Whole Life Carbon Assessment

RIBA Stage 2

Simat Properties Limited

26 Rosslyn Hill
London
NW3 1PA

London Borough of Camden

Version	Revision	Date	Author	Reviewer	Project Manager
1	A	14.02.2025	Manas Bane	Alisha Pinheiro	Manas Bane
1	B	17.02.2025	Manas Bane	-	Manas Bane
1	C	05.03.2025	Manas Bane	Alisha Pinheiro	Manas Bane

The figures within this report may be based on indicative modelling and an assumed specification outlined within the relevant sections. Therefore, this modelling may not represent the as built emission or energy use of the Proposed Development and further modelling may need to be undertaken at detailed design stage to confirm precise performance figures. Please contact SRE should you have any questions, or should you wish further modelling to be undertaken post planning.

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Executive Summary

This report has been written for Simat Properties Ltd (The Client) to present the results of the Whole Life Carbon Assessment (WLCA) undertaken to calculate the embodied and operational carbon emissions for the multiple design options for the residential development at 26 Rosslyn Hill, London, NW3 1PA.

The aim of this assessment is to model the Whole Life Carbon impact of the design options in accordance with RICS Guidance[1], in order to determine the total Global Warming Potential (GWP) of the optioneering exercise.

The results from the assessment depicted that whilst the proposed façade retention and redevelopment option has the highest upfront carbon emissions (A1-A5), the operational emissions savings over the 60-year Reference Study Period (RSP) make it the most sustainable scenario. In addition, within Scenarios 2, 3 & 4, it is expected that the ground/upper floors and roof will need to be replaced, which may lead to unquantifiable carbon emissions resulting from supporting the external façade during the construction phase.

Therefore, after consideration of all options over the 60-year RSP, the new-build would be the least carbon-intensive option due to efficient MEP systems and improved building fabric. Additionally, the new build option meets the GLA benchmark for residential schemes.

The assessment undertaken complies with and meets the London Plan Policy SI2 and Camden Local Plan Policy CC1 to calculate and reduce whole-life cycle carbon emissions to fully capture the Proposed Development's carbon footprint.

Based on the information provided by the Project Team, the overall results at this stage show that the options proposed will have cradle-to-grave emissions as shown in Figure 1.

[1] RICS Professional Standards – Whole life carbon assessment for the built environment

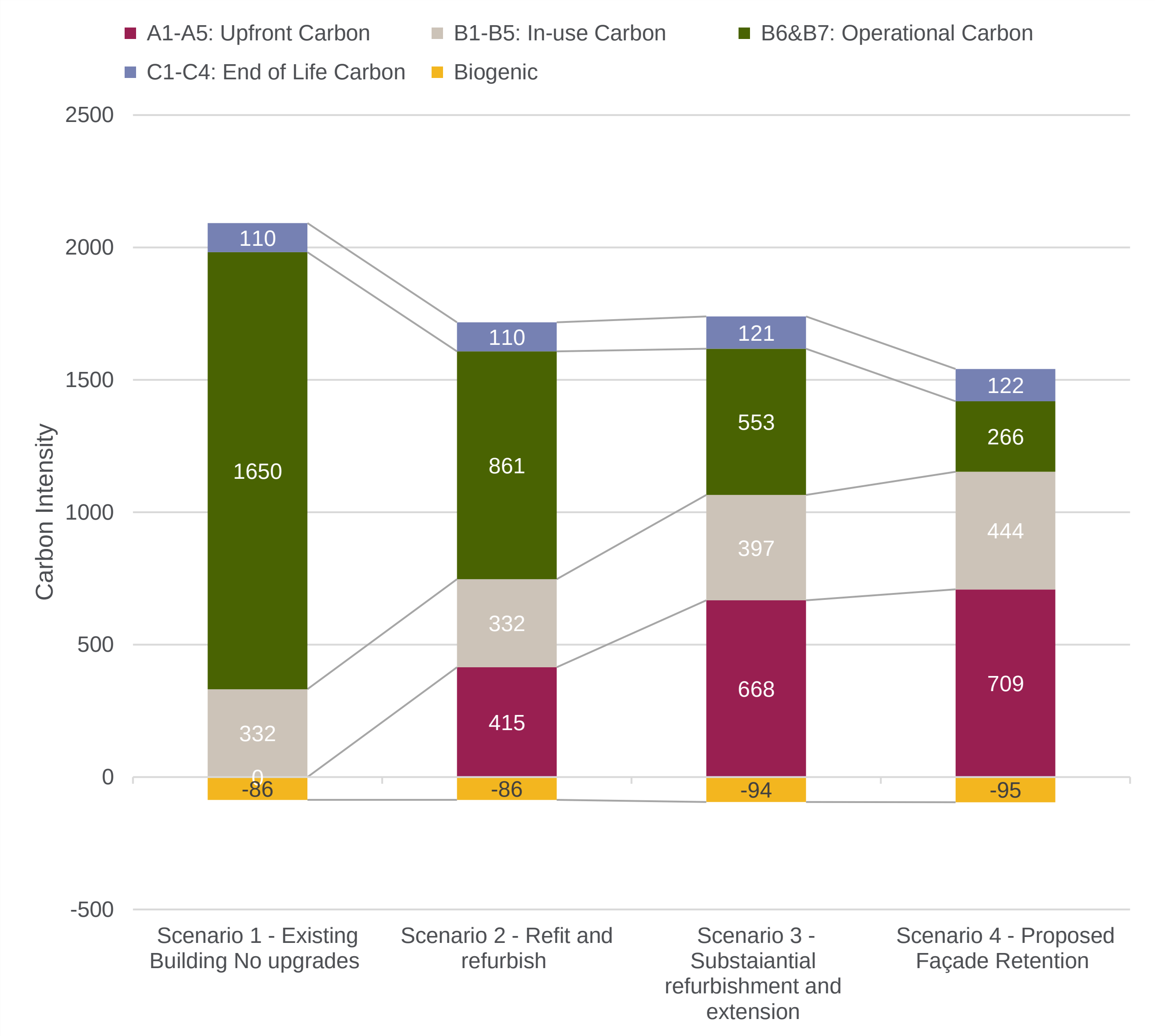

Figure 1 - Whole Life-cycle Carbon comparison for Options appraised

Introduction

1.0 Introduction

This report has been written for Simat Properties Limited (The Client) to present the results of the Whole Life Carbon Assessment (WLCA) undertaken to calculate the embodied and operational carbon emissions for the multiple design options for the residential development at 26 Rosslyn Hill, London, NW3 1PA (the Proposed Development).

The Whole Life Carbon Assessment (WLCA) is being undertaken in accordance with the London Plan Whole Life-Cycle Carbon Assessments Guidance (March 2022), which outlines how to calculate the Whole Life-Cycle Carbon (WLC) emissions in line with Policy SI 2 F of the 2021 London Plan. The WLCA has been undertaken at the Royal Institute of British Architects (RIBA) Stage 2-3 in accordance with the standard practice methodology defined within the 'RICS Whole Life Carbon Assessment for the Built Environment' (First Edition, November 2017), where applicable. The standard provides technical detail and calculation requirements on the practical implementation of the European standard EN 15978: 2011 'Sustainability of Construction Works' principles.

The WLCA inputs information detailed within drawings, reports and surveys received from the Project Team into the Lifecycle Carbon Assessment (LCA) software to evaluate the carbon content of the materials planned to be used.

In order to inform the Proposed Development's operational energy demand, the assessment utilises recognised industry software and inputs from Elmhurst Energy – Standard Assessment Procedure (SAP 10) Modelling to model the mechanical, electrical, and plumbing (MEP) strategy of the Proposed Development to inform the operational emissions. The assessment of both embodied and operational carbon across a projected 60-year span has been conducted, thus resulting in a cradle-to-grave approach required for WLCA.

The assessment of both embodied and operational carbon across a projected 60-year span thus results in a 'Cradle to Grave' approach required for WLC comparison against benchmarking values established by the Greater London Authority (GLA). The WLCA optioneering study has been instructed by the Client as part of an ongoing commitment to support the Royal Borough of Camden's sustainability goals for the Proposed Development.

1.1 Strategy

The aim of the WLCA optioneering study is to assess the carbon performance of the Stage 2-3 design, both upfront and over its whole-life (A-C) carbon emissions for the potential strategies. The assessment is based on the design stage analysis outlined by the Project team and includes the following options as requested by the London Borough of Camden:

- **Scenario 1**: Existing building – No upgrades
- **Scenario 2**: Refit and refurbish – existing building with 3-unit layout and refit/refurb to Building Regs standard
- **Scenario 3**: Substantial refurbishment and extension – proposed scheme retaining front and side elevations and any internal walls where possible
- **Scenario 4**: Proposed façade retention / new build

The optioneering study will assist in determining the predicted embodied and operational carbon emissions of the Proposed Development over the building's 60-year Reference Study Period (RSP). The results from the assessment can also provide multiple benefits such as the comparison of reduced environmental impact, superior energy status, higher Energy Performance Certificate (EPC) ratings, and lower operational costs.

1.2 The Site and Proposed Development

The application site is located in Hampstead, connecting the south end of Hampstead High Street and the north end of Haverstock Hill (A502). The existing building is a three-storey detached property comprising accommodation on the lower ground floor, upper ground floor and the first floor.

The existing building at 26 Rosslyn Hill front elevation is facing southwest and is adjacent to Hampstead Police Station on its North boundary. On the South side of the site is a brick retaining wall separating properties No 26 and Nos 22-24.

Figure 2 - Location of the application site (Google Earth)

The Proposed Development plans to retain the front façade and provide 3 no. residential units through full redevelopment, meeting the building standards.

Figure 3 - Application site and existing building

Please refer to Appendix A for further architectural details of the Proposed Development.

1.3 Policy & Regulations

The Proposed Development is required to meet the relevant planning requirements with regard to whole-life cycle carbon strategies. These are summarised in Table 1.

Planning Policy	Requirement
The London Plan 2021	Policy SI 2 Minimising greenhouse gas emissions F. Development proposals referable to the Mayor should calculate whole life-cycle carbon emissions through a nationally recognised Whole Life-Cycle Carbon Assessment and demonstrate actions taken to reduce life-cycle carbon emissions. Policy SI 7 Reducing waste and supporting the circular economy A. Resource conservation, waste reduction, increases in material re-use and recycling, and reductions in waste going for disposal will be achieved by the Mayor, waste planning authorities and industry working in collaboration to: 1) promote a more circular economy that improves resource efficiency and innovation to keep products and materials at their highest use for as long as possible 2) encourage waste minimisation and waste prevention through the reuse of materials and using fewer resources in the production and distribution of products 3) ensure that there is zero biodegradable or recyclable waste to landfill by 2026 4) meet or exceed the municipal waste recycling target of 65 per cent by 2030 5) meet or exceed the targets for each of the following waste and material streams: a) construction and demolition – 95 per cent reuse/recycling/recovery b) excavation – 95 per cent beneficial use 6) design developments with adequate, flexible, and easily accessible storage space and collection systems that support, as a minimum, the separate collection of dry recyclables (at least card, paper, mixed plastics, metals, glass) and food
Camden Local Plan (2017)	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. a. promote zero carbon development and require all development to reduce carbon dioxide emissions through following the steps in the energy hierarchy;

	b. requires all major development to demonstrate how London Plan targets for carbon dioxide emissions have been met; c. ensures that the location of development and mix of land uses 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. requires all proposals that involve substantial demolition to demonstrate that it is not possible to retain and improve the existing building; and f. expects all developments to optimise resource efficiency
Energy Efficiency & Adaptation (January 2021)	9. Reuse and optimising Resource Efficiency • We will expect creative and innovative solutions to repurposing existing buildings, and avoiding demolition where feasible; • All development should seek to optimise resource efficiency and use circular economy principles.

Table 1 - Summary of Planning Policy requirements

Technical Guidance

2.0 Technical Guidance

This WLCA for the Proposed Development will follow the industry-wide methodology and standards outlined in the following guidance, compliant with BS EN 15978:2011.

2.1 Whole Life Carbon Assessment for the Built Environment, RICS Professional Standard

RICS Professional Standard (PS) addresses all element and component categories making up a built asset during every stage: from extracting raw materials and manufacturing constituent construction products, through operation, to recovery or disposal at the end of life. It also assesses the potential loads and benefits of recovery beyond the system boundary in the next life cycle. All aspects of WLCAs covered by this document are explained and put into context.

This document can be applied to any type of construction or civil engineering project, including building and/or infrastructure assets involving any of the following:

- New construction/new-build assets
- Demolition of existing and construction of new assets
- Retrofit/refurbishment of existing assets
- Masterplans with multiple built assets, including associated project infrastructure, and
- Fit-out of built assets.

2.2 Whole Life-cycle Carbon Assessments Guidance – Greater London Authority (2022)

The GLA guidance explains how to prepare the Whole Life-cycle Carbon (WLC) assessment in line with Policy SI2 F of the London Plan (2021) using the WLC assessment template. Policy SI 2 F applies to planning applications that are referred to the Mayor of London. However, WLC assessments are also supported and encouraged on major applications that are not referable.

This guidance explains how to calculate WLC emissions and the information required 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 that have low operational carbon and low embodied carbon.

2.3 TM65 Embodied carbon in building services: A calculation methodology (2021)

TM65 outlines the need for assessments of the embodied carbon of products linked to MEP systems to increase knowledge and facilitate WLC research in these areas. In this technical manual, embodied carbon is understood as the greenhouse gas emissions (GHG) associated with the making of a product, its installation, maintenance, repair and replacement, and its end of life. It covers the whole life cycle, excluding operational aspects and the potential recovery, reuse or recycling of materials. The embodied carbon associated with MEP design can be significant in a building's lifetime due to the materials that MEP equipment is made of and high replacement rates.

This guidance provides a consistent approach for:

- The data required from manufacturers

- An embodied carbon calculation methodology for MEP products, depending on how much information from manufacturers is available
- The way in which embodied carbon assessments are reported.

Scope

3.0 Scope

There are multiple definitions of Zero Carbon Development which can impact the method of reporting. For the purpose of this assessment, the following definition by the UK Green Building Council[2] has been used:

Net Zero Carbon – Whole Life "When the amount of carbon emissions associated with the building's embodied and operational impacts over the life of the building, including its disposal, are zero or negative".

To this end, the WLCA has been undertaken in accordance with the guidance and technical manuals mentioned in Section 2.0, which outlines the process of WLCA as well as what is and is not included. The aim of the document is to provide clarity on EN 15978: 2011 for the sustainability assessment of buildings and describe the approach required within this methodology.

The assessment covers the carbon emissions of the Proposed Development over the RSP of 60 years, accounting for:

- Upfront Carbon Emissions (A1-A5)
- In-Use Embodied Carbon Emissions (B1-B5)
- Operational Carbon Emissions for energy and water consumption (B6-B7)
- End-of-life embodied carbon emissions (C1-C4)

3.1 Whole Lifecycle Carbon Assessment Modules

A WLCA should follow a modular structure for carbon reporting, covering each stage of a building's life cycle (as per Figure 4). The modules are further broken down into sub-modules, summarised as follows:

- **Product Stage (A1-A3)**: Emissions associated with the extraction (A1), transporting (A2) and manufacturing processes (A3) necessary to produce the construction products, components and technical equipment required to construct the asset.
- **Construction Stage (A4-A5)**: Emissions arising from the transportation of construction products and the construction process, up to project completion. Module A5 also includes any on-site demolition or strip-out works required at the beginning of the project.
- **In Use Stage (B1-B7)**: Emissions generated during the operation of the building. This covers the impact of the use (B1), maintenance (B2), repair (B3), replacement (B4) and refurbishment (B5) of the building as well as energy and water use (B6-B7).
- **End-of-Life Stage (C1-C4)**: Emissions addressing the deconstruction, demolition (C1), transport (C2), waste processing (C3) and disposal (C4) of materials.
- **Benefits and Loads beyond the System Boundary (D)**: Covers any potential benefit from the reuse, recovery and recycling potential of the building materials or products.

As per the RICS WLCA PS, 2nd Edition, the pre-construction stage (A0) of buildings can be considered relatively insignificant in terms of carbon emissions when compared to the overall carbon footprint throughout the entire lifespan of the building. Additionally, User Carbon (B8) is an optional module[3] that covers the emissions arising from user activities and would typically

[2] Net Zero Carbon Buildings: A Framework Definition
[3] Although these emissions shall be reported by the building user's ESG reporting as part of the Scope 1, 2 & 3 criteria, as applicable.

depend on the application use of the building. Consequently, the emissions related to B8 are excluded from the WLCA.

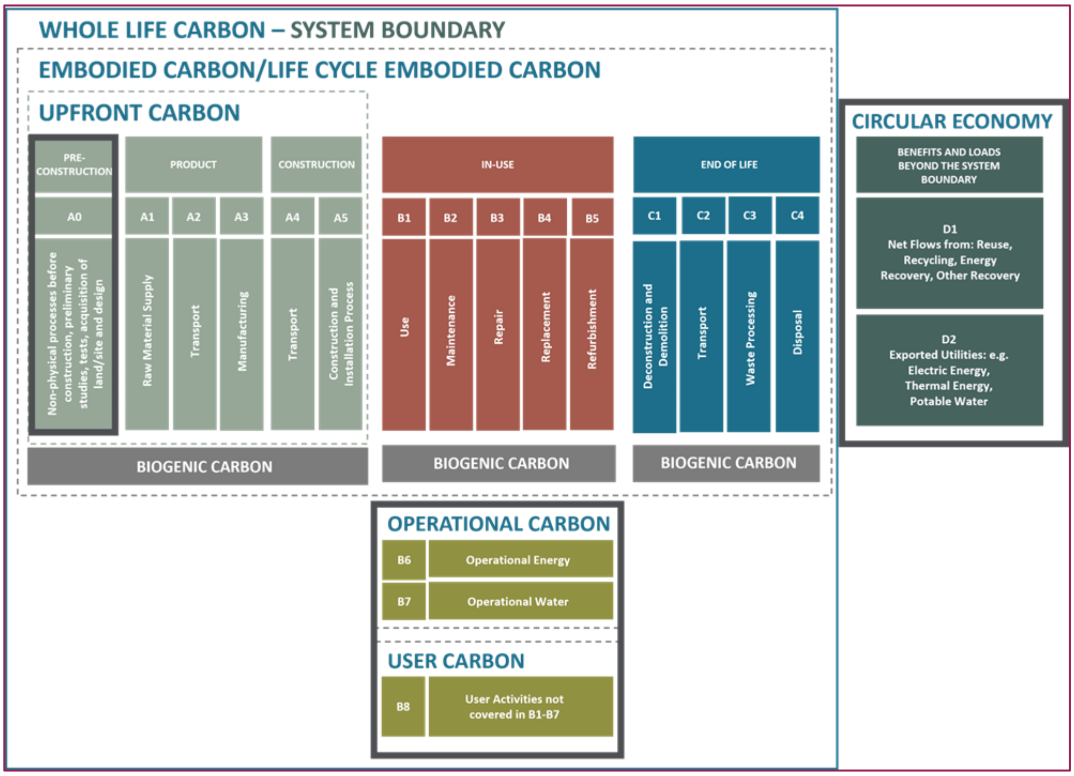

Figure 4 - Building life cycle stages and information modules (RICS WLCA Professional Statement)

3.2 Data Source

The WLCA can be carried out in different ways based on the information available from the Project Team at the relevant RIBA Stage. However, when utilising information from multiple sources, a hybrid approach of product-specific Environmental Product Declarations (EPD) and generic datasets from OneClick should be implemented. Additionally, the data source used for the Proposed Development's WLCA can be seen below:

Data Source	Discipline/Company	Description
Generic Materials	OneClick - LCA Software	OneClick generic EPD database
Design Input	Simat Properties Limited – Client	Email conversation with SRE (Re: 26 Rosslyn Hill - WLCA scenarios)
Architectural Plans	Square Feet Architects - Architect	Drawing Number: 2408_L_040 to 2408_L_058
Energy Strategy	SRE - Energy & Sustainability Consultant	20250214_SRE_Rosslyn Hill (26), London_Energy and Sustainability Statement_V1RevA
Structural Feasibility	Kiosque Ltd – Structural Engineer	1031-rep-003-P1-structural survey

Table 2 - Data Sources for the WLCA

3.3 Modelling Inputs

The section elaborates on the building element categories in line with the 'RICS Whole Life Carbon Assessment for the Built Environment' (2nd Edition, November 2023). The building elements are based on the NRM Level 3 as defined by the granularity level at the planning/pre-tender stage as applicable for the Proposed Development (Scenario 4).

Building element group	Building element (NRM Level 3)	Scope notes
0.1 Treatment and Demolition Works/ Facilitating Works	0.1.1 Toxic/contaminated material treatment & Demolition works	The design currently assumes that no contaminated land removal or treatment will be necessary. This will be reviewed as the project progresses. Demolition of Proposed Development: The demolition of the Proposed Development is factored using an average deconstruction/ demolition process benchmark data from the OneClick LCA tool, using a GWP of 3.4kgCO_2e/m^2. Demolition of Existing Development: In relation to the demolition of the existing building on-site, GLA guidance recommends utilising actual figures for the existing building demolition that shall be provided from the Pre-Demolition Audit. This informs the emissions arising from waste streams, waste processing & transportation of waste from the site. On-site utility consumption for Demolition activities can be recorded at the post-construction stage. GLA advises including a carbon emission impact of 50kgCO_2e/m^2 of demolished floor space in assessments. RICS guidance provides a standard assumption for the UK of 35kgCO_2e/m^2. As a result, RICS guidance has been utilised for the assessment.
	0.1.2 Facilitating works	It is expected to be covered with the Construction Activities factor accounted with A5 - 40kgCO_2e/m^2.
1 Substructure	1.1 Foundations and piling	Foundations with underpinning to the retained façade and associated works to form/remove lower ground, including disposal of excavated materials.
	1.2 Basement retaining walls and lowest slab	Lower ground floor and retaining wall/slab included as per the SAP specifications within the supporting Energy Statement

2 Superstructure	2.1 Frame	Concrete frame/Solid wall to support the bearing slabs or timber joist for the upper floors.
	2.2 Upper floors	Timbers joists on structural frame
	2.3 Roof	Tiled roof for the top floor apartment
	2.4 Stairs and ramps	Precast Concrete staircases
	2.5 External envelope including roof finishes	Brickwork for the façade with the potential to reuse the existing brickwork for the cladding
	2.6 Windows and external doors	External Door/Windows have been inputted using Generic EPDs or products which closely resemble the specification and Part L regs.
	2.7 Internal walls	Fixed gypsum board partitions along with steel stud framing components
	2.8 Internal doors	Internal Doors have been inputted using Generic EPDs or products which closely resemble the specification exclusions.
3 Finishes	3.1 Wall finishes	Finishes to walls/floors/ceiling have been inputted by measuring the areas from the Proposed Development floor plans
	3.2 Floor finishes	
	3.3 Ceiling finishes	
4 Fittings, Furnishings & Equipment (FF&E)	4 FFE – Building/Non-building related	FFE included as per the indicative layout from floor plans
5 Mechanical, Electrical & Plumbing (MEP)	5.1 - 5.5 – MEP services building/non-building related	MEP supplementary tables from RICS guidance are utilised for the accounting of the embodied carbon associated with the building services/ MEP components. Based on the energy strategy recommended for the Proposed Development.
6 Prefabricated Buildings and Units	6 Prefabricated buildings and units	Not Applicable
7 Works to existing building	7.1 Works to existing building or alterations	Not applicable to the Proposed Development

8 External Works	8.1 Roads, paths, paving, surfaces, fencing, railings, walls, and external fixtures	External Hard landscaping has been estimated in line with the information from the site plan
	8.2 Soft Landscape planting, irrigation	
	8.3 External drainage, external services, and minor building works	External services were excluded from the assessment due to a lack of information/standard assumptions at the early design stage. This should be considered in the post-planning assessment

Table 3 - RICS WLCA Building Element Categories for the Proposed Development

Additionally, Table 4 provides detailed information covering each lifecycle module and a description of the source of the information or the assumption made for each stage, as per the industry standards and guidance.

Module	Description	Data Source/ Assumption
A1-A3 Product Stage	A1 – Raw material supply: This Stage considers the environmental impact of raw materials, which includes extraction from their natural source, transporting to factories, energy used and emissions released during both extraction and transportation. A2 – Transport: This stage focuses on the environmental impact associated with transporting raw materials from suppliers to the manufacturing facility. This impact arises from the emissions generated by the fuels consumed by transportation vehicles. A3 – Manufacturing: This stage captures the environmental impact of manufacturing, which includes the fuels/materials used by machines, as well as the disposal of any waste generated during the production process.	The assessment has calculated the embodied carbon using EPDs, which align the most applicable/similar product and using standard specifications outlined by RICS guidance. For the external façade, construction design specification was provided by the project team. For the structural design, the engineer's inputs have been utilised to make assumptions on the substructure. For the MEP services, the energy strategy and standard assumptions have been utilised.
A4 Transport to Site	Captures the impacts associated with the transportation of the materials and components from the factory gate to and from the project site.	Due to the project being in the early design stage, transport scenarios outlined by RICS guidance have been utilised (Appendix B)
A5 Construction & Installation Process	A5.1 – Pre-construction demolition: Carbon impacts resulting from deconstruction/ demolition, transporting and disposal of waste as part of the main works to the existing scheme.	Pre-construction demolition can be estimated from the Pre-Demolition Audit undertaken by the design team. In the absence of the audit, the RICS standard assumption of 35kgCO_2e/m^2 should be adopted.

	A5.2 – Construction activities: Carbon impacts from any construction activities and installation processes on-site, including temporary works, energy consumption for site accommodation and use of plant, machinery and equipment. A5.3 – Waste & waste management: Carbon impacts from the production and transport of products that will be wasted, as well as any impacts associated with waste treatment	For the Proposed Development, the emissions from demolition activities are calculated to be aligned with RICS assumptions. Construction - emissions will be captured at the post-construction stage. However, to include at the early design stage, the RICS standard assumption of 40kgCO_2e/m^2 has been utilised. Waste figures are to be captured at the post-construction stage. However, RICS-assigned waste rates for typical materials are used to calculate the carbon impact.
B1 In-use emissions	B1.1 – Material emissions & removals: Non-energy related carbon removals/emissions arising from components during operation. B1.2 – Fugitive emissions: Accidental release of refrigerants from MEP equipment	Refrigerant charges can be provided by MEP engineers or taken from the product datasheet of the HVAC systems. The refrigerant leakage rates for the proposed VRF system are taken in line with CIBSE TM65 as below: Annual Leakage Rate – 5% End-of-life – 10%
B2 Maintenance	Accounts for the carbon impacts from any activities relating to maintenance processes, including cleaning, as well as any relevant products used and waste produced	Following the RICS and GLA WLCA guidance, B2 impacts can be assumed to be 10 kgCO_2e/m^2 or 1% of modules A1-A5 to cover all building element categories.
B3 Repair	Captures carbon impacts from all activities that relate to repair processes and any products used and waste produced, including impacts from production, transportation to and from the site, and installation of the repaired items	Following the RICS and GLA WLCA guidance, B3 impacts can be assumed to be equivalent to 25% of B2 maintenance impacts and 10% of A1-A3 impacts of MEP equipment (Building Element no. 5).
B4 Replacement	Accounts for any carbon impacts associated with the anticipated replacement of built asset components, including any impacts from the replacement, including the production, transportation to site and installation of the replacement items as well as any losses during these processes, as well as any impacts associated with the removal and end-of-life treatment of replaced items	The carbon impacts have been determined by utilising the expected lifespans for typical building elements/components as per the RICS (Appendix C).
B5 Refurbishment	Captures impacts from production, transport to site and installation of the components used for a change or refurbishment planned prior to project completion during the in-use stage	Not applicable for the Proposed Development.

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B6 Operational Energy	Captures carbon emissions from all operational energy use by a building over its lifecycle	Energy Use Intensity is expected to be 30.42kWh/m^2/year as per the SAP Dwelling Primary Energy rate
B7 Operational Water	Capture carbon impacts related to water supply and wastewater treatment, as measured and/or predicted over the life cycle	Assumed to be 110 litres/person/day as per the Part G optional building Regs
C1-C4 End-of-Life	C1 – Deconstruction/demolition impacts: The impacts arising from any on- or offsite deconstruction and demolition activities at the end of the life of the asset, including any energy consumption for site accommodation and plant use C2 – Transport Impacts: carbon impacts associated with the transportation of material from deconstruction and demolition to the appropriate final location. C3 – Waste processing: Impacts associated with their preparation for reuse, waste treatment and recovery prior to reaching the end-of-waste state. C4 – Disposal: Impact of elements not expected to be reused, recycled or recovered, but intended for final disposal either in landfill or incineration.	All the end-of-life scenarios are based on the default values and scenarios modelled within OneClick to divert at least 95% of the waste away from landfills/incineration and achieve circularity.

Table 4 - RICS WLCA life cycle modules for the Proposed Development

Results

4.0 Results

The embodied carbon result encapsulates all lifecycle stages (A1-A5, B1-B5, C1-C4), excluding Modules B6-B7 (operational energy and water) and Module D (benefits beyond the proposed system). Operational carbon emissions are represented within Modules B6 (operational energy demand) and B7 (water demand).

The total calculated whole life-cycle emissions over the 60-year RSP resulting from all the design options can be seen in Figure 5.

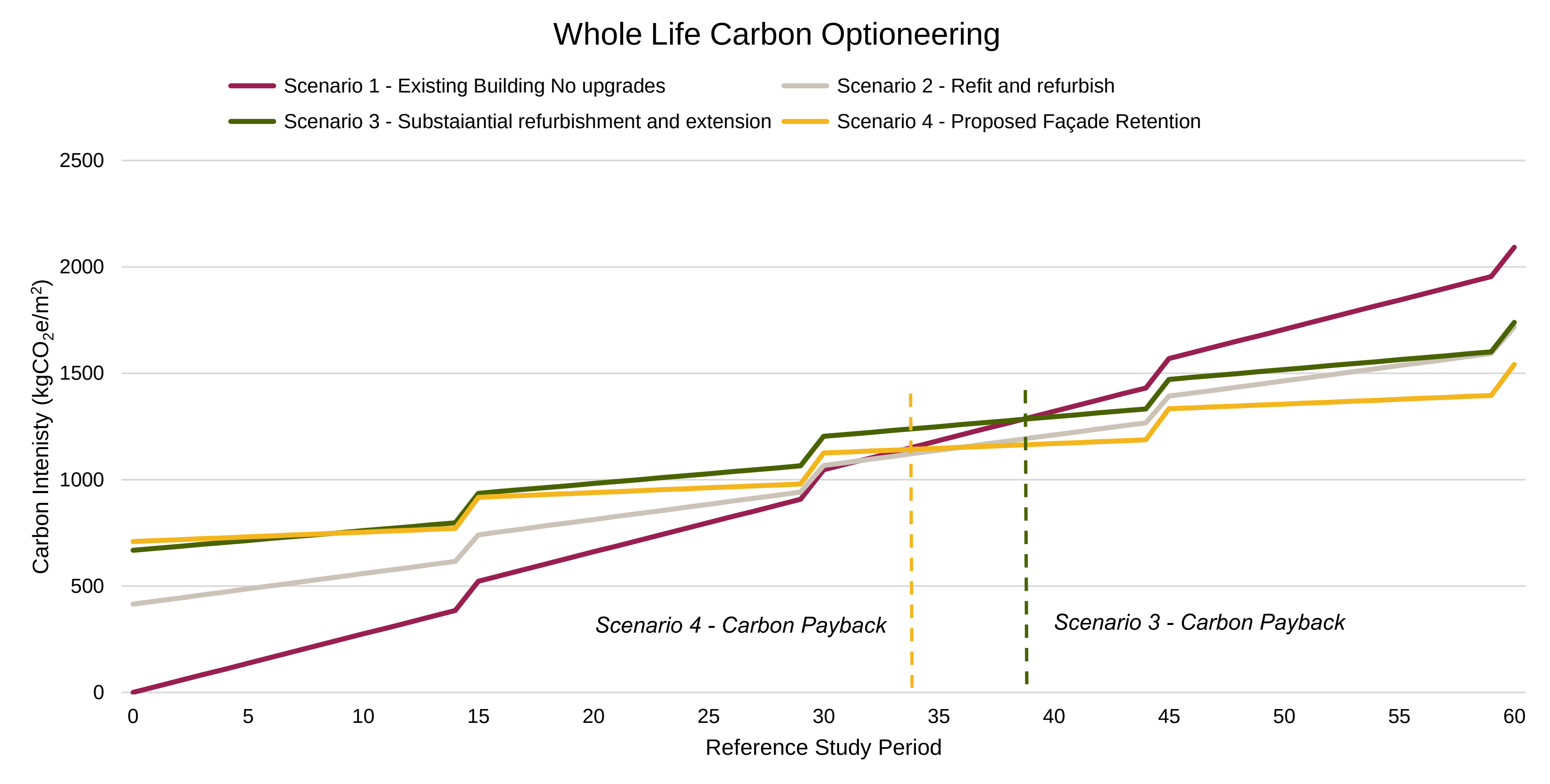


Figure 5 - Whole Life Carbon Optioneering for 26 Rosslyn Hill

4.1 Design Option Appraisal

The option appraisal is carried out during the application process to understand the feasibility and concept design for the Proposed Development and to comply with the planning requirements. During this stage, a WLCA feasibility study for a series of options for the project was undertaken. The following scenarios were assessed. The results summary of the scenarios can be seen below.

	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Upfront Embodied Carbon A1-A5 ($kgCO_2e/m^2$)	0	415	668	709
Structure retained relative to existing (% by volume)[4]	100	70	30	10
EPC Rating	NA	76 C	69 C	85 B
Whole life-cycle embodied carbon A-C, excluding B6 ($kgCO_2e/m^2$)	442	857	1,186	1,275
Operational Emissions B6/B7 ($kgCO_2e/m^2$)	1,650	861	553	226
Total WLCA ($kgCO_2e/m^2$)	2,006	1,632	1,645	1,446

Table 5 - WLCA Scenarios summary results

[4] % retention assumed by analysis floor plans elevations for each scenario

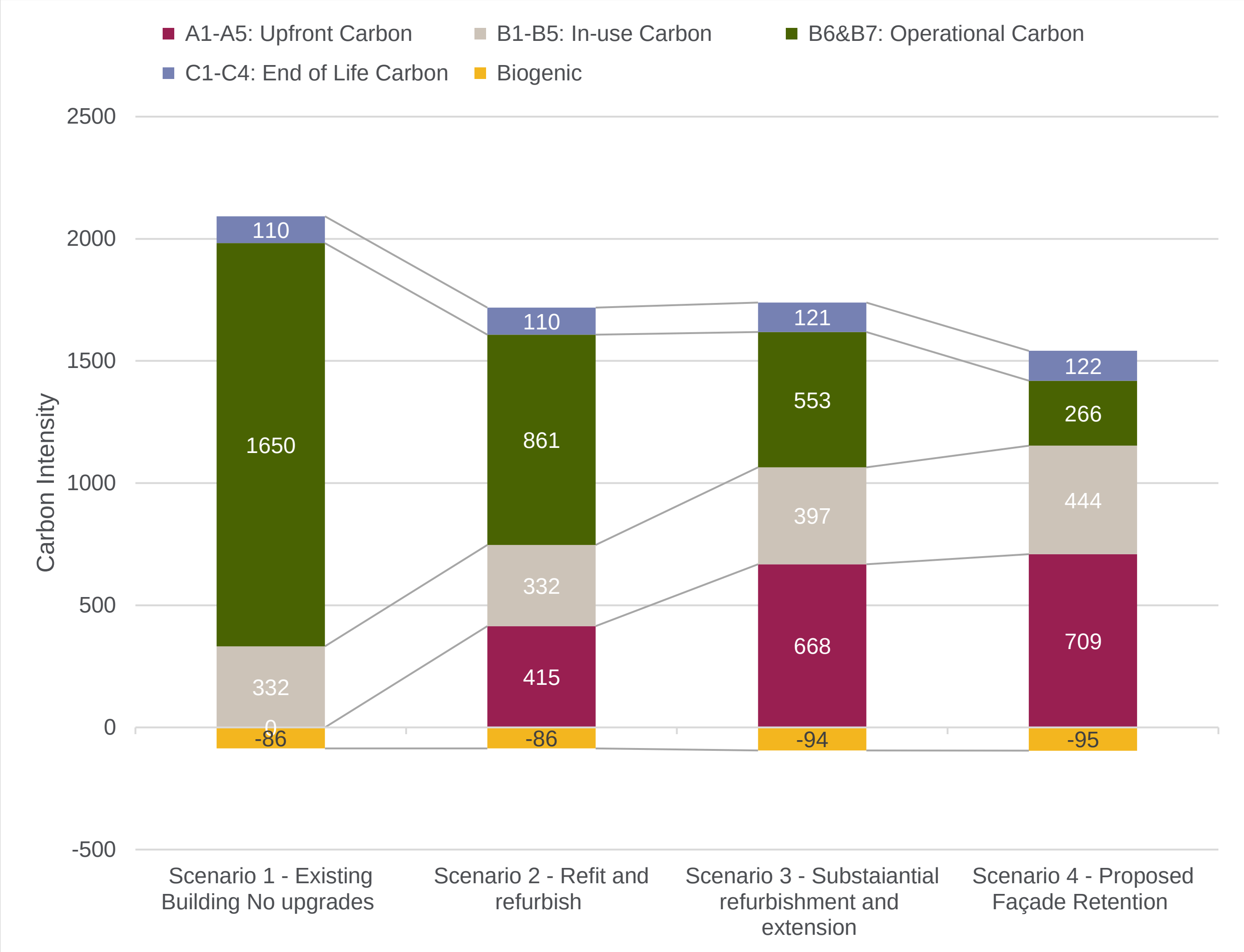


Figure 6 - Whole Life-cycle Carbon comparison for Options appraised

4.1.1 Scenario 1 – Existing Building No upgrades

This option assesses the existing building, which currently operates with a gas-based heating system and inefficient building fabric. This results in the highest operational emissions of all scenarios considered. Although the existing building is structurally unsafe for occupancy, this option is included to provide a baseline for comparison with the other appraised options and demonstrate the relative carbon impact.

4.1.2 Scenario 2 – Refit and Refurbish

This option necessitates structural alterations throughout the building and the entire boundary wall. The structural survey confirms that the existing building does not meet modern standards and would require underpinning. To accommodate three apartments within the current building envelope, internal alterations are needed to comply with Building Regulations. This includes creating an entrance at the rear of the building, accessed by a ramped side path leading to the main entrance from the west. Because there are no cavities in the walls, internal insulation will be required, which will reduce the internal floor area.

As expected, the refit and refurbishment option achieves the lowest upfront embodied carbon (A1-A5) emissions. By retaining the majority of the building envelope, the predicted embodied carbon for Scenario 1 would be 415 $kgCO_2e/m^2$, accounting for the new roof structure, enabling/temporary works, finishes and fit-out for the Proposed Development. However, this option fails to provide an energy-efficient building as the sample flat modelled has an EPC rating of ‘C’ with a Dwelling Primary Energy Rate (DPER) of 103.29 kWh/m^2/year.

As a result, the whole life-cycle carbon, including the operational emissions of the proposed design option over the RSP would surpass the emissions of all other options.

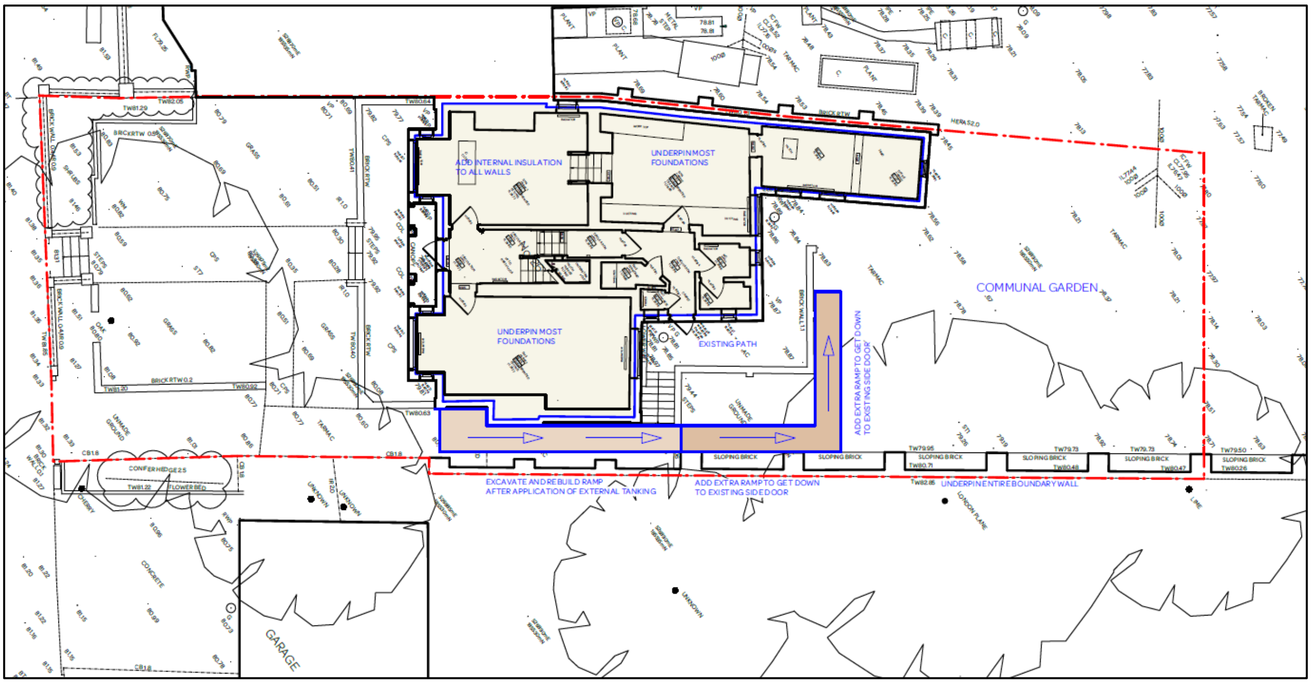


Figure 7 - Architectural sketch for the refit and refurbishment option (Scenario 2)

4.1.3 Scenario 3 – Substantial refurbishment and extension

The design option is similar to the new build proposal, although it plans to retain the front and side elevations and partially retain the internal walls where possible.

However, this option requires a substantial part of the existing internal structure and the rear elevation to be demolished by retaining the front and side elevations as part of the temporary works. This action has a higher chance of inflicting damage to the façade along with lateral stability, which compromises the structural integrity of the Proposed Development. Since the existing building structure is derelict and damaged, the retained façade will require intimate support points in order to replicate its current support condition.

As per the architectural sketches, where the walls are shown in orange, this signifies that the wall could theoretically be retained, but it would be hugely complex and dangerous, as the entirety of this section has to be removed at the Lower Ground Floor level, undermining the orange sections above. Considering the underpinning of the garden boundary wall nearby and the below-ground nature of much of the section requiring removal, any sensible risk assessment/method statement analysis must surely conclude that the higher-level orange sections should be taken down and rebuilt as well.

From a Construction Design and Management perspective, this option is not considered viable given the constraint of the site footprint and the complexities involved in retaining the existing structure. Additionally, the identification of any ground obstruction at the application site might increase the upfront carbon emissions further, which won’t be clear until the completion of a ground investigation report.

As a result, higher upfront carbon emissions of 668kgCO_2e/m^2 associated with structural strengthening for the building in combination with an EPC rating ‘C’ and higher DPER of 65.57 kWh/m^2/year considered over the RSP, does not make it the most sustainable alternative.

Figure 8 - Architectural markup for Lower & Upper Ground retained walls

4.1.4 Scenario 4 – Proposed façade retention

The new build option seeks to provide 3 no. apartments with a replacement building behind the existing front façade, together with associated landscaping. The building will have traditional construction of load-bearing masonry walls which support timber joists floors.

Figure 9 - Proposed Development west elevation façade

The proposal seeks to follow circular economy principles, reusing the existing bricks, slates and timber, and recycling the demolition waste off-site by diverting it from the landfill. The outline energy strategy enables the scheme to incorporate energy efficient HVAC systems, improved building fabric and implementation of rooftop PV systems.

The new build option does have the highest upfront carbon of 709 $kgCO_2e/m^2$, when compared to the other refurbishment design options appraised. However, the carbon savings are reflected during the operational phase of the building due to the energy-efficient building fabric and HVAC system. These measures allow the residential units to achieve an EPC rating of ‘B’ and a DPER of 30.42 kWh/m^2/year

As seen in Figure 5, Scenario 4 has the initial carbon payback during its operational phase (year 34) when compared to other design options appraised and further proves to be the most sustainable design option when considered over the 60-year RSP.

5.0 Improvement Options

This section presents recommended opportunities on how to further reduce the Proposed Development's embodied carbon emissions. A series of improvement options have been identified during the current design stage, which are subject to feasibility. The feasibility of the recommended improvement options should be analysed during the next design stages to assess implications on cost, programme as well as market availability and procurement options.

The following options are under consideration:

- The Structural engineer can incorporate elements of the existing perimeter retaining wall.
- Reused elements from the existing building should be investigated, such as: brickworks, slates, internal and external doors/windows and comply with the recommendations of the Pre-Demolition audit to maximise the reuse on the site.
- Increasing the cement replacement within the concrete elements of the building, which would not compromise the structural integrity of the Proposed Development.
- Rebar specifications - As one of the most contributing material, beyond quantity optimisation, low-carbon specifications should be considered. Adopting a national EAF rebar manufactured with renewable energy could offer one of the biggest potential savings.
- Recycled gypsum plasterboard and stud framing shall be considered for the internal partitions within the conditioned areas.
- Blockwork products with no cement are available in the market and could be considered for those masonry partitions that cannot include reused elements.

To aid the tangibility of decarbonisation across the Proposed Development as it moves from design to construction, the following recommendations can be incorporated:

- The appointed Principal Contractor should endeavour to comply with the principles of a Sustainable Procurement Policy or provide their own similar policy, subject to review by the Applicant.
- The appointed Principal Contractor shall endeavour to source materials with valid EPDs and Responsible Sourcing Certification and gather documentation. The Principal Contractor shall endeavour to procure EPDs at the product level, or if unavailable, EPDs at the manufacturer/Organisational level, for all material types and categories.
- The Principal Contractor shall endeavour to procure materials with valid certification from BES 6001 (all), CARES (steel), FSC/PEFC/SFI (timber), or alternatively EMS (all), for all material types and categories.

Additionally, to support responsible sourcing of materials and services, the following websites can be extremely useful resources to gather organisational and product-level material EPD/Certification:

- ***Global product EPDs*** – EPD Library | EPD International (environdec.com)
- ***Global product/Organisation Responsible sourcing certificates*** – Responsible Sourcing League Tables - BRE Group
- ***Global PEFC timber products*** – PEFC - Programme for the Endorsement of Forest Certification
- ***Global FSC timber products*** – FSC Certificates Public Dashboard
- ***Global product/Organisation Responsible sourcing certificates – Greenbook Live: BES 6001 The Framework Standard for Responsible Sourcing***

6.0 GLA Benchmarking

As per the assessment, the complete demolition and redevelopment design resulted in the lowest whole life carbon intensity estimated to be 1,351 $kgCO_2/m^2$.

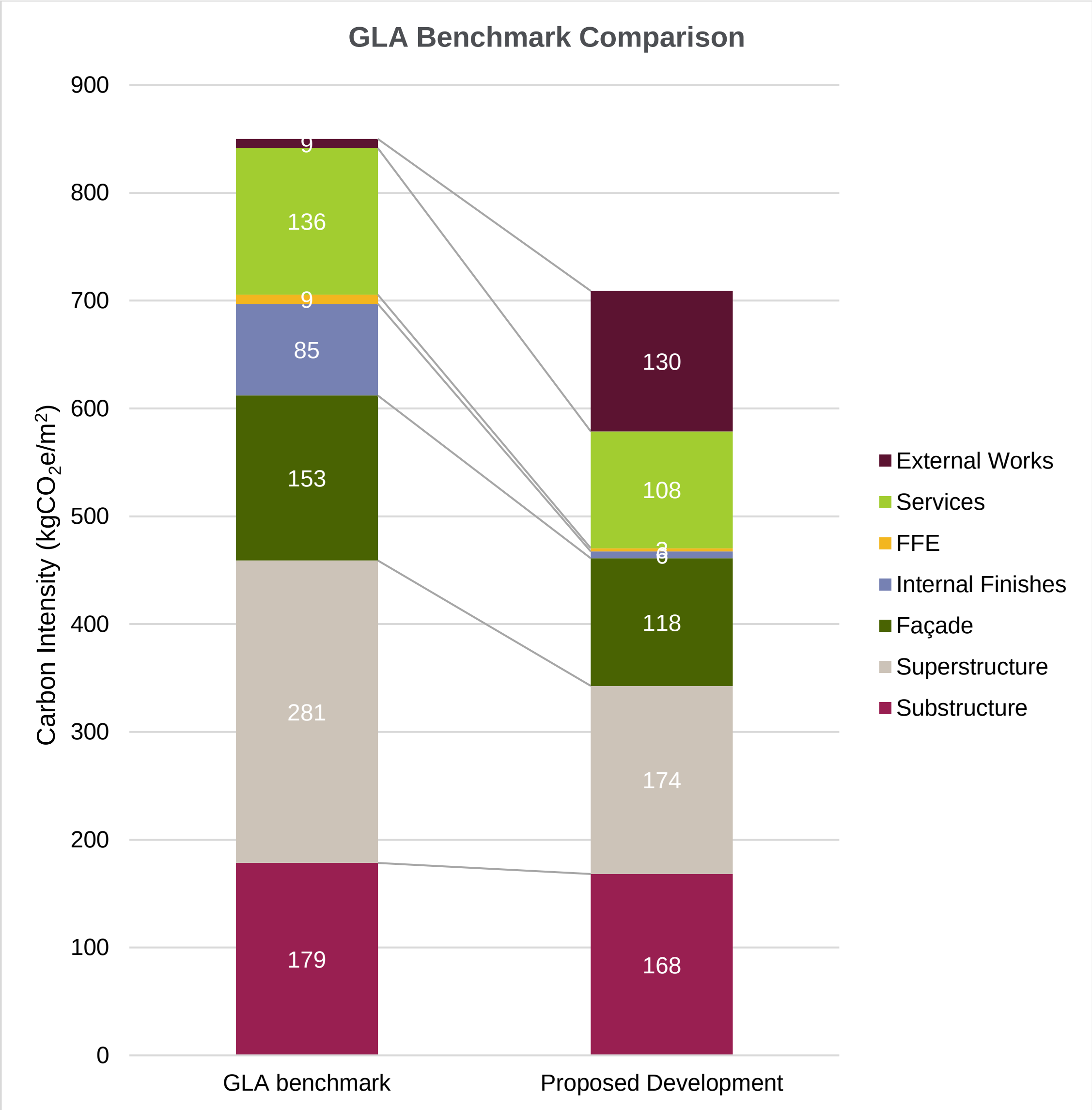


Figure 10 - Comparison of the Proposed Development's Carbon Emissions against GLA Residential Benchmarks

As seen in Figure 10, the Proposed Development meets the GLA benchmark for residential buildings (850$kgCO_2e/m^2$) by incorporating lower embodied carbon alternatives for structure and façade. Additionally, the energy efficiency of the building fabric proved that the complete demolition and redevelopment option results in carbon payback when compared to other design options. The residential units are also able to achieve higher EPC ratings when compared to refurbishment options due to efficient HVAC systems and the incorporation of rooftop PV systems for on-site energy generation.

Conclusion

7.0 Conclusion

The WLCA optioneering appraisal was undertaken at the design stage to assess the viability of utilizing the existing building and establish a pathway to reduce the lifecycle emissions for 26 Rosslyn Hill. The results from the assessment depicted that whilst the refit and refurbishment option have the lowest upfront carbon emissions (A1-A5), the operational emissions showcase a significant increase over the 60-year RSP. In the retention of the front and side elevation scenario, the emissions culpable with the additional structural strengthening of the façade result in several construction complexities and higher operational carbon emissions.

The existing building has a traditional masonry structure supported by concrete foundations with brick cladding. As per the structural survey, any option involving retaining or refurbishment would require strengthening and reinforcing the existing structures, primarily through underpinning to support the loading of the Proposed Development. This would increase the unquantifiable embodied carbon emissions, as it would involve significant temporary enabling works, monitoring of the existing structure, improvement of the fabric and installation of efficient MEP systems to meet the Building Regulations (Part L) within the constrained space. Therefore, as quantified in Figure 5, the increase in embodied carbon emissions from refurbishment/retention makes Scenario 4 the more sustainable one, along with a shorter carbon payback period.

The optioneering study determined that Scenario 2 doesn’t future-proof the building, even with the best possible U-values possible. It is also deemed impractical to retain the building, as the property might become derelict and unrentable in 10-15 years due to the implementation of new building standards. Thermal bridging cannot be undertaken on a refurbishment scheme, consequently, the building is never going to be able to reach the same standards as a new build, making an EPC rating of ‘B’ or above unattainable.

Furthermore, the energy that will be used to heat & power the refurbishment options will be considerably more than the new build due to efficiencies and air penetration rates. So, even though the new builds will have higher embodied carbon, they will operate more efficiently, releasing lower operational carbon emissions in the long run. This can be enacted by reusing the materials from the existing scheme to reduce the upfront embodied carbon.

Additionally, for a building constructed in the 1900s, the refurbishment/retention scenario has a higher chance of inflicting damage to the existing structure during the enabling works, which will result in the project being unsustainable and uneconomical.

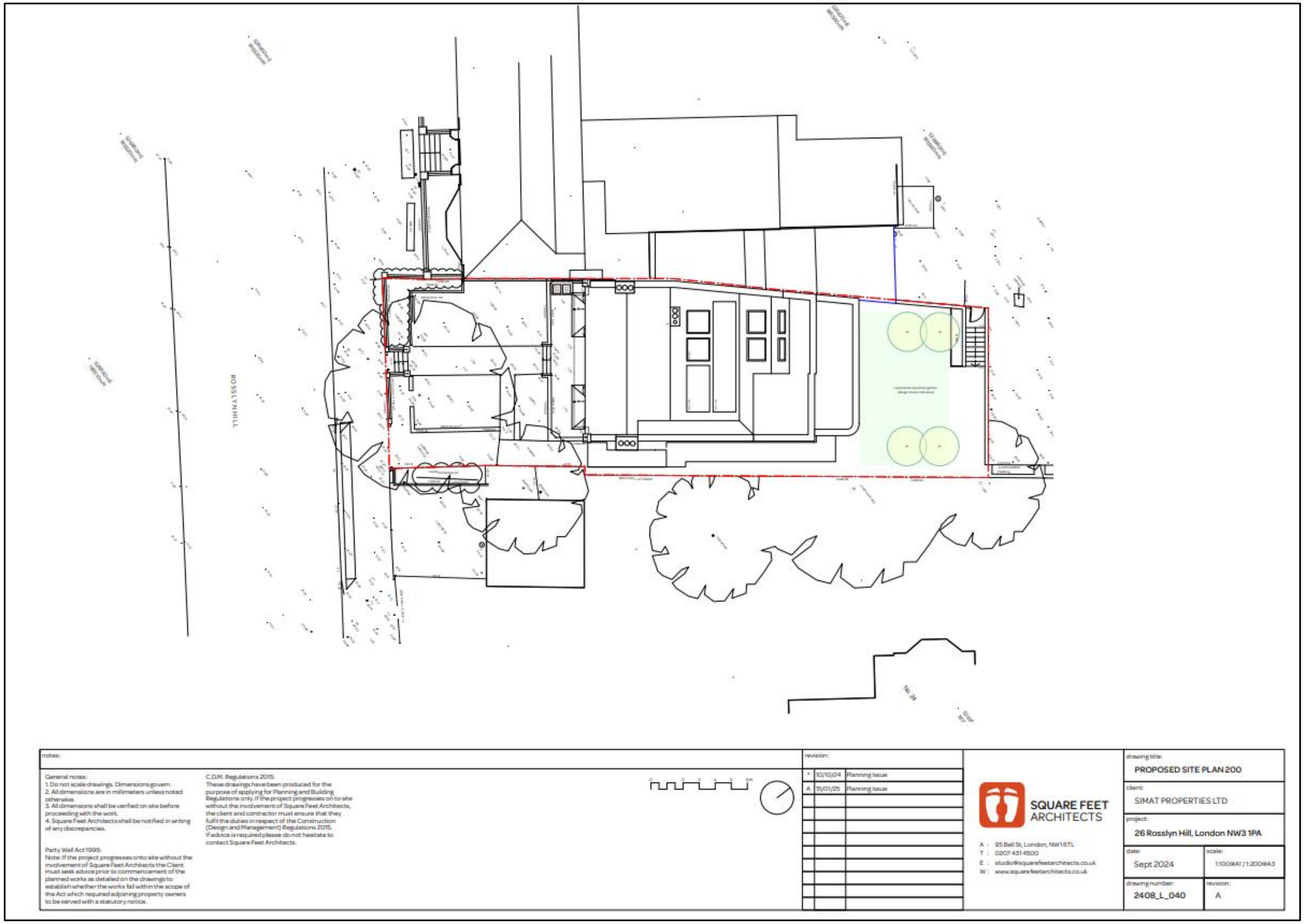
However, as the existing building is reaching the end of its intended lifecycle period, the building elements can be reused or repurposed as part of Lifecycle Stage D of the development. The design team proposal outlines strategies for the recycling, reuse and repurposing (on-site/off-site) of the building materials following the principles of Circular Economy. The design team has undertaken a Pre-Demolition audit, which has investigated the materials from the existing building that can be repurposed and diverted from the landfill to maintain circularity.

As a result, the Proposed Development assessed in Scenario 4 will comply with the London Plan Policy SI2 and Camden Local Plan Policy CC1, adhering to the whole-life carbon principles.

Additional carbon savings have been identified and will be further investigated at the subsequent design stages, focusing primarily on reducing material volume, reusing materials, sustainable procurement practices, and also opting for low-carbon alternatives.

Appendix

Appendix A Site Plan



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Appendix B RICS Transport Values

Transport Scenario (both road and sea to be used)	km by road*	km by sea**
Locally manufacturer (ready-mix concrete)	20	-
Locally manufactured (general) e.g. aggregate, earth, asphalt	50	-
Regionally manufactured e.g. plasterboard, blockwork, insulation, carpet, carpet, glass	80	-
Nationally manufactured e.g. structural timber, structural steelwork, reinforcement, precast concrete	120	
European manufacturers e.g. Cross Laminated Timber (CLT), façade modules	1,500	100
Globally manufactured e.g., specialist stone cladding	500	10,000
* Means of transport assumed as average of all average rigid HGVs or other road vehicles where details available (average laden) ** Means of transport assumed as average container ship		

Appendix C RICS Material Replacement Values

Building Part	Building Elements/Components	Expected Lifespan
Substructure	Piling and foundations	60 years (or building lifespan)
	Lowest ground floor	
Superstructure: frame, upper floor and roof structure	Structural elements, e.g. columns, walls, beams, upper floor and roof structure	60 years (or building lifespan)
Facade	**Opaque modular cladding**	
	Rains screens, timber panels	30 years
	Glazed cladded/ curtain walling	35 years
	Windows and external doors	30 years
	Hardwood/steel/aluminium windows	
	Doors	20 years
Roof	**Roof Covering**	
	Single-ply membrane	30 years
	Standing seam metal	30 years
	Tiles, clay and concrete	60 years

Superstructure	**Internal Partitioning and dry lining**	
	Stud work	30 years
	Blockwork	60 years
Finishes	**Wall Finishes**: Render/paint	30/5 years
	Floor Finishes	
	Carpet/Vinyl	7 years
	Stone tiles	25 years
	Raised access floor (RAF) pedestal/tile	50/30 years
	Ceiling Finishes	
	Substrate/paint	10 years
FF&E	Loose furniture and fittings	10 years
Services/MEP	Heat Source e.g. boilers, calorifiers	20 years
	Heat source, e.g. heat pumps (except ground surce)	15 years (20 years)
	Space heating and air treatment	20 years

	Central cooling systems (cooling only) e.g. fan coil systems, variable air volume, variable refrigerant volume	15 years
	Ductwork	
	Galvanised	40 years
	Plastic or flexible	15 years
	Electrical installations	30 years
	Lighting fittings	15 years
	Communications installations and controls	15 years
	Water and disposal installations	25 years
	Rainwater harvesting and grey water collection	30 years
	Sanitaryware	20 years
	Lift and conveyor installations	20 years
Hard Landscaping	Asphalt	35 years
	Concrete and stone paving	60 years
	Timber decking	15 years

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