RICS Whole Life Cycle Assessment (WLCA)

RIBA Stage 2 Report

7 REDDINGTON GARDENS

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Contents

1. EXECUTIVE SUMMARY

1.1. This report outlines the Whole Life-Cycle Carbon Assessment which has been undertaken for the proposed dwelling at 7 Reddington Gardens, in accordance with the GLA requirements. The study has been carried out at RIBA Stage 2 (or equivalent) and aims to demonstrate compliance with the RICS 'Whole life carbon assessment for the built environment'. The assessment has been based on materials data gauged from the information provided by the design team for applicable building elements required by the GLA methodology.

1.2. The total carbon emissions at Stage 2 is anticipated to be 1105 kgCO2e/m2, which includes the results of Modules B6 (operational energy use) & B7 (operational water use). The carbon emissions without the results for Modules B6 & B7 is anticipated to be 745.6 kgCO2e/m2, which is below the GLA's WLCA aspirational targets for residential schemes at 800 kgCO2e/m2. It has been noted that this figure will most likely increase as further details are added to the design. Therefore, it is imperative that the CO2 emissions of the building be reviewed again at Stages 3, 4 and 5 to ensure that the GLA's residential WLCA target is maintained.

1.3. The LCA has been carried out for the current building design using One Click LCA software and includes building elements in accordance with the RICS methodology,

1.4. Options to reduce the CO2 emissions of the proposed scheme as far as feasibly as possible have been analysed and presented within Chapter 5 of this report. It is envisaged that best practice solutions to reduce embodied carbon will be explored by the design team as the project develops throughout Stages 3-5.

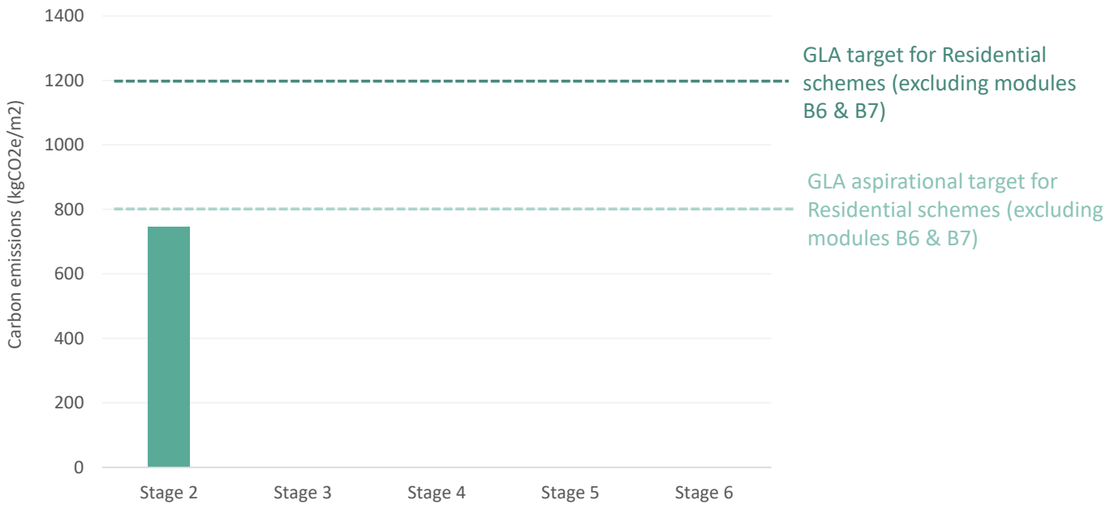


Figure 1: Stage 2 Results (excluding Modules B6 & B7) vs. GLA targets.

2. INTRODUCTION

2.1. GreenBuild have been appointed to carry out a Whole Life Cycle Assessment (WLCA) for the proposed dwelling at 7 Reddington Gardens, located in London. The strategy in this report focuses on the CO2 emissions associated with the embodied carbon of material production, construction and demolition processes on site, as well as the emissions associated with operational energy use.

2.2. This WLCA study has been carried out at RIBA Stage 2 and aims to demonstrate compliance with the London Plan "Whole Life-Cycle Carbon Assessment" guidance (March 2022) and the Royal Institute of Chartered Surveyors (RICS) 'Whole life carbon assessment for the built environment' methodology. The aim of the analysis is to reduce the burden on the environment from construction products by recognising and encouraging measures to optimise the selection of products with a low environmental impact over the life cycle of the building and the construction product consumption efficiency.

2.3. The approach taken at Stage 2 has been a collaborative process and included liaising with the design team and client to enable the design to reduce its WLC emissions as feasibly as possible and identify any priorities and potential constraints.

Site Proposal

2.4. The proposed scheme is located in Hampstead, London which falls within the borough of Camden and consists of a single three-storey 5-bedroom dwelling, with a floor area of approximately 492 m^2.

2.5. The site location is situated within the Redington Frognal Conservation Area and the proposal includes the demolition of an existing dwelling built during the 1950's. Therefore, the local authority has deemed a GLA London Plan compliant WLCA assessment necessary for this minor development.

2.6. Figure 2 presents the site plan of the proposed dwelling while and Figure 3 shows the front (southeast) elevation.

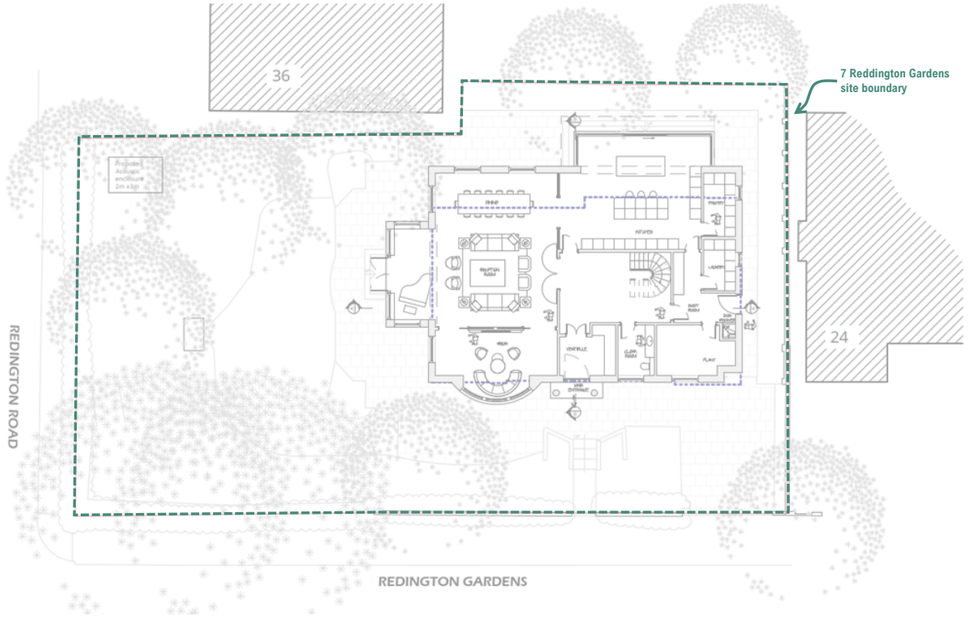


Figure 2: Site Plan - 7 Reddington Gardens

Figure 3: Front elevation of proposed scheme (Southeast elevation)

3. PLANNING POLICIES & LEGISLATIVE CONTEXT

3.1. There are several national policy drivers for energy efficiency and reduced carbon dioxide (CO2) emissions, which have been introduced to address the issue of global warming and the implications of climate change including the Energy White Paper, National Planning Policy Framework (NPPF). On a regional level, the London Plan provides the policy drivers for major developments within Greater London and at the local level the relevant policies are within the London Borough of Camden Local Plan (2017) .

National Policy Drivers

National Planning Policy Framework

3.2. The National Planning Policy Framework (NPPF) was updated in 2021 and sets out a key part of the Government's reforms to make the planning system less complex and more accessible, whilst protecting the environment and promoting sustainable growth. The NPPF supersedes the previous national planning guidance, namely the Planning Policy Statements and Planning Policy Guidance Notes.

3.3. At the heart of the NPPF is a 'presumption in favour of sustainable development', which requires Local Authorities as part of any plan-making or decision-making to provide clear guidance on how the presumption should be applied locally. In addition, the NPPF sets out land-use planning principles that underpin both plan-making and decision-making. Of these, the following has been identified as being relevant to the reduction of CO2 emissions:

> *'The planning system should support the transition to a low carbon future in a changing climate, taking full account of flood risk and coastal change. It should help to; shape places in ways that contribute to radical reductions in greenhouse gas emissions, minimise vulnerability and improve resilience; encourage the reuse of existing resources, including the conversion of existing buildings; and support renewable and low carbon energy and associated infrastructure.'*

Regional Policy Drivers

London Plan Guidance: Whole Life-Cycle Carbon Assessments (March 2022)

3.4. The current London Plan guidance on WCLA assessments indicates the following.

> *1.2.1 WLC emissions are the total 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 - that is, emissions associated with raw material extraction, the manufacture and transport of building materials, and construction; and the emissions associated with maintenance, repair and replacement, as well as dismantling, demolition and eventual material disposal. A WLC assessment also includes an assessment of the potential savings from the reuse or recycling of components after the end of a building's useful life. It provides a true picture of a building's carbon impact on the environment.*

> *1.2.2 The Mayor's net zero-carbon target for new development continues to apply to the operational emissions of a building. The WLC requirement is not subject to the Mayor's net zero-carbon target; but planning applicants are required to calculate operational and embodied emissions, and demonstrate how they can be reduced as part of the WLC assessment.*

Local Policy Drivers

London Brough of Camden Local Plan (2017)

3.5. Camden Council's Local Plan indicates the following under section 'Climate Change Mitigation: Embodied Carbon'.

> *8.20 As part of the assessment of resource efficiency, all developments involving five or more dwellings and/or more than 500 sqm gross internal floor space 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 we would encourage that the results are logged on the WRAP embodied carbon database in order to contribute to the embodied carbon knowledge base.*

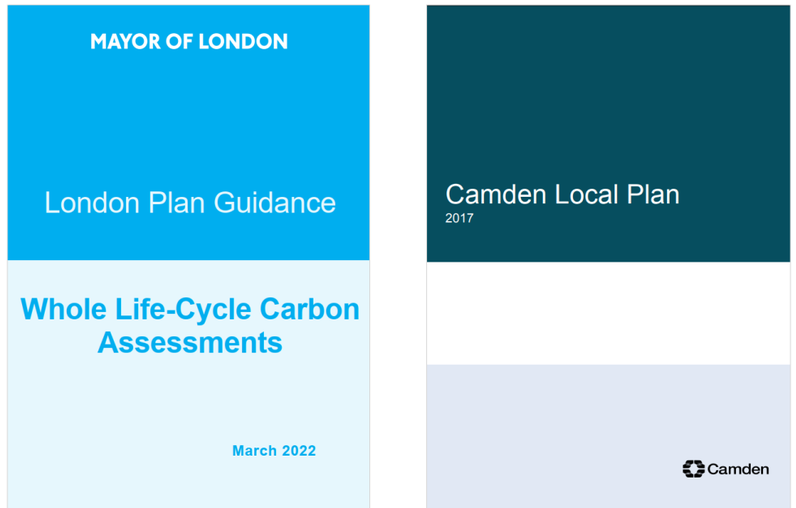


Figure 4: Policy documents considered within the WLCA.

4. WLCA SCOPE & METHODOLOGY

4.1. The introduction of Building Regulations Part L has led to reductions in the operational energy consumption of buildings and these regulations are being progressively tightened. As a result, greenhouse gas emissions from other aspects of buildings, such as embodied emissions, are becoming increasingly important in terms of reducing the overall emissions that lead to climate change over the building's lifetime.

4.2. Embodied CO2 emissions consider the effects of utilising construction products leading to a range of environmental impacts through initial procurement and construction, wastage, maintenance, replacement, and demolition/end of life (Figure 5). Construction products make a highly significant contribution to the overall carbon emissions of a building, in some cases exceeding that of its operational energy uses over its lifespan. Therefore, a holistic approach to considering the CO2 emissions of a proposed scheme is necessary.

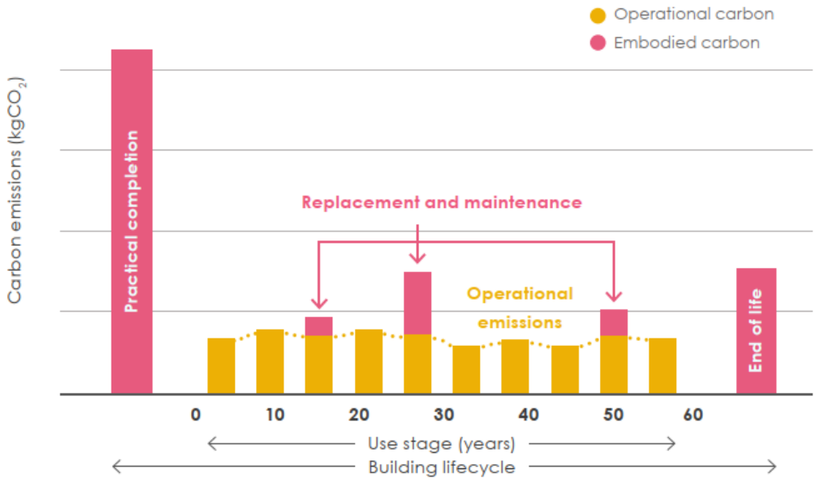


Figure 5: Carbon emissions over the lifespan of a building (image courtesy of LETI Embodied carbon Primer)

WLCA Scope

4.3. Whole Life-Cycle Carbon Assessments (WLCA) are carried out to estimate the carbon emissions of a building over its entire life, resulting from operational carbon emissions, embodied carbon emissions, construction processes and the emissions associated with maintenance, as well as demolition and material disposal. The life-cycle stages shown within Figure 6 are in accordance with BS EN 15804:2012 (+A1:2017) are included in a typical WLCA.

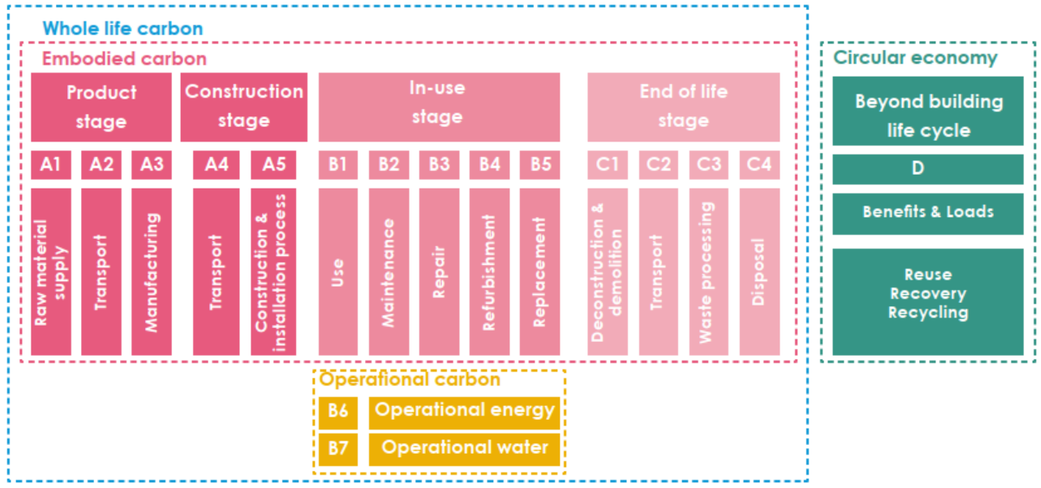


Figure 6: Life-cycle stages in line with BS EN 15804 (image courtesy of LETI Embodied Carbon Primer)

GLA's WLCA Guidance

4.4. The WLC principles in line with the GLA's *London Plan Guidance: Whole Life-Cycle Carbon Assessments* is presented within Table 1. These should inform the design of the development from the earliest stages and throughout the WLCA process.

Table 1: WLC Principles in line with the London Plan Guidance: Whole Life-Cycle Carbon Assessments (March 2022)

No.	Principle	Relevant life-cycle stages
1	Reuse and retrofit of existing built structures	A1-A5, B1-B6, C1-C4, D
2	Use repurposed or recycled materials	A1-A5, B1-B5, C1-C4, D
3	Material selection	A1-A5, B1-B5, C1-C4, D
4	Minimise operational energy use	A1-A5, B1-B5, B6
5	Minimise the carbon emissions associated with operational water use	A1-A5, B1-B7
6	Disassembly and reuse	A1-A5, B1-B5, C1-C4, D
7	Building shape and form	A1-A5, B1-B6
8	Regenerative design	A1, B1, D
9	Designing for durability and flexibility	A1-A5, B1-B5, C1-C4, D
10	Optimisation of the relationship between operational and embodied carbon	A1-A5, B1-B6
11	Building life expectancy	A1-A5, B1-B5, C1-C4, D
12	Local sourcing	A1-A5, B3-B5

No.	Principle	Relevant life-cycle stages
13	Minimising waste	A1-A5, B1-B7, C1-C4, D
14	Efficient construction	A1-A5, B1-B7, C1-C4, D
15	Lightweight construction	A1-A5, C1-C4, D
16	Circular Economy	A1-A5, B1-B5, C1-C4, D

4.5. The London Plan compliant WLCA assessments should cover the following.

- any carbon emissions associated with pre-construction demolition.
- any carbon savings associated with the retention, reuse and recycling of existing structures and materials that are already on-site.
- its operational carbon emissions (both regulated and unregulated).
- its embodied carbon emissions.
- any future potential carbon savings post end-of-life, including savings from reuse and recycling of building structures and materials.

The GLA's WLCA Targets

4.6. The following tables present the GLA's WLCA carbon emissions benchmarks in terms of project category or type. Table 2 presents the standard WLC benchmark while Table 3 presents an aspirational target. The target for residential schemes will be used within this assessment.

GLA's WLC benchmarks (kgCO2e/m2)			
Project category	**A1-A5**	**B-C (excl. B6 & B7)**	**A-C (excl. B6 & B7)**
Offices	<950	<450	<1400
Residential	**<850**	**<350**	**<1200**
Schools, Universities etc.	<750	<250	<1000
Retail	<850	<200	<1050

Table 3: Aspirational Carbon emissions targets set within the London Plan Guidance: Whole Life-Cycle Carbon Assessments

GLA's Aspirational WLC benchmarks (kgCO2e/m2)			
Project category	**A1-A5**	**B-C (excl. B6 & B7)**	**A-C (excl. B6 & B7)**
Offices	<600	<370	<970
Residential	**<500**	**<300**	**<800**
Schools, Universities etc.	<500	<175	<675
Retail	<550	<140	<690

GLA Recommended Methodology for WLCAs

4.7. The London Plan guidance indicates that WLCA's should be carried out using BS EN 15978: 2011. The *RICS Professional Statement: Whole Life Carbon assessment for the Built Environment* (RICS PS) is a useful guide to the practical implementation of the BS EN 15978 principles and should be used as the methodology for this WLCA assessment, except the key areas where compliance with London Plan Policy SI 2 takes a different approach as shown in Figure 7,

4.8. The additional requirements meeting the London Plan policy criteria will be presented alongside the results of the WLCS following the RICS methodology.

Box 1: Key requirements of this guidance that differ from the RICS PS methodology

1. Operational carbon emissions should be reported following the GLA's approach to carbon emission factors – see section 2.8.
2. Operational carbon emissions for non-residential uses should be reported using CIBSE TM54 - see paragraph 2.5.14.
3. All life-cycle modules (A-D) should be reported to comply with the WLC policy – see section 2.5 for further details.
4. Carbon emissions from pre-construction demolition should be reported– see section 3 for further details.
5. Reporting the key actions undertaken to reduce WLC emissions and the associated carbon savings, including those associated with the retention, reuse and recycling of existing structures and materials that are already on-site – see section 3 for further details.

Figure 7: London Plan requirements that differ from RICS PS (image courtesy of London Plan Guidance: Whole Life-Cycle Carbon Assessments)

RICS Methodology and One-Click LCA Tool

4.9. One Click LCA tool was used to carry out the analysis in this report. Its database contains average materials for construction materials life cycle emissions and building in-use phase water and energy consumption data, based on the UK market according to EN 15804 standard and is also fully compliant with the BS EN 15978 standard,

4.10. The One-Click LCA tool's database allows the materials of a building to be broken down into each applicable building element in accordance with the RICS PS methodology. Table 4 presents a full overview of elements assessed within this WLCA at RIBA Stage 2.

4.11. A range of generic data sources such as ICE and One-Click datasets have been included within the RIBA Stage 2 WLCA calculation. The product service life and transport distances are based on RICS default figures.

4.12. The impact of the materials is displayed in terms of embodied CO2e emissions of materials, which indicates a measure of the adverse impact the greenhouse gases emitted via production of construction materials might have upon the atmosphere.

4.13. The assessment has covered the following life cycle stages in accordance with BS EN 15978 and the building's service life was estimated to be 60 years which is fixed in the tool settings.

- A1-A3 Construction Materials
- A4 Transport
- A5 Construction site impacts
- B1-B5 Use, maintenance, replacements and refurbishment
- C1-C4 End of life

4.14. It should be noted that as the project is at Stage 2, there is limited confirmed information for input within the life-cycle stages and these have been estimated in line with the RICS methodology within the One-Click LCA Tool.

Table 4: Proposed Scheme - Elements included/excluded from WLCA.

RICS Building Element Groups to be considered in WLCA				
Element group				Included at Stage 2?
0	Demolition	1	Toxic/ hazardous / contaminated material treatment	N/A
		2	Major demolition works	Yes
	Facilitating works	3 / 5	Temporary / enabling works	N/A
		4	Specialist ground works	N/A
1	Substructure	1	Substructure	Yes
2	Superstructure	1	Frame	Yes
		2	Upper floors (inc balconies)	Yes
		3	Roof	Yes
		4	Stairs and ramps	Yes
		5	External walls	Yes
		6	Windows & external doors	Yes
		7	Internal walls and partitions.	Yes
		8	Internal doors	Yes
3	Finishes	1	Wall finishes	Yes
		2	Floor finishes	Yes
		3	Ceiling finishes	Yes
4	FF&E	1	FF&E (Fittings, furnishings & equipment) Inc. building related and non-building related	Yes
5	Building services / MEP	1 to 14	Services Inc. building related and non-building related	Yes
6	Prefabricated buildings and building units	1	Prefabricated buildings and building units	N/A
7	Work to existing buildings	1	Minor demolition and alteration work	N/A
8	External works	1	Site preparation works	Yes
		2	Roads, paths, paving and surfacing	sYes
		3	Soft landscaping, planting and irrigation systems	Yes
		4	Fencing, railings and walls	N/A
		5	External fixtures	N/A
		6	External drainage	Yes
		7	External services	Yes
		8	Minor building works and ancillary buildings	N/A

5. WLCA STAGE 2 RESULTS

Stage 2 Information Used

5.1. The project information available to carry out the WLCA at Stage 2 was as follows. Further details can be found within the Architect's drawings and Energy Statement included within the planning application for this project.

- Architect's floor plans and elevations titled 2252-PL-Proposed set_06.06.2023, 2252-PL-Existing set_01.06.2023 and 2252-PL-Demolition set_06.06.2023.
- Wall, roof, floor and openings (windows, rooflights and doors) U-value targets within the document 'SAP Design Summary - Reddington Gardens' by E& S Bristol Ltd issued 31.05.2023.
- Building services assumptions (heating, lighting services and photovoltaic panel installation) within the document 'SAP Design Summary - Reddington Gardens' by E& S Bristol Ltd issued 31.05.2023.
- Structural design information provided by Michael Alexander Consulting Engineers and Halstead Associates via email on 26.06.2023 and 30.06.2023 respectively.

5.2. Material quantities were calculated by measuring the architect's drawings, structural engineers' quantities information and by assuming construction build-ups which would meet the relevant U-value targets for the thermal elements within the proposed scheme. Aspects such as insulation types were noted within the energy assessor's calculations, and these have been used within the WLCA.

5.3. The demolition impacts on site have been estimated using the existing building drawings provided by the architect. This estimation will require review and revision at later stages.

Stage 2 Results – Baseline Case

5.4. This portion presents the results for the dwelling as it has been proposed. No part of the existing building is to be reused on site and no provision for reuse has been considered. While a portion of concrete has been estimated to be replaced with fly ash within the foundations (approx. 15%), no other recycled or reused content has been assumed. Therefore, a 'worst case' scenario is presented in the Baseline Case results.

5.5. The Baseline model accounts for demolition works, substructure, superstructure, internal finishes, building services and external work elements. The CO2 emissions for materials repairs and refurbishment have not been considered within the calculations at Stage 2. The 'WLCA GLA planning spreadsheet' (version March 2022) submitted alongside this report includes a full list of materials and quantities calculated.

5.6. Figure 8 presents the anticipated CO2 emissions from the proposed scheme at Stage 2, in comparison to the GLA's targets. The total CO2 emissions for the proposed scheme, including operational energy and water uses (i.e., lifecycle stages B6 & B7) is anticipated to be 1105 kgCO2e/m2.

5.7. However, the figure which is compared to the GLA's residential benchmark target excludes the results of modules B6 & B7. Therefore, the WLCA result for the proposed scheme which is considered in terms of meeting the GLA's requirements is 745.6 kgCO2e/m2 at Stage 2 and this is below the GLA's aspirational target.

5.8. The result at Stage 2 will most likely increase at Stages 3,4 and 5, as the calculation inputs become more detailed, and more materials are added. Therefore, it is imperative that the WLCA calculations are updated in line with the progression of the design and delivery of the building on site, to ensure that the GLA's carbon emissions target is achieved.

Figure 8: Proposed scheme anticipated CO2 emissions VS. GLA targets

5.9. Figure 9 shows the aforementioned carbon emissions results for the proposed scheme, separated into lifecycle modules A1-A5 and B-C (including B1-B5 & C1-C4). These have been compared against the related GLA targets and aspirational targets for residential projects. While the proposed scheme meets the GLA's aspirational targets in terms of modules B-C, they only meet the GLA's standard target for modules A1-A5.

5.10. This is most likely due to the increased concrete material quantity required for the foundations of the proposed scheme, noted as being 24no. 18m piles by the structural engineer, due to the existing soil

conditions on site. It should be highlighted that the CO2 emissions associated with module types B (In Use) and C (End of life stage) could increase over the 60-year lifespan of the building.

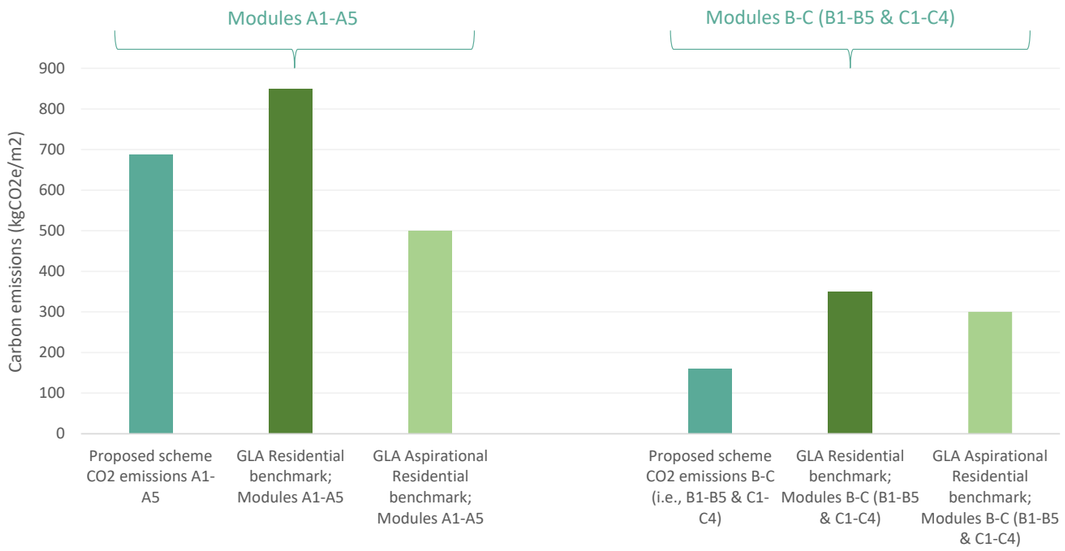


Figure 9: Proposed scheme results and GLA's WLCA targets for lifecycle module sections.

5.11. Figure 10 presents a breakdown of the proposed scheme CO2 emissions into the Life-cycle stages of BS EN 15804. Figure 11 presents these results as a percentage of the total CO2 emissions of the proposed scheme.

5.12. The results indicate that the largest emission is expected in the form of the embodied carbon of materials used on site at stages A1-A3 (i.e., raw materials supply, transport and manufacturing), which accounts for approximately 60% of the total anticipated CO2 at Stage 2, while the embodied carbon of regulated energy use over the 60-year lifespan of the building accounts for approximately 21% of its total anticipated CO2 emissions. These results demonstrate the importance of considering the embodied CO2 of materials when designing a project, in addition to ensuring a building's energy efficiency.

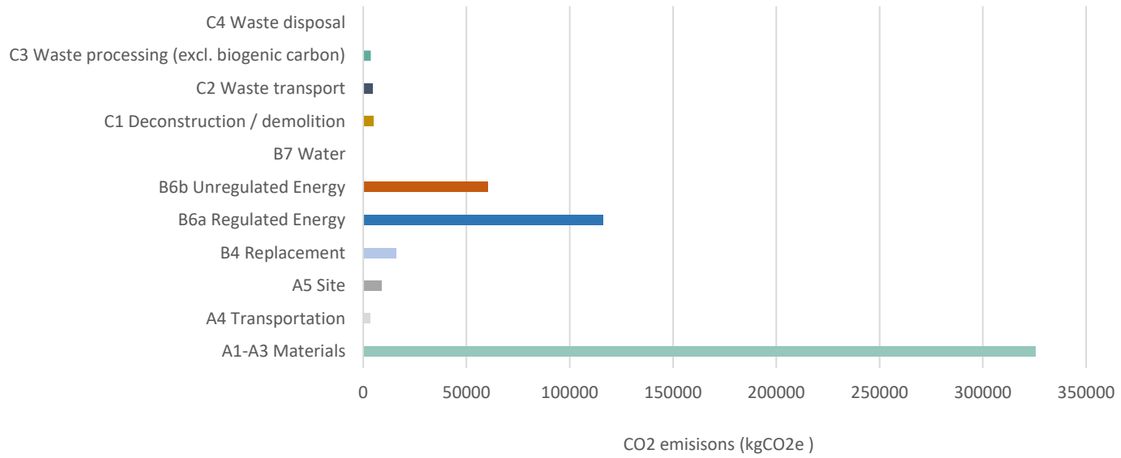


Figure 10: Stage 2 CO2 emissions from proposed scheme - Life-cycle Stages (BS EN 15804)

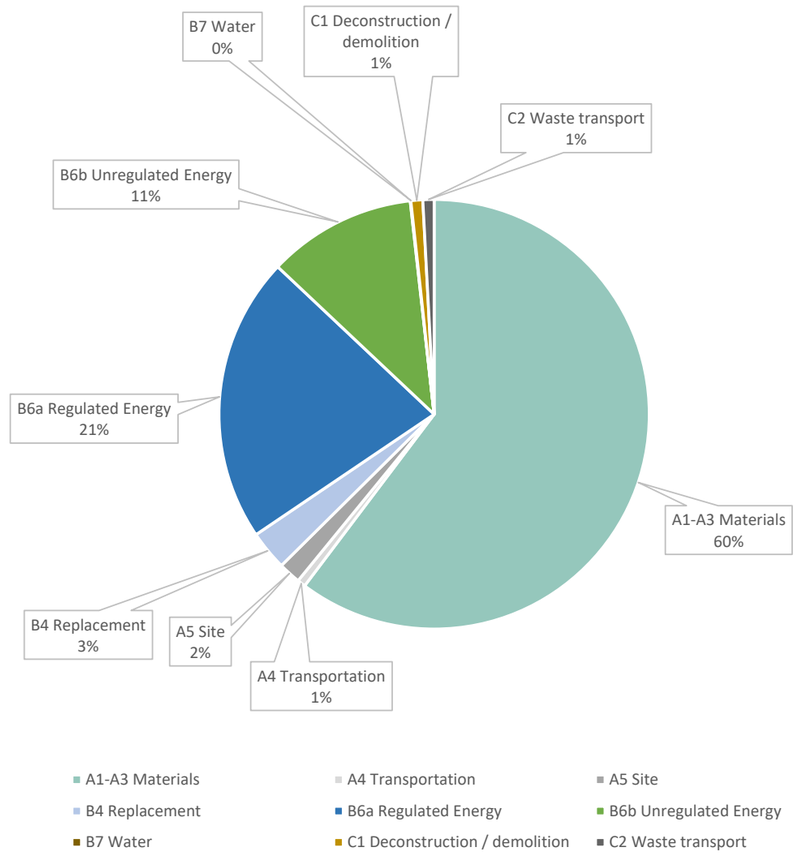


Figure 11: CO2 emissions at Life-cycle Stages by percentage of total CO2 for proposed scheme.

5.13. Figure 12 presents the total carbon emissions grouped by the RICS PS building element categories. The largest CO2 emissions are associated with the foundations of the building and its services. The foundations are to consist of 24no. 18m long concrete piles with reinforced ground beams, while the services account for the MEP kit in addition to its lifetime regulated and unregulated energy uses. The next highest emissions include the steel frame of the proposed dwellings, covering columns and beams across all three floors.

Figure 12: CO2 emissions according to the RICS PS building element classification.

5.14. Figure 13 presents the overall WLCA performance of the proposed scheme at Stage 2, showing the CO2 emissions breakdown in line with the RICS PS and in terms of the life-cycle stages. It is evident that the impacts of material extraction, procurement and transportation in line with A1-A3 are distributed throughout the material categories, indicating where improvements could be made to reduce emissions from the scheme.

5.15. The total anticipated Stage 2 carbon emissions of the dwelling of 1105 kgCO2e/m2. However, the results considered in terms of meeting the GLA's requirements, excluding the results for modules B6 & B7, is 745.6 kgCO2e/m2. This is below the GLA's recommendation for residential projects. This will most likely increase at Stage 3, 4 and 5 and measures need to be taken to ensure that the proposed scheme stays within the GLA's WLCA target of 1200 kgCO2e/m2. Therefore, recommendations to improve the embodied carbon performance have been tested for the design team to consider as the project progresses further.

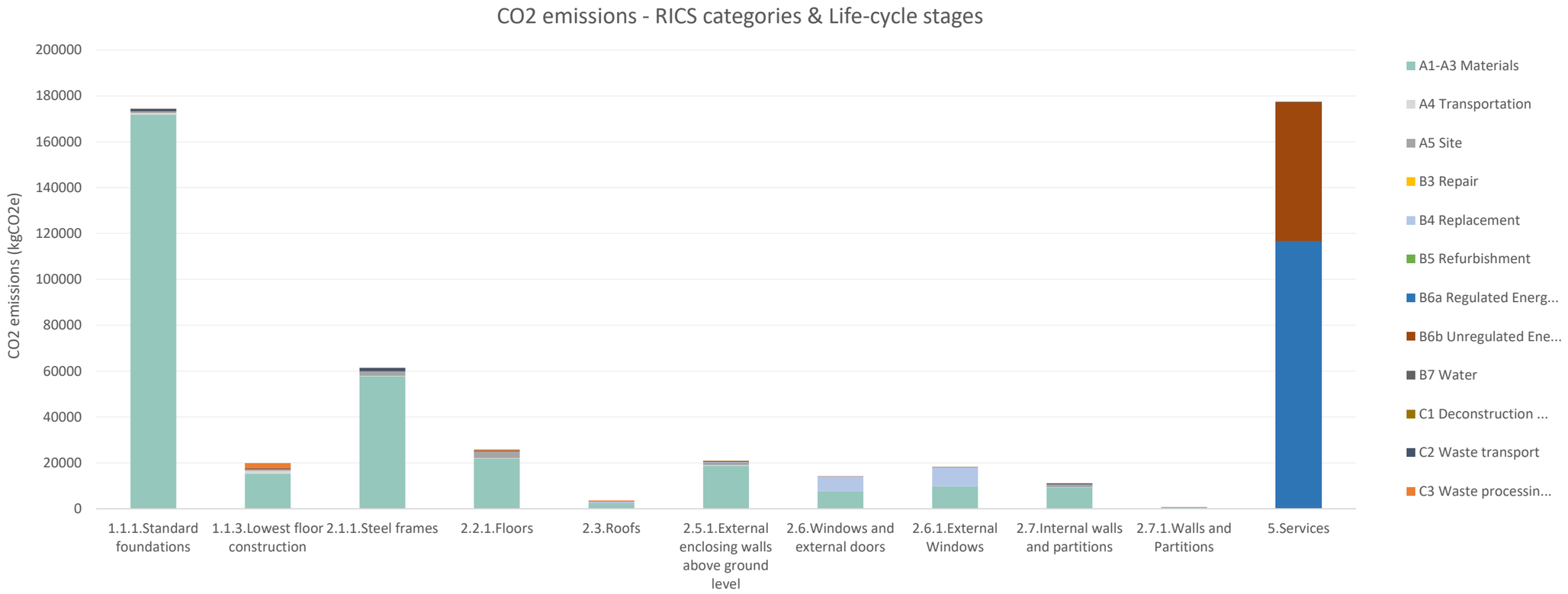


Figure 13: RICS categories & Life-cycle Stages - Proposed scheme breakdown

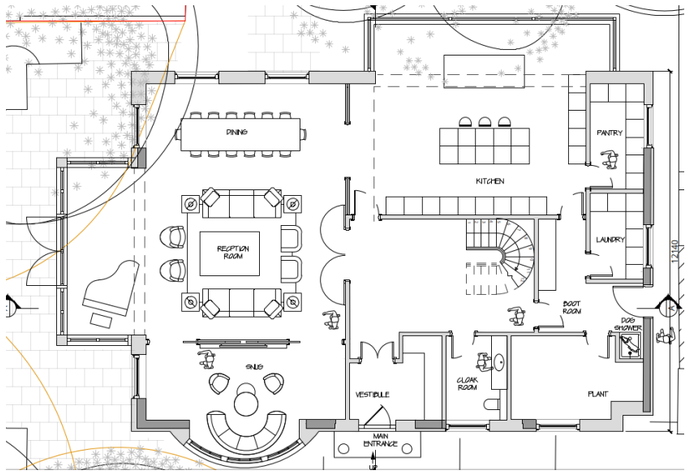
Stage 2 Recommendations for Improvement

5.16. The following options have been considered to potentially reduce the embodied CO2 emissions of the proposed scheme. The options have been tested individually against the Stage 2 proposal, to gauge the improvements made with each alteration more clearly.

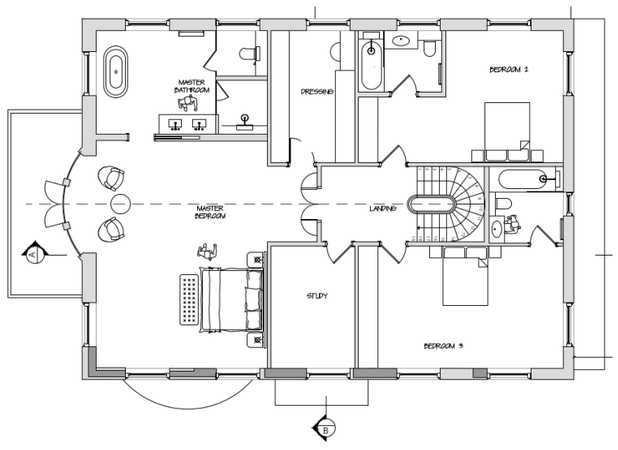
- Option 1 - to retain some of the existing building's walls where the existing and proposed front façade overlap.
- Option 2 - to retain at least 25% of the existing foundations materials and reuse them within the proposed scheme's foundation ground beam structure.
- Option 3 - to use ground beam reinforcements with at least 97% recycled steel content.

5.17. Figure 14 shows the extent of the existing building's walls that were to be retained previously. The existing building's façade intercepts with the proposed scheme at the ground and first floor levels at its southeastern side. In addition, the reuse of portions of the existing foundations has been considered as well. However, the design team had decided to demolish the existing building, due to the changes made to Building Regulations Part A *Structure,* which has increased requirements for structural stability within new buildings.

5.18. Figure 15 presents the results of the improvement options considered against the Baseline Case results. The CO2 emissions are presented in line with the life-cycle stages, showcasing the reductions for each portion. The largest reduction in carbon emissions is shown to be achieved by Option 3, using ground beam reinforcements with at least 97% recycled steel content. Options 1 and 2 are also shown to have reductions over the Baseline results, with option 2 having a slightly larger saving. Therefore, it is recommended that these alterations be considered where feasible.



Ground Floor



First Floor

Figure 14: Extent of the wall retention considered by the design team.

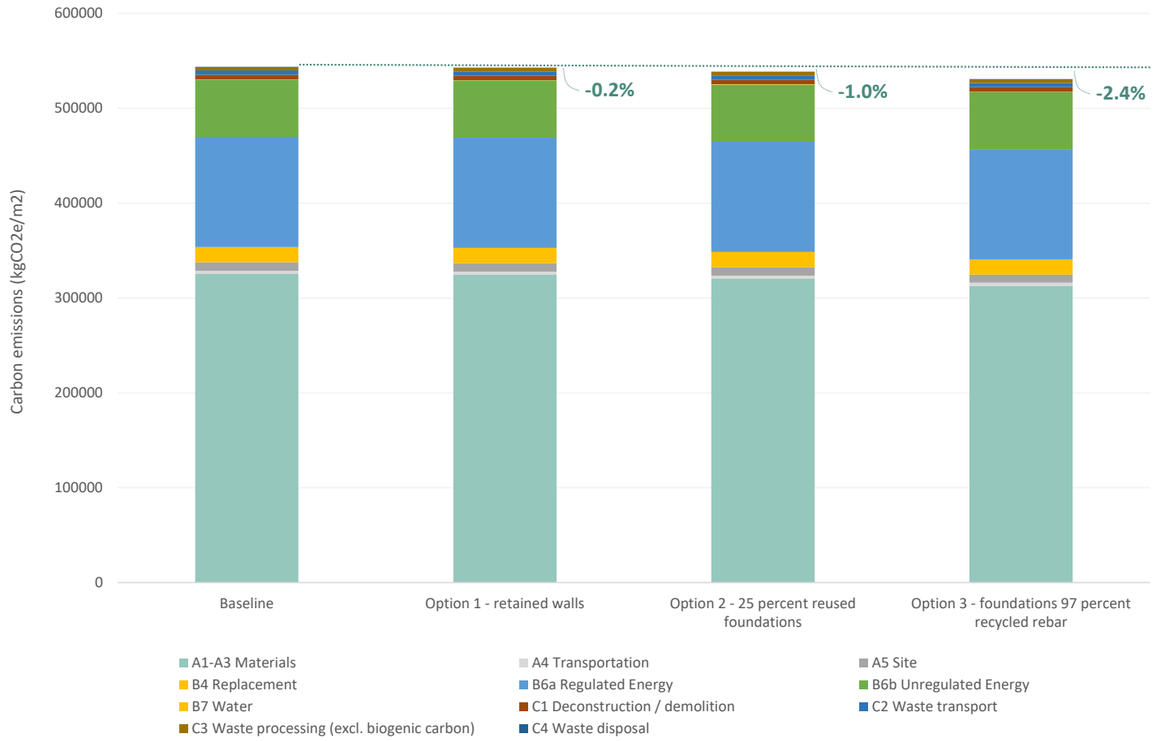


Figure 15: Options comparisons with Baseline results – Reduction of Overall CO2 emissions and at Life-cycle Stages.

Stage 2 Additional GLA WLCA Criteria

5.19. The additional criteria to be met in line with the London Plan Guidance: Whole Life-Cycle Carbon Assessments document (Box 1) has been considered within the proposed scheme. As such, the operational CO2 emissions have been reported, via life-cycle category B6a Regulated Energy Use, following the GLA's approach to carbon emission factors.

5.20. Life-cycle modules A-C have been reported within this WLCA assessment thus far. The consideration of Module D Circular Economy principles of reduce, reuse and recycle will be considered throughout the development of the proposal, as demonstrated within the improvement options. This will be reported as the design progresses.

5.21. The carbon emissions from the anticipated demolitions process have been reported via the CO2 emissions figures for life-cycle modules C1, C2 and C3.

5.22. Key actions to reduce WLC emissions, including those associated with the retention, reuse and recycling of existing structures and elements already on-site have already been considered.

Stage 2 Best Practice Principles for Further Reductions in CO2 Emissions

5.23. A set of best practice principles, based on embodied carbon and life-cycle principles have been detailed below. These should be considered alongside other design decisions as the design of the dwelling proceeds at Stage 3, 4 and 5.

- Designing for manufacturing and assembly (DfMA) principles should be considered by the design team.

- Low-carbon concrete such as limecrete or hempcrete where performance requirements allow should be considered as a concrete alternative, such as in ground floor slabs.

- Recycled construction & demolition (C&D) waste and waste glass from the existing residential building can be used to in concrete aggregates to reduce the use of virgin materials and provide a second useful life for high volume of waste otherwise destined for landfill.

- Traditional brick build-up can be a low carbon solution further enhanced by using recycled bricks and lime mortar. Local reclaimed brick should be sourced wherever possible.

- External works proposals should consider the use of fewer materials and low carbon materials. Preference should be given to natural stone paving slabs compared to concrete products, where less material is required to achieve the same strength.

- When considering building services systems such as air source heat pumps, preference should be given to the following design requirements: Low Global Warming Potential (GWP) refrigerant & leakage, high thermal efficiency, long lifetime & service life, light weight, low embodied carbon materials, materials that can be demounted, disassembled, and reused.

- The transportation of materials from the manufacturing facility to the building site increases the buildings carbon emissions. Consideration to specify materials from local sources is recommended and will reduce the emissions produced during the transportation phase (A4).

- Preference should be given to materials with Environmental Product Declarations (EPDs). EPDs are independently verified and registered documents that provide transparent and comparable information about the life cycle environmental impact of a product, materials with EPDs generally achieve a better life cycle performance compared to non-registered materials.

6. CONCLUSIONS

6.1. A Whole Life-Cycle Carbon Assessment in accordance with the GLA requirements has been undertaken for the proposed dwelling at 7 Reddington Gardens at RIBA Stage 2. This has been done with the aim of recognising and encouraging measures to optimise construction products, consumption efficiency, and the selection of products with a low environmental impact (including embodied carbon) over the life cycle of the building. The WLCA has been run for the entire building and is based on materials data gauged from the information provided by the design team for applicable building elements required by the GLA methodology.

6.2. The total carbon emissions at Stage 2 is anticipated to be 1105 kgCO2e/m2, which includes the results of Modules B6 (operational energy use) & B7 (operational water use). The carbon emissions without the results for Modules B6 & B7 is anticipated to be 745.6 kgCO2e/m2, which is below the GLA's WLCA aspirational targets for residential schemes at 800 kgCO2e/m2.

6.3. It has been highlighted that this result is most likely to increase as further details are added to the design. It is imperative that the CO2 emissions of the building be reviewed again at Stages 3, 4 and 5 to ensure that the GLA's WLCA targets are maintained.

6.4. It must be noted that the materials dataset on which this report is based, has been generated by One Click LCA in partnership with several industry members, such as the BRE and EPD. It is important to note that as with any other simulation it can never completely reflect reality. With the environmental impact of materials, there are variables which are subject to vary such as materials transported to site. The distance travelled to deliver materials to site and the modes of transport used are most likely to be unknown until building materials are being procured prior to Stage 5, and therefore cannot be accurately reflected in the analysis at Stage 2.

6.5. Options to reduce the CO2 emissions of the proposed scheme as far as feasibly as possible have been analysed and presented within this report. It is envisaged that best practice solutions to reduce embodied carbon will be explored by the design team as the project develops throughout Stages 3-5.

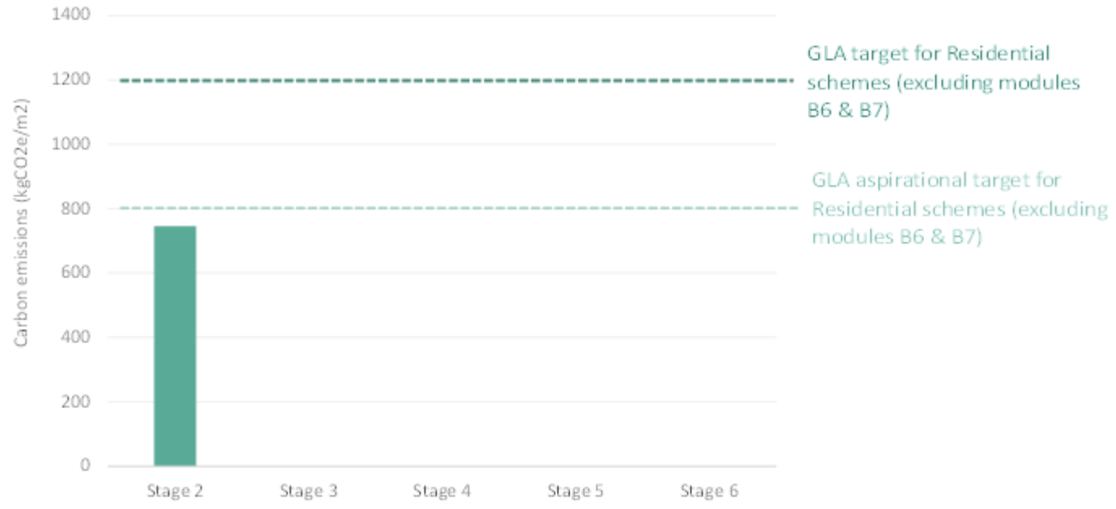


Figure 16: Stage 2 Results (excluding Modules B6 & B7) vs. GLA targets.