied carbon benchmark (CH Q3 2021 U.K.).



The embodied carbon relating to each stage of this development is shown in the table below.

Result category	**kg CO_2e kg CO_2e**
Biogenic carbon (kg CO_2e)	-2363.33
A1-A3 Product Stage	88261
A4 Transportation to site	883.51
A5 Site operations	2287.58
B1 Use Phase	
B2 Maintenance	-808
B3 Repair	0
B4 Material replacement - materials	5414.05
B5 Material refurbishment	0
B6 Operational Energy use - Regulated	-40390
B6 Operational Energy use - Unregulated	
B7 Operational Water use	12000
C1 Deconstruction / demolition	
C2 Waste Transportation	2869.39
C3 Waste processing	2939.54
C4 Waste disposal	49.94
TOTAL kg CO_2e	71143.67
D External impacts (not included in totals)	-31454.5

1 Introduction

1.1 Control Electrical Engineers Ltd has appointed Peter Deer and Associates Ltd (PDA) to undertake the design stage whole life carbon assessment for the proposed development at 264 Belsize Road, Camden, London, NW6 4BT.

1.2 The current owner proposes alterations and extensions to the existing redundant non-residential institutional and mixed-used commercial building, replacing it with new residential development containing 5 dwelling units (5 no. two-bedroom duplexes).

1.3 This document should be read in conjunction with:

- Design and Access Statement
- Energy Statement
- Sustainability Report

Site location

1.4 Location: 264 Belsize Road, Kilburn, London, NW6 4BT. Proposed dwelling units face southeast.

Figure 1 Site location (Open Street Map 2022)

1.5 The site is located in Kilburn within the Borough of Camden. It is located on the northern side of Belsize Road (https://www.openstreetmap.org/#map=19/51.53769/-0.19249). The site area is approximately 470m², previously occupied by an existing redundant non-residential institution building.

1.6 The site is within an Archaeological Priority Area due to its close proximity to an old Roman road, now the A5. It is approximately 40 metres east of Kilburn High Road. It is adjacent to the Priory Road Conservation Area but is not in the Conservation Area itself.

2 Planning Policy Requirements

National Planning Policy

London Plan

2.1 The London Plan (March 2021) is the mayor's planning strategy for Greater London. It sets borough-level housing targets and identifies locations for future growth of London-wide importance.

2.2 The London Plan is the overall strategic plan for London, setting out an integrated economic, environmental, transport and social framework for the Development of London over the next 20 to 25 years.

2.3 The London Plan is part of the Development Plan. It guides boroughs' development Plans to ensure they work toward a shared vision for London. It establishes policies that allow everyone involved in new developments to know what is expected.

Policy SI 2 Minimising greenhouse gas emissions
A) Major Development should be net zero-carbon. This means reducing greenhouse gas emissions in operation and minimising both annual and peak energy demand under the following energy hierarchy: 1) be lean: use less energy and manage demand during operation 2) be clean: exploit local energy resources (such as secondary heat) and supply energy efficiently and cleanly 3) be green: maximise opportunities for renewable energy by producing, storing, and using renewable energy on-site 4) be seen: monitor, verify and report on energy performance. B) Major development proposals should include a detailed energy strategy to demonstrate how the zero-carbon target will be met within the framework of the energy hierarchy. C) A minimum on-site reduction of at least 35 per cent beyond Building Regulations is required for major development. Residential development should achieve 10 per cent, and non-residential development should achieve 15 per cent through energy efficiency measures. Where it is demonstrated that the zero-carbon target cannot be fully achieved on-site, any shortfall should be provided, in agreement with the Borough, either: 1) Through cash in lieu contribution to the Borough's carbon offset fund, or 2) off-site provided that an alternative proposal is identified and delivery is certain. D) Boroughs must establish and administer a carbon offset fund. Offset fund payments must be ring-fenced to implement projects that deliver carbon reductions. The operation of offset funds should be monitored and reported annually E) Major development proposals should calculate and minimise carbon emissions from any other part of the development, including plant or equipment, that are not covered by Building Regulations, i.e., unregulated emissions. F) Development proposals to the mayor should calculate whole lifecycle carbon emissions through a nationally recognised Whole Lifecycle Carbon Assessment and demonstrate actions to reduce lifecycle carbon emissions.

Table 1 GLA Policy SI 2 Minimising greenhouse gas emissions

2.4 Becoming zero-carbon will require reducing all greenhouse gases, of which carbon dioxide is the most prominent. London homes and workplaces are responsible for producing approximately 78 per cent of its greenhouse gas emissions. New development must meet the framework's requirements if London aims to become a zero-carbon city by 2050. Development involving major refurbishment should also aim to complete this framework.

2.5 Electricity is essential for the functioning of any modern city. Demand is expected to rise in London in response to a long-term growing population and economy, the increased take-up of electric vehicles, and the switch to electric heating systems (such as through heat pumps). The electricity network and substations are at or near capacity in several areas, especially central London. The mayor will work with the electricity and heat industry, boroughs, and developers to ensure that appropriate infrastructure is integrated within a broader innovative energy system designed to meet London's needs.

2.6 Operational carbon emissions will make up a declining proportion of a development's whole lifecycle carbon emissions as operational carbon targets become more stringent. To fully capture a development's carbon impact, a whole lifecycle approach is needed to capture its unregulated emissions (i.e., those associated with cooking and small appliances), its embodied emissions (i.e., those related to raw material extraction, manufacture and transport of building materials and construction) and emissions associated with maintenance, repair and replacement as well as dismantling, demolition and eventual material disposal. Whole lifecycle carbon emission assessments are required for development proposals referred to the mayor. Major non-referable development should calculate unregulated emissions and are encouraged to undertake whole lifecycle carbon assessments. The approach to whole lifecycle carbon emissions assessments, including when they should take place, what they should contain and how information should be reported, will be set out in the guidance.

Waste and circular economy

2.7 Waste is defined as anything that is discarded. A circular economy is one where materials are retained at their highest value for as long as possible and reused or recycled, leaving minimal residual waste.

2.8 The London Environment Strategy sets out a pathway to achieving a municipal recycling target of 65 per cent by 2030 and outlines the mayor's approach to municipal waste management in detail. This includes London achieving a 50 per cent reduction in food waste and associated packaging waste per person by 2030. London local authorities need to provide residents with a minimum level of recycling service, including separate food waste. To achieve these recycling targets, it will be important that recycling, storage, and collection systems in new developments are appropriately designed. Further detail on how developments should do this is set out in the guidance.

Policy SI 7 Reducing waste and supporting the circular economy

A) *Resource conservation, waste reduction, increases in material reuse and recycling, and reductions in waste going for disposal will be achieved by the mayor, waste planning authorities and industry working in collaboration to:*

1) Promote a more circular economy that improves resource efficiency and innovation to keep products and materials at their highest use for as long as possible
2) encourage waste minimisation and waste prevention through the reuse of materials and using fewer resources in the production and distribution of products
3) ensure that there is zero biodegradable or recyclable waste to landfill by 2026
4) meet or exceed the municipal waste recycling target of 65 per cent by 2030
5) meet or exceed the targets for each of the following waste and material streams:
    a) construction and demolition – 95 per cent reuse/recycling/recovery

b) excavation – 95 per cent beneficial use

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

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

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

C) *Development Plans that apply circular economy principles and set local lower thresholds for the application of Circular*

Table 2 GLA London Plan SI 7

2.9 The reuse/recycling of building materials and aggregates is a significant and well-established component of the circular economy advocated in Policy SI 7. Reducing waste, supporting the circular economy, and reducing the demand for natural materials.

London Borough of Camden – Local Plan 2017

2.10 The Camden Local Plan sets out the Council's planning policies and replaces the Core Strategy and Development Policies planning documents (adopted in 2010). It ensures that Camden continues to have robust, effective, and up to- date planning policies that respond to changing circumstances and the borough's unique characteristics and contribute to delivering the Camden Plan and other local priorities. The Local Plan will cover the period from 2016-2031.

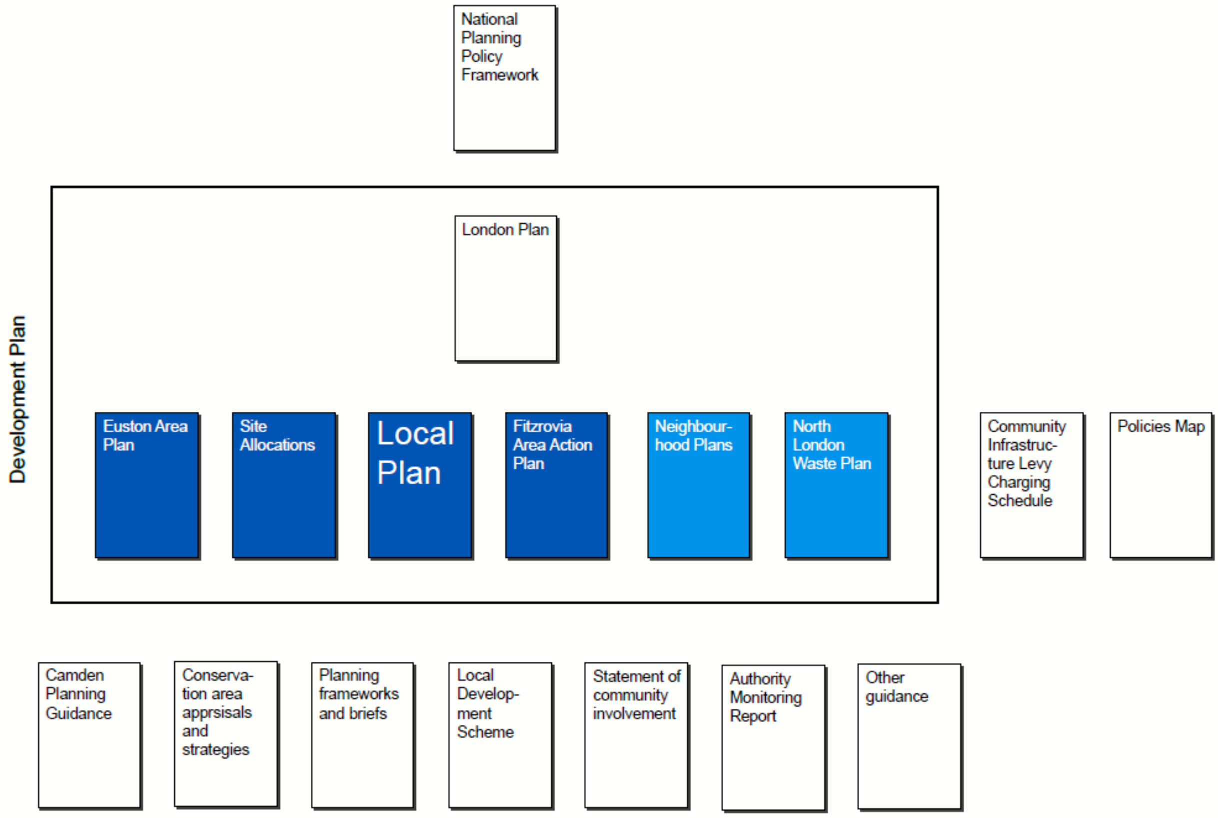


Figure 2 London Borough of Camden - Planning Documents Hierarchy.

Sustainability and Climate Change Policies.

- **Policy CC1 Climate Change Mitigation –** Energy efficiency and carbon emission reduction, Carbon neutral developments and connection to district heat networks.
- Policy CC2 Adapting to climate change – summertime overheating risk
- Policy CC3 Water and flooding – SUD options
- **Policy CC4 Air quality -** Reduction of polluting emission sources and provision of cleaner ventilation systems
- **Policy CC5 Waste –** Reduction of waste in construction, use and demolition.
- **Policy A4 Noise and vibration** - External Noise Report - Use acoustic glass, ventilation and building fabric.

2.11 The Council aims to tackle the causes of climate change in the Borough by ensuring developments use less energy and assessing the feasibility of decentralised energy and renewable energy technologies.

2.12 Climate change and minimising the use of resources – there are links between poor health and wellbeing and the ability to heat a home cost-effectively and ensure that the home does not overheat in hot weather. Policies CC1 Climate change mitigation and CC2 Adapting to Climate Change will seek to ensure that buildings are designed to be more energy efficient and to deal effectively with changes to our climate, such as colder winters and hotter summers.

Policy CC1 Climate Change Mitigation
The Council will require 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.
LBC will:
a. promote zero carbon development and require all development to reduce carbon dioxide emissions through following the steps in the energy hierarchy;
b. require all major development to demonstrate how London Plan targets for carbon dioxide emissions have been met;
c. ensure that the location of the development and mix of land uses to minimise the need to travel by car and help to support decentralised energy networks;
d. support and encourage sensitive energy efficiency improvements to existing buildings;
e. require all proposals that involve substantial demolition to demonstrate that it is not possible to retain and improve the existing building; and
f. expect all developments to optimise resource efficiency.
For decentralised energy networks, LBC will promote decentralised energy by:
g. working with local organisations and developers to implement decentralised energy networks in the parts of Camden most likely to support them;
h. protecting existing decentralised energy networks (e.g. at Gower Street, Bloomsbury, King's Cross, Gospel Oak and Somers Town) and safeguarding potential network routes; and
i. Requiring all major developments to assess the feasibility of connecting to an existing decentralised energy network, or where this is not possible establishing a new network.
j. To ensure that the Council can monitor the effectiveness of renewable and low carbon technologies, major developments will be required to install appropriate monitoring equipment.

Table 3 LBC Policy CC1 Climate Change Mitigation

Resource efficiency, demolition and retrofitting of existing buildings

2.13 Given the significant contribution existing buildings make to Camden's CO_2 emissions, the Council will support proposals that seek to improve the energy efficiency of existing buildings.

2.14 The construction process and new materials employed in developing buildings are major consumers of resources and can produce large quantities of waste and carbon emissions. Before demolition is proposed, the possibility of sensitively altering or retrofitting buildings should always be strongly considered.

2.15 In comparison with the existing building, all proposals for substantial demolition and reconstruction should be fully justified in terms of the optimisation of resources and energy use. Where building demolition cannot be avoided, LBC will expect developments to divert 85% of waste from landfills, comply with the Institute for Civil Engineer's Demolition Protocol, and either reuse materials on-site or salvage appropriate materials to enable their reuse off-site.

2.16 LBC will also require developments to consider the specification of materials and construction processes with low embodied carbon content.

2.17 LBC will expect all developments, whether for refurbishment or redevelopment, to optimise resource efficiency by:

- Reducing waste;
- Reducing energy and water use during construction;
- Minimising materials required;
- Using materials with low embodied carbon content; and
- Enabling low energy and water demands once the building is in use.

Embodied carbon

2.18 Embodied carbon is the carbon impact associated with material production, transport, assembly, use and disposal. This will include consideration of maintenance and repair but not the carbon emissions associated with the energy used for heating, lighting or cooling in the completed building (please see Policy T4 Sustainable movement of goods and materials).

2.19 Additionally, the Council will expect developers to consider the service life of buildings and their possible future uses to optimise resource efficiency. The durability and lifespan of the buildings' components should be matched to their likely service life. Where appropriate, the building should be flexible in terms of adaptation to future alternative uses to avoid the need for future demolition.

2.20 As part of the resource efficiency assessment, all developments involving five or more dwellings and/or more than 500 sqm of gross internal floor spaces are encouraged to assess the embodied carbon emissions associated with the development within the energy and sustainability statement. Where such an assessment has been completed, LBC would encourage that the results are logged on the Waste Resource Action Plan (WRAP) embodied carbon database to contribute to the embodied carbon knowledge base.

2.21 Further guidance on resource efficiency and embodied carbon assessment can be found in the supplementary planning document Camden Planning Guidance on sustainability.

3 Whole Life Cycle

What is this guidance?

3.1 This guide explains preparing a Whole Lifecycle Carbon (WLC) assessment in line with Policy SI 2DB of the Intend to Publish London Plan (London Plan). It is for anyone involved in, or with interest in, developing WLC assessments, including planning applicants, developers, designers, energy consultants and local government officials. Policy SI 2DB applies to plan applications which are referred to the mayor. However, WLC assessments are also supported and encouraged on significant applications which are not referable to the mayor. The WLC guide explains how to calculate WLC emissions and the information that needs to be submitted to comply with the policy. It also includes information on design principles and WLC benchmarks to aid planning applicants in designing buildings with low operational and embodied carbon.

What are Whole Lifecycle Carbon Emissions?

3.2 WLC emissions are those carbon emissions resulting from the construction and the use of a building over its entire life, including its demolition and disposal. They capture a building's operational carbon emissions from both regulated and unregulated energy use, as well as its embodied carbon emissions, i.e., those associated with raw material extraction, manufacture and transport of building materials, construction and the emissions associated with maintenance, repair and replacement as well as dismantling, demolition and eventual material disposal. A WLC assessment also includes assessing the potential carbon emissions benefits from the reuse or recycling of components after the end of a building's useful life. It provides an accurate picture of a building's carbon impact on the environment. The World Green Building Council estimates that construction accounts for 11% of carbon emissions globally. Key players in the construction industry, from developers to engineers and architects, must respond to the climate emergency by designing and building according to WLC principles.

The Mayor's Net Zero-Carbon Target

3.3 National Building Regulations and the mayor's net zero-carbon target for new developments account for a building's operational carbon emissions. As targets have become more stringent, methods and approaches for reducing operational emissions have become better understood, and these emissions are now beginning to make up a declining proportion of a development's carbon emissions. Attention now needs to turn to WLC to incorporate embodied carbon emissions.

3.4 The mayor's net zero-carbon target continues to apply to the operational emissions of a building. The WLC requirement is not subject to the mayor's net zero-carbon target for new development, but, as set out in London Plan Policy SI 2, planning applicants are required to calculate these emissions and demonstrate how they can be reduced as part of the WLC assessment. Planning applicants should continue to follow the GLA's Energy Assessment Guidance to assess and mitigate operational emissions and insert the relevant information into the WLC assessment.

3.5 A set of WLC benchmarks have been developed, which applicants are asked to compare against their results as part of their WLC assessment and which the GLA will refer to in its review of these assessments.

Principal Benefits of a WLC assessment

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

3.7 Ensuring that a significant source of emissions from the built environment is accounted for is necessary for achieving a net zero-carbon city.

3.8 Achieving resource efficiency and cost savings by encouraging the reuse of existing materials instead of new materials and the retrofit and retention of existing structures and fabric over new construction.

3.9 Identifying the carbon benefits of using recycled material and designing for future reuse and recycling to reduce waste and support the circular economy.

3.10 Encouraging a 'fabric first approach to building design minimises mechanical plant and services in favour of natural ventilation.

3.11 Considering operational and embodied emissions simultaneously to find the optimum solutions for the development over its lifetime.

3.12 Identifying the impact of maintenance, repair, and replacement over a building's lifecycle improves lifetime resource efficiency and reduces lifecycle costs, contributing to the future-proofing of asset value.

3.13 Encouragement by the GLA for local sourcing of materials and short supply chains, with resulting carbon, social and economic benefits for the local economy.

3.14 Encouraging durable construction and flexible design contribute to greater longevity, reduced obsolescence of buildings and avoiding carbon emissions associated with demolition and new construction.

Life Cycle Stages

3.15 A WLC assessment needs to cover the entirety of modules A, B, C and D to comply with Policy SI 2, rather than just the minimum requirements identified in the RICS Planning Stage.

- Module A1 – A5 (Product sourcing and construction stage)
- Module B1 – B7 (Use stage)
- Module C1 – C4 (End of life stage)
- Module D (Benefits and loads beyond the system boundary)

3.16 Each module should be presented separately, as identified in the WLC assessment template. The assessment's reference study period (i.e., the assumed building life expectancy) is 60 years. Where the project's design life exceeds or is less than 60 years, the assessment should still be done for 60 years but with an accompanying explanation of the lifecycle and end-of-life scenarios for the actual design life.

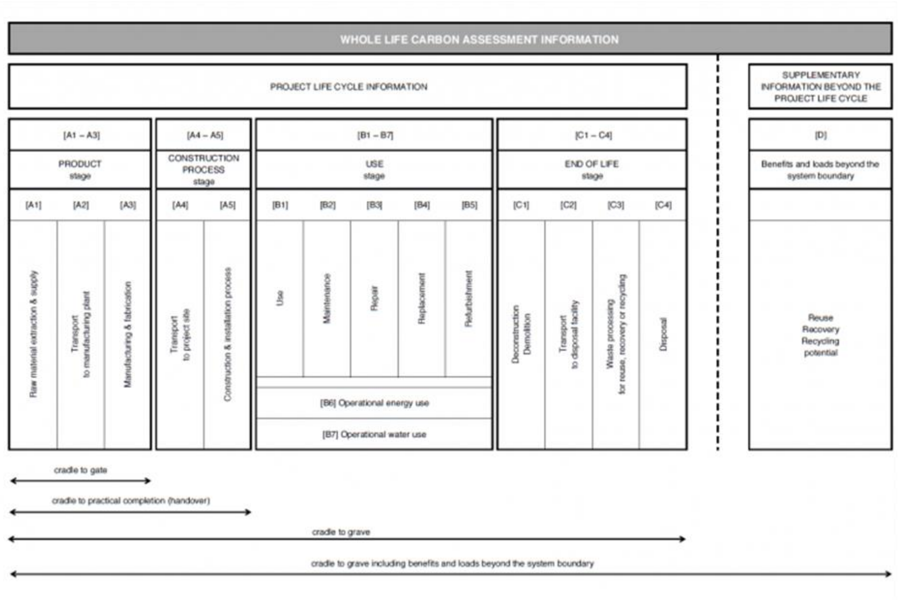


Figure 3 Life Cycle Modules (BS EN 15978)

Assessed building, general information:

3.17 Assessment method: EN 15978:2011

3.18 Building type: Residential dwelling with 5 new dwellings (5 no. two-bedroom duplexes). Building area: 558.6m², proposed construction year: 2023

3.19 The proposed building was calculated in One Click LCA based on design data provided by the Architects and structural drawings.

3.20 Required service life:

3.21 The type of building general undergoes major refurbishment between the twenty-to-thirty-year life cycle. The calculation is for a 60-year life cycle with one major refurbishment period.

Environmental data sources

3.22 One Click 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.

3.23 Life cycle impact assessment result summary

3.24 The life cycle assessment was calculated using One Click LCA. The results represent the total life cycle impact during 30-year / 60-year service life. The results are summarised in Appendix A One-click LCA Results.

The life cycle assessment scope and system boundaries

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

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

Element	Description
A1-A3 Construction Materials	Raw material supply (A1) includes emissions generated when raw materials are taken from nature and transported to industrial units for processing. Loss of raw material and energy are also taken into account. Transport impacts (A2) include exhaust emissions resulting from transporting all raw materials from suppliers to the manufacturer's production plant, as well as impacts on the production of fuels. Production impacts (A3) cover the manufacturing of the production materials and fuels used by machines, as well as the handling of waste formed in the production processes at the manufacturer's production plants until the end-of-waste state.
A4 Transportation to Site	A4 includes exhaust emissions from the transport of building products from the manufacturer's production plant to the building site, as well as the environmental impacts of the production of the used fuel.
A5 Construction/installation process	A5 covers the exhaust emissions from using energy during site operations, the environmental impacts of production processes of fuel and energy and water production processes, as well as the handling of waste until the end of the 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 replacing new material, as well as the effects from manufacturing the replacement material and handling 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 effects of the production processes of fresh water and the implications of wastewater treatment.
C1-C4 Deconstruction	The impacts of deconstruction include consequences for processing recyclable construction waste flows for recycling (C3) until the end-of-waste stage or the effects of pre-processing and landfilling for waste streams that cannot be recycled (C4) based on the type of material. Additionally, deconstruction impacts include 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 reused or recycled material types include the positive impact of replacing virgin-based material with recycled material and benefits from materials that can be recovered for energy cover the positive effect of replacing other energy streams based on average implications of energy production.

Table 4 Explanation of Life Cycle Stages.

4 Analysis material scope

4.1 Estimated quantities of the materials anticipated to be generated during the demolition process are provided.

4.2 It should be noted that the recovery potential of materials is based on the best practices suggested by the Waste and Resource Action Program (WRAP).

4.3 The existing structure, including external walls, ground and 1st-floor slabs, and steel structure, will be retained and reused as part of the construction, which will greatly reduce the on-site construction waste.

4.4 The recyclability of main selective materials is shown in Appendix B Recyclability of Materials.

4.5 Reusing material on-site or on a nearby, similar project is the ideal option from an environmental and economic perspective. Doing so also often results in reduced transportation, reducing embodied CO_2 emissions and costs associated with material management on the project. The Client and Architect are best positioned to consider these options and enable these initiatives. It is advised that the following are considered to take advantage of this opportunity:

- Opportunities for reuse on-site,
- Safe storage of these items on-site, in a separate storage area, if feasible,
- Opportunities for reuse by the Client on other projects,
- Opportunities for reuse on local/similar projects,
- Advertisement of specific items on websites,
- Contacting local architectural salvage merchants about objects, and
- Selling or gifting items locally.

4.6 Waste arising during demolition should be continually monitored to provide a thorough understanding of the types and amounts of waste coming from the site. This data collection will help with the continual improvement of material and waste management on-site. Data collection can also help set more demanding waste segregation targets for future demolition and refurbishment projects.

4.7 The LCA analysis included the basic construction elements, the fixture-fittings and building service details.

4.8 As part of RIBA Stage 3 works, the design team will complete a pre-demolition audit of any existing buildings, structures or hard surfaces being considered before stripping out. The scope of the pre-demolition audit is to consider materials for reuse and set targets for waste management. The pre-demolition audit will be regarded as if buildings can be reused or recycled to maximise material recovery for subsequent high-grade or value applications.

4.9 This project intends to retain the existing structure and reuse or recycle the existing building material to maximise its sustainability potential and reduce embodied carbon emissions related to this development; where possible new material will be sourced locally.

4.10 The principal contractor will operate an environmental management system (EMS) covering their primary operations. The EMS will be either:

- Third-party certified, to ISO 14001/EMAS or equivalent standard; or
- Compliant with B.S. 8555:2016

4.11 The principal contractor will implement best practice pollution prevention policies and procedures on-site following Pollution Prevention Guidelines, working at construction and demolition sites: PPG61

External Wall Type	Material	Volume (m^3)	Recyclability
Ground Floor	Existing Boundary wall	17.7 m^3	Retained/reuse
	Cavity	13.7 m^3	
	Wall-mate Insulation	13.7 m^3	
	Durox Blockwork	41.0 m^3	
	Sand& Cement Render	6.8 m^3	
	Plaster skim	0.8 m^3	
	Metal Furring's	6.8 m^3	New
	Plaster Insulation	17.7 m^3	
	Plasterboard	3.4 m^3	
	Plaster skim	0.8 m^3	
First Floor	Metal Cladding	0.9 m^3	Retained/reuse
	Mineral Wool	13.7 m^3	
	Durox Blockwork	25.7 m^3	
	Sand& Cement Render	4.3 m^3	
	batten	4.3 m^3	New
	Plaster Insulation	11.2 m^3	
	Plasterboard	2.1 m^3	
	Plaster skim	0.5 m^3	
Mezzanine Type 1	Brickwork	9.6 m^3	New
	Cavity Insulation	4.8 m^3	
	Blockwork	14.4 m^3	
	Plaster Insulation	6.2 m^3	
	Plasterboard	1.2 m^3	
	Plaster skim	0.3 m^3	
Mezzanine Type 2	Polymer Render	0.7 m^3	New
	Mineral wool	10.9 m^3	
	cement board	0.8 m^3	
	SFS system with mineral wool insulation	6.8 m^3	
	Sound bloc	2.0 m^3	
	Plaster skim	0.2 m^3	
Steel Structure	Steel	0.37 m^3	Retained

Table 5 Retained and proposed material for wall structure

Floor-type	Material	Volume (m^3)	Recyclability
Ground Floor	Marble	2.5 m^3	New
	Screed	1.4 m^3	
	Jabfloor Insulation	15.7 m^3	
	Beam	8.7 m^3	
	Block	34.6 m^3	
	Jabfloor Insulation 70	32.4 m^3	
	Screed	8.6 m^3	Retained/reuse
	Insulation	9.2 m^3	
	Concrete slab	43.3 m^3	
First/Mezzanine Floor	Marble	7.6 m^3	Retained/Reuse
	Screed	19.9 m^3	
	XPS Insulation	12.2 m^3	
	Concrete Slab	22.9 m^3	New
	XPS insulation	84.1 m^3	
	Screed	18.3 m^3	
	Jabilte Insulation	9.2 m^3	
	Concrete slab	68.8 m^3	

Table 6 Retained and proposed material for floor structure

Roof material	Volume (m^3)
green roof system	43.46 m^3
single ply-membrane	0.81 m^3
Roof insulation	124.95 m^3
vapour check bituminous	1.63 m^3
metal deck	27.16 m^3

Table 7 Proposed material for the roof structure

Other materials	Volume (m^3)	
Glazing	43.46 m^3	Recycle
Door	0.81 m^3	
Timber structure	124.95 m^3	

Table 8 Demolished material from the existing building

Project data sources and assumptions

4.12 The proposed building was calculated in One Click LCA based on design data provided by the Architects and structural drawings.

4.13 One Click 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.

5 Circular Economy

5.1 A Circular Economy (C.E.) is a systematic approach to economic development designed to benefit businesses, society, and the environment. The circular economy activity focuses on design that is regenerative and restorative. In contrast to the 'take-make-waste' linear model, a circular economy is regenerative by design and aims to decouple growth from the consumption of finite resources gradually. The circular economy is based on three principles:

- Design out waste and pollution,
- Keep products and materials in use, and
- Regenerate natural systems.

5.2 Circularity: process considering the potential for recovery, reuse and recycling of items following circular economy principles.

5.3 This report can help encourage a Circular Economy by:

- Influencing the wider design team to consider reclamation and reuse waste/materials found on-site to be incorporated in the proposed MSC development, avoiding disposal of valuable materials.
- Identifying reuse and re-processing companies for on-site materials, extending the product's useful life before remanufacturing.

Figure 4 Circular Economy (image form www.sustainabilityhub.no)

5.4 Figure 4 demonstrates the key stages and principles of applying the Circular Economy to the built environment.

5.5 Use of Demolition Waste

5.6 The material to be demolished from this existing building includes mass concrete, concrete block, insulation material, and brick.

5.7 The Main Contractor will identify the waste types that are likely to be produced and aim to reduce the amount of waste as much as possible, including identifying routes to reuse or recycle materials. The Main Contractor will refer to the Waste and Resources Action Programme (WRAP- www.wrap.org.uk), which provides a list of quick wins for reducing and reusing waste:

- Control access to storage areas to minimise the risk of theft or damage
- Set up a dedicated store for timber, from which workers can reuse supplies
- Store any materials away from sensitive locations in fenced-off areas
- Employ a just-in-time policy to deliver materials to reduce the storage time on the site
- Recycled materials will be used where possible, and any materials used on site will be recycled rather than disposed of (including timber, aggregates, soil, bricks, masonry, and concrete).

5.8 The indicated methods to process the building materials from demolition work are proposed in the table below.

Element	Potential for reuse	Action
Brick	Crushed on site	reuse on-site or transport to another site
Concrete Block	Crushed on site	reuse on-site or transport to another site
Mass Concrete	Crushed on-site and steel reinforcement removed	reuse on-site or transport to another site
Insulation (wall & roof)	Polyurethane insulation is non-recyclable. And Glass and stone mineral insulation is recyclable.	Polyurethane is separated, and the mineral sends back to manufacturers.
Plasterboard	Demolition plaster stripped, broken, and reused as aggregate.	Separated from other waste and send to a specialist contractor.
Metal Cladding (sheeting)	General not re-useable on site.	Separated send to scrap merchant
Roof membrane	Clean EPDM and reform into rubber matting or soft surface	Separate out and send to a specialist contractor.
Metal roof sheeting	General not re-useable on site.	Separate out and send to scrap merchant
Steel Work's main structure	General not re-useable on site. There is an option to sell the frame for reuse in another building	Separate out and send to scrap merchant
Sub-metal support	General not re-useable on site. There is an option to sell all frames for reuse in another building	Separate out and send to scrap merchant
Wood (internal fitting)	Most timber products are already composite materials and unsuitable for reuse	Separate waste and remove metal parts. Wood is chipped for energy or compositing
Glass Wall	Glass separated from frames.	Generally crushed for use as backfill or as part of a tarmac non-slip road surface

Element	Potential for reuse	Action
Hard tarmac surface	Leave a place for the piling mat and remove it toward the end of the project. Uncontaminated Tarmac surfaces are potentially reusable.	Separate out from other waste and send to a specialist contractor.
Subsurface	Use it on-site or send it away for grading and reuse if clean and reusable.	Strip and send away for grading or reuse on-site

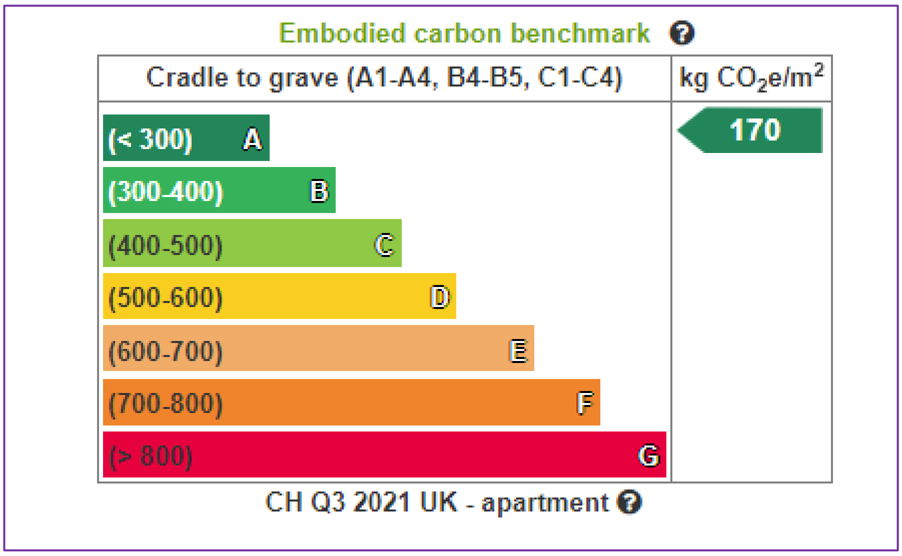
Table 9 Indicated Actions Towards Demolition Waste

5.9 A modern building services plant is designed with a 15 to the 20-year life span with the expectation that the complete plant is regularly replaced with a more efficient plant. Items like ductwork, pipes and cables have longer life spans but require replacing as major works. Heat pumps and boilers are replaced on a 15-to-20-year cycle.

5.10 The building has already been used for 40 years, and many of the original major structural components will be refreshed and used for another 40-plus years.

Appendix A. One-click LCA Results

Future Energy Scenarios (FES) represent various credible ways to decarbonise our energy system as we strive toward the 2050 target. We are less than 30 years from the Net Zero deadline, which is not long when you consider investment cycles for gas networks, electricity transmission lines and domestic heating systems. FES is critical in stimulating debate and helping shape the future's energy system.



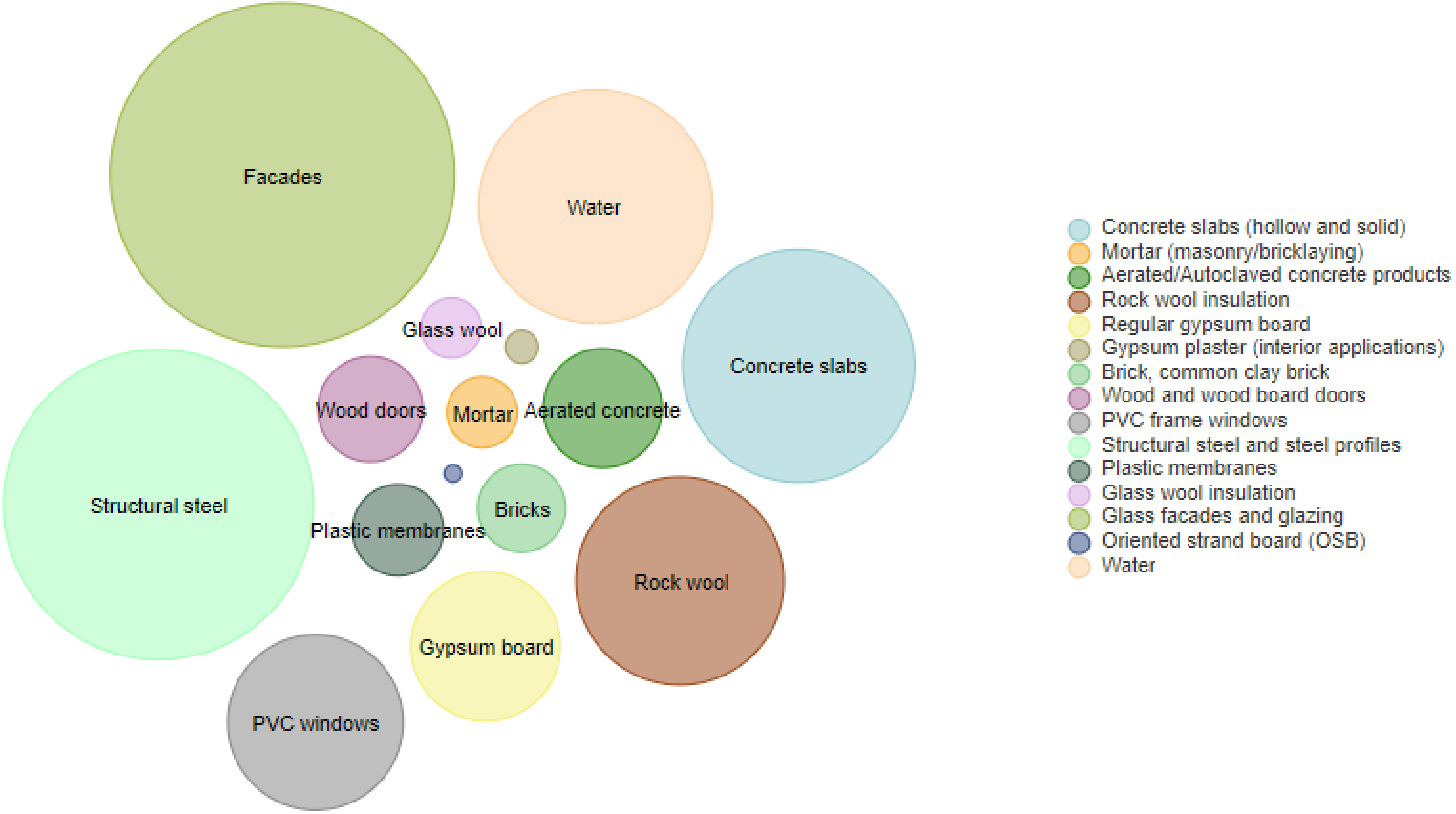
The base year without discount.

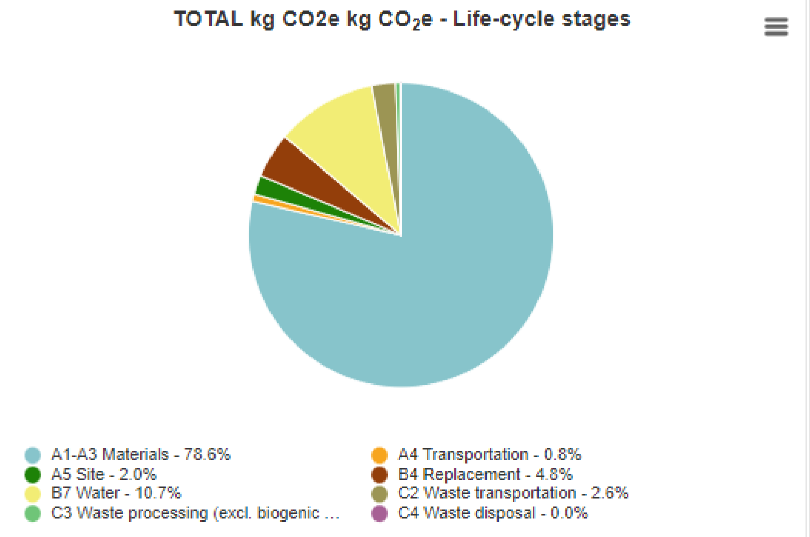
Decarbonisation scenario for materials manufacturing. The scenario assumes that 20% of material impacts in B2-5 and stages derive from electricity consumption. Electricity impact changes are calculated based on FES Reports (Steady Progression scenario) and RICS equation. The base year for this calculation is set to be 2022. The scenario will adjust impacts for relevant stages as per GLA requirements.

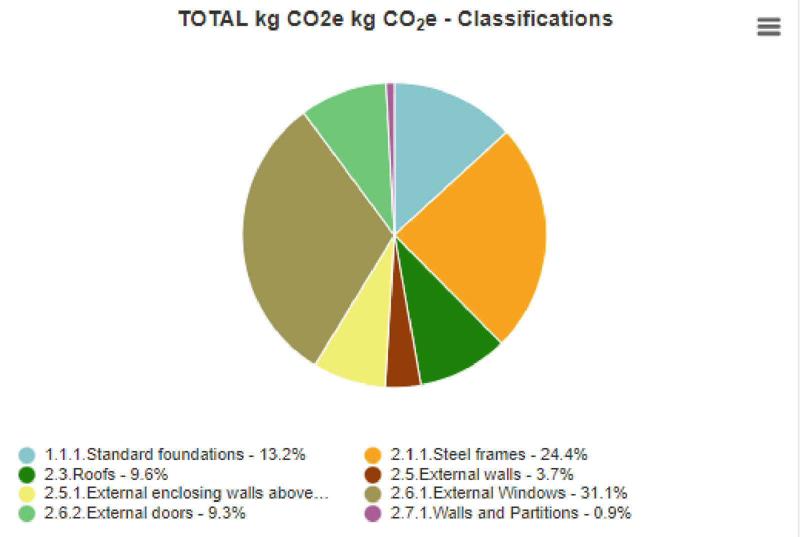
Result category	Biogenic carbon (kg CO_2e)	A1-A3 Product Stage	A4 Transportation to site	A5 Site operations	B1 Use Phase	B2 Maintenance	B3 Repair	B4 Material replacement - materials	B5 Material refurbishment	B6 Operational Energy use - Regulated	B6 Operational Energy use - Unregulated	B7 Operational Water use	C1 Deconstruction / demolition	C2 Waste Transportation	C3 Waste processing	C4 Waste disposal	TOTAL kg CO_2e	D External impacts (not included in totals)
0.1 Toxic Mat.																		
0.2 Demolition																		
0.3 Supports																		
0.4 Groundworks																		
0.5 Diversion																		
1 Substructure	**0**	**12405.81**	**360.48**	**0**			**0**							**459.11**	**54.27**		**13279.67**	**-6848.91**
2.1 Frame	**0**	**22431.15**	**123.69**	**768.82**			**0**							**1124.44**	**63.89**		**24511.98**	**-23904**
2.2 Upper Floors																		
2.3 Roof	**0**	**7923.76**	**14.84**	**677.84**			**0**	**708.12**	**0**					**18.89**	**322.2**	**16.25**	**9681.89**	**-1158.79**
2.4 Stairs & Ramps																		
2.5 Ext. Walls	**0**	**9453.45**	**334.19**	**936.78**			**0**	**30.67**	**0**					**719.15**	**117.57**	**31.73**	**11623.53**	**-2673.05**
2.6 Windows & Ext. Doors	**-2363.33**	**35344.83**	**44.77**	**39.67**			**0**	**4675.26**	**0**					**494.83**	**2379.9**	**1.97**	**40617.9**	**-157.26**
2.7. Int. Walls & Partitions	**0**	**702**	**5.54**	**95.28**			**0**							**52.96**	**1.71**		**857.5**	**-5.97**
2.8 Int. Doors																		
3 Finishes																		
4 Fittings, furnishings & equipment																		
5 Services (MEP)										**-40390**		**12000**					**-28390**	**3293.52**
6 Prefabricated																		
7 Existing bldg																		
8 Ext. works																		
Unclassified / Other				**-230.8**		**-808**											**-1038.8**	
TOTAL kg CO_2e kg CO_2e	**-2363.33**	**88261**	**883.51**	**2287.58**		**-808**	**0**	**5414.05**	**0**	**-40390**		**12000**		**2869.39**	**2939.54**	**49.94**	**71143.67**	**-31454.5**

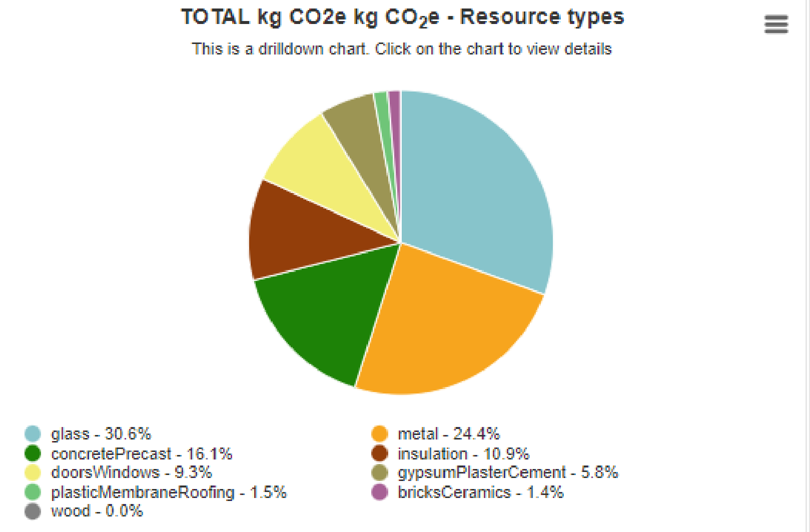
Bubble chart, total life-cycle impact by resource type and subtype, TOTAL kg CO2e

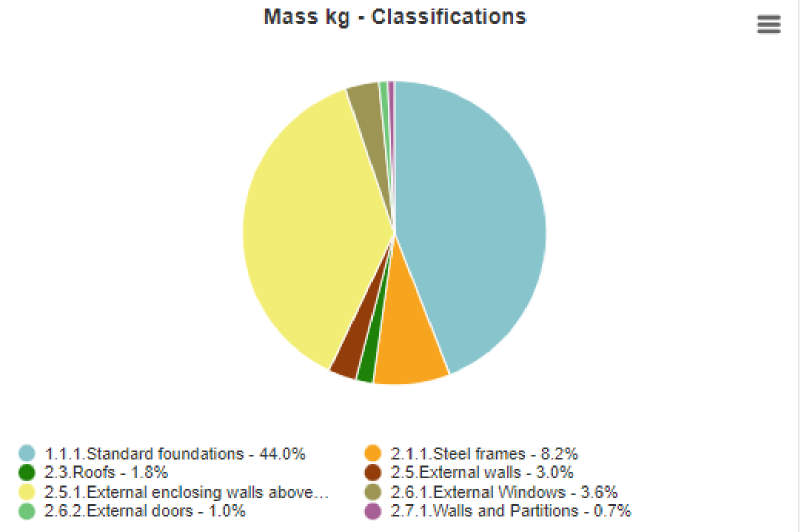
Hover your mouse over legends or the chart to highlight impacts. Bubble minimum and maximum sizes constrained for readability



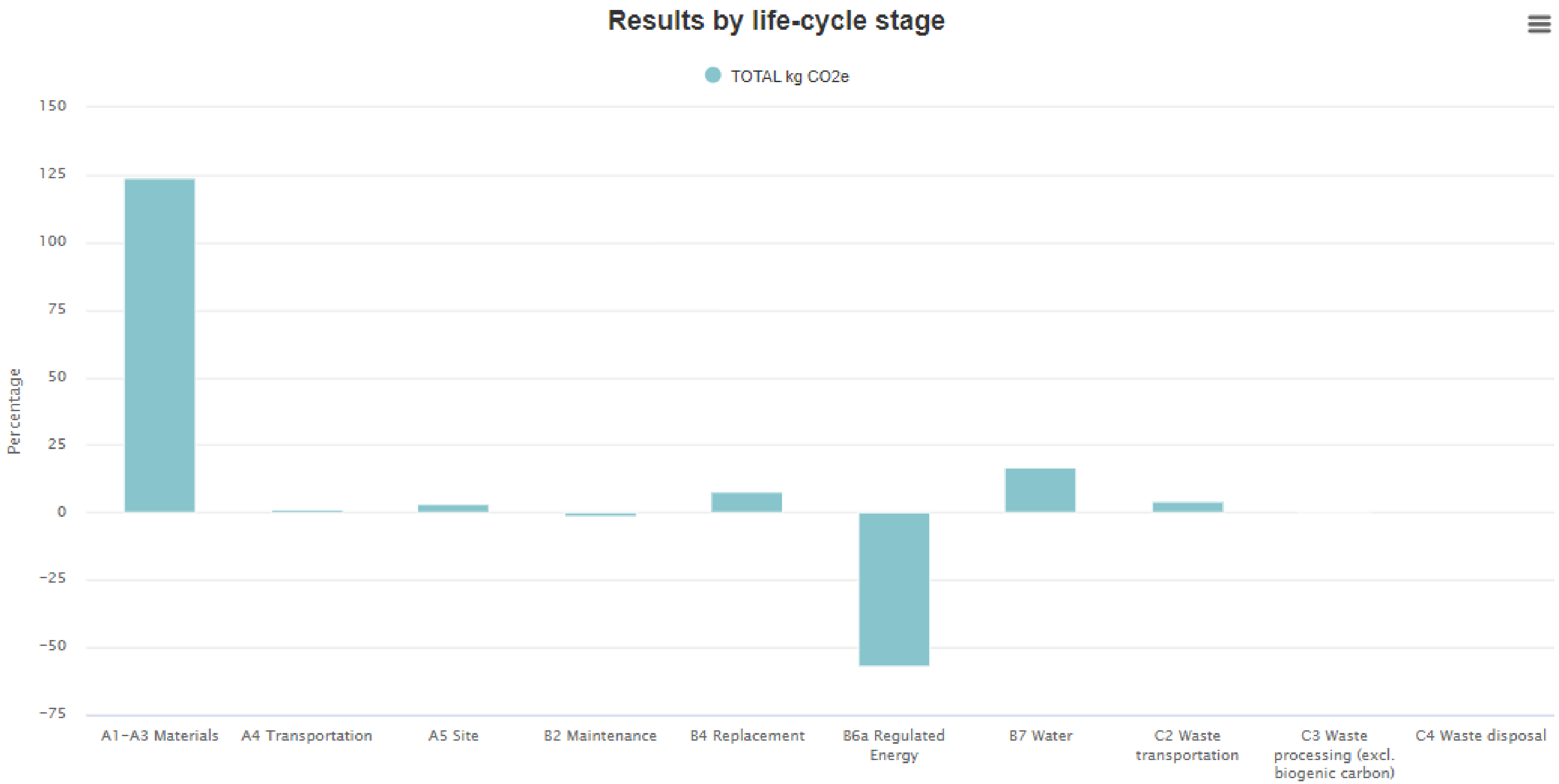


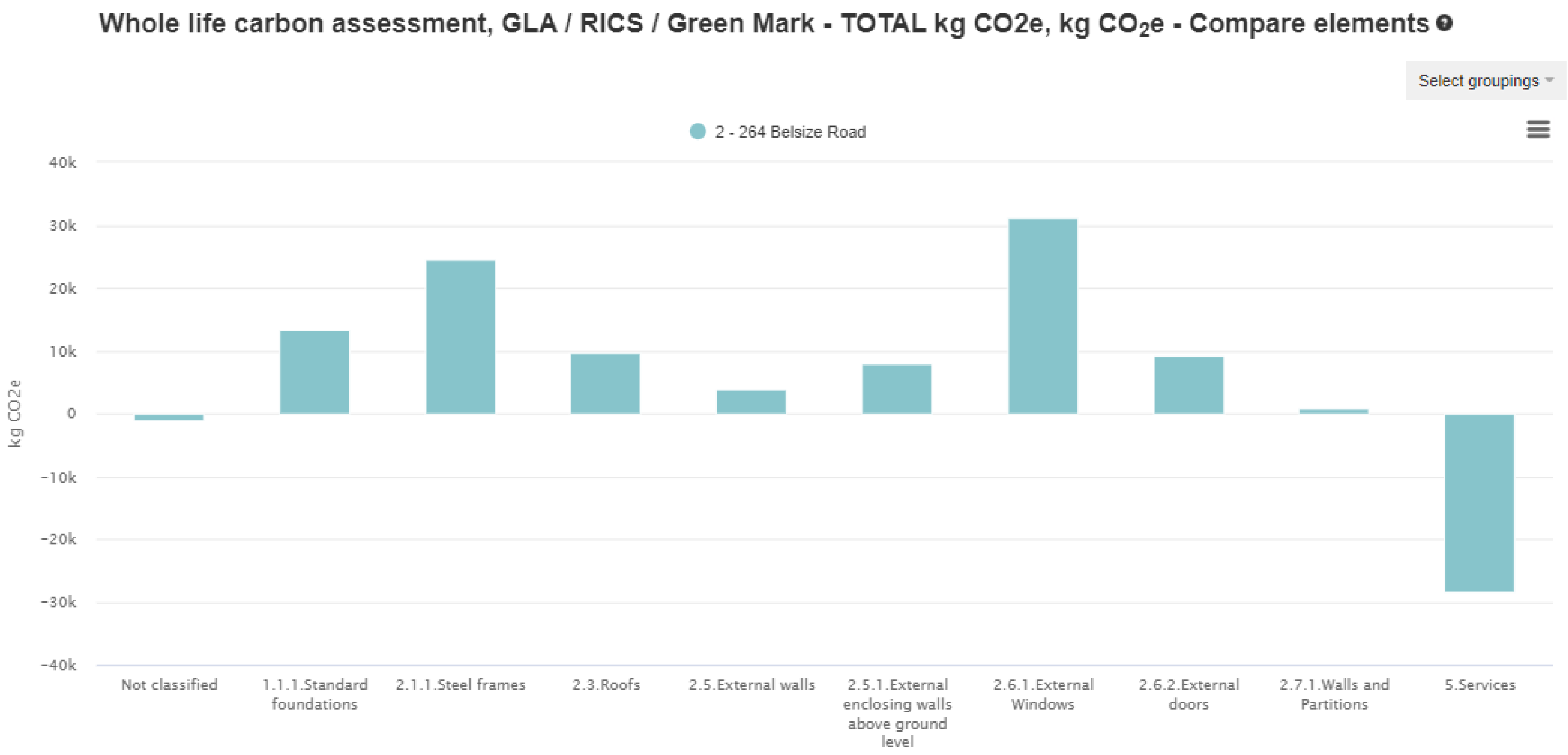






Show data table: ☐TOTAL kg CO2e kg CO_2e - Life-cycle stages ☐TOTAL kg CO2e kg CO_2e - Classifications ☐TOTAL kg CO2e kg CO_2e - Resource types ☐Mass kg - Classifications


Results by life-cycle stage
TOTAL kg CO2e
Percentage
150
125
100
75
50
25
0
-25
-50
-75
A1-A3 Materials
A4 Transportation
A5 Site
B2 Maintenance
B4 Replacement
B6a Regulated Energy
B7 Water
C2 Waste transportation
C3 Waste processing (excl. biogenic carbon)
C4 Waste disposal


Whole life carbon assessment, GLA / RICS / Green Mark - TOTAL kg CO2e, kg CO2e - Compare elements
Select groupings
2 - 264 Belsize Road
40k
30k
20k
10k
0
−10k
−20k
−30k
−40k
kg CO2e
Not classified
1.1.1.Standard foundations
2.1.1.Steel frames
2.3.Roofs
2.5.External walls
2.5.1.External enclosing walls above ground level
2.6.1.External Windows
2.6.2.External doors
2.7.1.Walls and Partitions
5.Services

Appendix B. Recyclability of Materials

Brick & block

Bricks have a lifespan of more than 200 years. You can reclaim or recycle bricks and blocks previously used in the construction of buildings, walls, paving and infrastructure, such as bridges and sewers. These include:

- clay bricks
- concrete precast
- aerated blocks
- stone blocks

It is expected to reclaim undamaged bricks and blocks and use them in new building projects or sell them to other businesses which deal in reclaimed bricks. It is easier to source reclaimed bricks from new projects but more difficult with demolition projects.

The brick and block from demolition work should be reclaimed on this site and recycled in compliance with waste management principles. The recycled-damaged bricks and blocks can be used:

- To make aggregate for use as general fill or highway sub-base
- in landscaping
- to produce new bricks and blocks
- to make sports surfaces such as tennis courts and athletics tracks
- as plant substrate

However, there are some limitations to using recycled bricks and blocks, including:

- bricks can be contaminated by other construction waste, such as plasterboard
- new concrete blocks are cheap to buy
- cleaning bricks is time-consuming and not always possible
- it is hard to assess the load-bearing capacity of recycled bricks

Insulation material

Glass and stone mineral insulation used in wall structures is recyclable.

P.U. insulation boards are most often mechanically fastened. Thus, separating them from other structural elements in buildings is possible to reuse.

Appropriate processing of P.U. waste means that it can form the basis of façade elements and partition walls, doors, window frames, kitchen benchtops, and even components of trucks and trains. One of the most effective methods to manage P.U. waste involves processing it into products for thermal and acoustic insulation of floors. Such insulation material is evenly distributed over the ground. Waste foam is then the basis of granules combined with cellulose and additives. The described solution allows, among other things, lower floor height, making it easier to assemble doors and stairs.

The insulation waste can be used in several construction applications and materials, including:

- Refurbishment projects - e.g., glass and stone wool batt insulation, can be incorporated into concrete blocks or fibreglass board
- Fibreglass ceiling tiles
- Voluntary sector waste projects

Plasterboard

In 2009, the Environmental Agency passed legislation that gypsum-based materials, such as plasterboard, must not be landfilled and should be separated for recovery and recycling. This project expects the demolition work to separate the plasterboard and send it to a specialist contractor for recycling and recovery. The potential route to recycle the plasterboard is as follows:

- sending waste to independent plasterboard recyclers to make into new plasterboard and cement
- sending waste to household waste recycling centres
- using gypsum as a soil conditioner
- using gypsum to make bathroom furniture mouldings

The recovered plasterboard can be used, including:

- New plasterboard products via suppliers' take-back schemes
- Vermicelli (dry-lining board for walls, ceilings, and floors)
- unfired clay-gypsum blocks
- mushroom compost
- slope stabilisation
- road foundation construction
- bathroom furniture mouldings

Metal -frames sheeting and cladding

Metal is a precious material, and much of it can be easily recycled and put back into use. The contractor is expected to separate the metal and send it to a specialist to recycle and reuse or resell the metal material to another needed buyer.

Wood and timber sheeting products

Most of the timber products are already composite materials and unsuitable for reuse. The wood materials are to be separated and removed from metal parts. The wood is chipped and can be used for energy or compositing recovery.

Most types of timber can be recycled. Reclaimed wood can be used in applications and materials, including:

- chipboard, oriented strand board and fibreboard manufacture
- bedding products for animals
- play surfaces and pathways
- remanufactured products - e.g., fibre composites
- architectural components
- landscaping
- commercial products - e.g., logs, fuel chips
- liquid fuel (ethanol and methanol)
- biofuel for combined heat and power plant

Glazing Windows and Rooflights

The glass is to be separated from frames and crushed for backfill or as part of a tarmac non-slip road surface.

Hard landscape Tarmac Surface

The hard-standing tarmac surface is expected to be left in place for the piling mat and removed by the end of the project completion. The rest is to be separated from other waste and sent to a specialist contractor. The uncontaminated tarmac surfaces are potentially reusable.

Internal Floor finishes

The floor and coverings include laminated flooring, wood, ceramic and terrazzo tiles, and wallpaper. The floor and wall coverings can be sold to:

- Social enterprises which recondition and refurbish floor and wall coverings
- Specialist recycling services which recover carpet fibres as plastics recycle and sell on to the plastics and horticultural markets

Floor and wall covering waste can also be used for:

- road cone manufacture
- animal bedding material
- polypropylene bead manufacture
- Reusing carpet recycle

Recycled material from Firestone and Carlisle was used to make walkway pads for new or existing roofs. The material was removed from roofs with loose-laid membrane covered by ballast or mechanically fastened systems. It was then transported to a grinding facility and ground into a powder-like substance.