

Interim Stage 3 Embodied Carbon Review Alberton House

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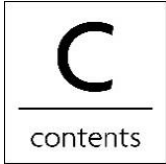
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1. Introduction

Hilson Moran has been commissioned by Bruntwood to undertake a building Life Cycle Assessment (LCA) for the proposed Alberton House development, located on 30 St Mary's Personage in Manchester.

As agreed with Bruntwood and the design team, the final Stage 3 embodied carbon report will be issued following release of Stage 3 cost plan by RLB, expected at the end of May 2022.

The report provides the summary of the embodied carbon results based on the Stage 2 materials information provided by the QS RLB, along with supplementary information provided by the project design team which includes the core relocation but excludes other changes such as those made to levels 17 & 18. This report then builds on those results to provide elemental carbon reduction strategies during Stage 3. this accounts for different materials options and EPD selections and outlines their effect on the overall building embodied carbon emissions. It should be noted that these recommendations look at individual elements in isolation and don't currently consider the cumulative effect of the changes, e.g., the effect of façade choice on the structure.

Note: There have been a number of fundamental changes to the building design, including reconfiguration of the top two floors. The **Stage 3 results** will be issued after Stage 3 is completed, following issue of the Stage 3 cost plan.

1.1. Project Overview

Alberton House is located in central Manchester, close to the River Irwell, adjacent to Cardinal House on St. Mary's Parsonage. The existing building, which consists of two linked wings, will be demolished, and replaced by an entirely new construction. A review of a major refurbishment and extension option was undertaken in Stage 2; however, it was decided the new build option would be taken forward by Bruntwood.

The aim of the project is to provide a high-quality modern office that will be flexible and adaptable for future types of workplaces, with an overall gross internal area of **30,549 m²** (Stage 2 floor area) of office space.

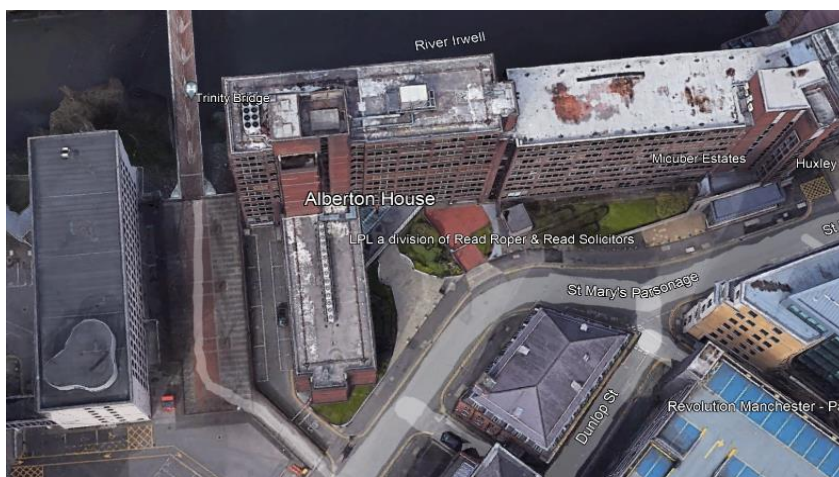


Figure 1 - Satellite view of Alberton House



Figure 2 - New proposed development of Alberton House

The new Alberton House will consist of an 18-storey building with 16 office floors, ground floor F&B space, a basement level containing principal plant, showers, changing rooms and cycle parking. At rooftop level (Level 17 & 18) further plant rooms will be provided alongside swimming pool, spa, and wellbeing suite with a communal terrace.

The office accommodation will have flexibility for three tenancies per floor.

1.1. Scope

The Building Life Cycle Assessment was prepared based on the Stage 2 materials information provided by the QS RLB, along with supplementary information provided by the project design team: EPR, Curtins and HM. There will be a number of differences in the outputs due to design changes made in Stage 3. Therefore, once the Stage 3 information is available, this assessment will be updated to reflect these changes made to the scheme such as façade structure, the rooftop levels 17 & 18, etc.

The embodied carbon assessment was carried out using the eToolLCD and UK LCI v17 database. The reference study period is 60 years, as required by EN15978. The proposed development comprises of demolishing the exiting Alberton House Building and construction of a new Shell and Core Development including:

- 1 Basement Level
- Ground Floor and mezzanine
- 16 upper floor levels
- 2 rooftop levels.

Table 1 - Project Summary.

Date of Assessment	18 TH May 2022
Property Type	Office
Project design life	60 years
Assessment Scope	Shell and Core
Assessment Stage	RIBA Stage 3*
Data Source	eToolLCD and UK LCI V17 database
Client	Bruntwood
Architect	EPR
M&E Consultant	Hilson Moran
Structural Engineer	Curtins
Quantity Surveyor	RLB

* Embodied carbon analysis in this report is not based on Stage 3 cost plan and represent an interim position prior to issue of the final Stage 3 cost plan.

2. Whole Life Embodied Carbon

Whole Life Embodied Carbon is the total greenhouse gas emissions arising from the extraction of raw materials, transport, construction, repair, maintenance, replacement and from the materials end of life. It is reported in terms of CO₂ equivalent (CO_{2e}). This is a metric measure used to compare greenhouse gases on the basis of their varying global warming potential (GWP), by converting amounts of other gases into an equivalent amount of CO₂ (GWP of 1 unit) with the same global warming potential. The emissions from materials are fast becoming the largest Carbon impact in the built environment, and mitigation of the impacts needs to be addressed if we are going to meet the UK Governments ambitious carbon targets and reduce the impacts of climate change.

Please refer to **Appendix A** for a detailed explanation of the Life Cycle Assessment method and an explanation of the different life cycle modules.

This study quantifies the potential life cycle environmental impacts of materials through the use of robust life cycle environmental assessment tools and environmental data. This then allows design decisions to be made to reduce the impacts and lower the overall carbon emissions of the development.

The analysis is in accordance with the RICS Professional Statement “*Whole life carbon assessment for the built environment*” (referred to as the RICS PS for the remainder of this document). The analysis was carried out using eToolLCD UK LCI 17 database (and including use of verified EPDs) over a 60-year lifecycle.

The review is based on the Stage 2 materials information provided by the QS RLB, along with supplementary information provided by the project design team: EPR, Curtins and HM. Once the Stage 3 Cost plan is available, this assessment will be updated to reflect the changes made to the development throughout Stage 3.

2.1. Life Cycle Assessment Scope and Assumptions

This assessment follows the modules outlined within the EN15804, excluding B6 (Operational Energy), B7 (Operational Water) and module D (Beyond end of building life) (see Appendix A).

Table 2 highlights in blue all the building elements to be considered within the scope of the LCA as per the RICS Professional Statement ‘Whole life carbon assessment for the built environment’¹.

In accordance with ISO14040/44 standards, the assumptions and limitations of the LCA have been identified as:

2.1.1. Building life expectancy

The life expectancy of the building has a large impact on the results of the LCA. Buildings with large life spans will have proportionally lower impacts in the construction stages and higher impacts due to operation. Although statistics on building life span are difficult to obtain, the literature that is available leads to the conclusion that redevelopment potential is the largest influence on a building’s service life, rather than the structural integrity. For this study the chosen life span is 60 years.

2.1.2. Carbon Model Inputs

The embodied carbon emissions were estimated based on:

- Generic market average values based on the eToolLCD ‘United Kingdom LCI – V17 – Life Cycle Strategies’ generic construction templates representative of the project’s constructions. Additional construction templates were created in order to account for bespoke design solutions.
- Environmental Product Declarations (EPD) were used for product specific items to provide potential reduction in carbon emissions.
- Self-declaration Embodied carbon data received from manufacturers.

2.1.3. Building Materials

The Stage 2 assessment was carried out following a number of assumptions made by the HM team. These assumptions should be confirmed by the design team following changes made during Stage 3 and updated in the final Stage 3 assessment.

- Building area GIA = 30,549 m²
- Piling reinforcement was assumed at 30 kg/m³.
- External wall insulation was assumed to be 25mm of Expanded Polystyrene (EPS) insulation. The Lowest floor insulation was assumed to be 300mm of polyurethane (PUR).
- All façade quantities for the baseline assessment were based on design information received from RLB in **October 2021**.

¹ RICS Professional Statement, Whole life carbon assessment for the built environment, November 2017, Table 3.

Table 2 - Building element groups considered in scope highlighted in blue.

Building part/Element group		Building element
0	Demolition	0.1. Toxic/Hazardous/Contaminated Material treatment
		0.2. Major Demolition Works
		0.3. & 0.5. Temporary/Enabling Works
1	Facilitating works	0.3. Specialist groundworks
		1.1. Substructure
2	Substructure	2.1. Frames
		2.2. Upper floors incl. balconies
		2.3. Roof
		2.4. Stairs and ramps
	Superstructure	2.5. External Walls
		2.6. Windows and external doors
	Superstructure	2.7. Internal walls and Partitions
		2.8. Internal Doors
3	Finishes	3.1. Wall finishes
		3.2. Floor finishes
		3.3. Ceiling finishes
4	Fittings, furnishings and equipment [FF&E]	4.1. Fittings, furnishings & equipment
		Incl. Building-related and non-building-related
5	Building services/MEP	5.1.-5.14. Services
		Incl. Building-related and non-building-related
6	Prefabricated buildings and buildings units	6.1. Prefabricated buildings and buildings units
7	Work to existing building	7.1. Minor demolition and alteration work
8	External works	8.1. Site preparation works
		8.2. Roads, pats, paving and surfacing
		8.3. Soft landscaping, Planting and irrigation systems
		8.4. Fencing, Railings and Walls
		8.5. External fixtures
		8.6. External drainage
		8.7. External Services
		8.8. Minor building works and ancillary buildings

3. Embodied Carbon Assessment

3.1. Stage 2 Assessment

An embodied carbon assessment was carried out for the proposed development at Stage 2 following the core relocation scheme. The latter identifies a carbon footprint represented by the baseline carbon model, outlined in **Table 3**.

Table 3 - Embodied Carbon over Life Cycle per life cycle stage, excluding operational energy and water use (modules B6, B7). Based on Stage 2 materials information provided by the QS RLB in February 2022.

Modules	Description	Impact TCO ₂ e	Impact KgCO ₂ e/m ² GIA	Percentage %
A1-A3	Production	15,407	504	54%
A4	Transport to Site	2,515	83	9%
A5	Construction	1,657	54	6%
A1-A3, A4 & A5	Practical Completion	19,578	641	69%
B1-B5	Use, Replacement, Maintenance	6,534	214	23%
C1-C4	End of Life, Disposal	2,232	73	8%
Total A1-A5, B1-B5, C1-C4	Whole Life Carbon (Excluding Operational Energy)	28,344	928	100%

- The embodied carbon footprint of the proposed Alberton House development at Practical Completion is **19,578 t CO₂e (641 kg CO₂e/m² GIA)** [EN 15978 system boundary: A1-A3, A4-A5]. This is lower than Bruntwood's target of **800 kg CO₂e/m² GIA**, which is equivalent to the RIBA 2030 target, but is slightly higher than the LETI target of **600 kg CO₂e/m² GIA**. See **Figure 3**.
- The embodied carbon over the lifespan of the building (60 years) is **28,344 t CO₂e (928 kg CO₂e/m² GIA)**. This excludes the operational embodied carbon emissions (EN 15978 system boundary: A1-A3, A4-A5, B1-B5, C1-C4, excluding modules B6 & B7)

The embodied carbon analysis has shown the construction elements with the greatest carbon footprint at Practical Completion are outlined in **Table 4**.

Table 4 - Construction elements with the highest embodied carbon at Practical Completion.

#	Level 1 Group Element	Level 2 Element	Embodied Carbon at Practical Completion	
			tCO ₂ e	kgCO ₂ e/m ² GIA
1	Superstructure	Structural Steel (Beams, Columns, Connections & extra)	7,716	252
2	Internal Finishes	Raised Access Floor	4,354	142
3	Superstructure	Concrete Frame (Beams & Columns)	4,101	134
4	Superstructure	Refrigerant	1,294	42
5	Superstructure	Double Glazed Curtain Wall	1,220	40

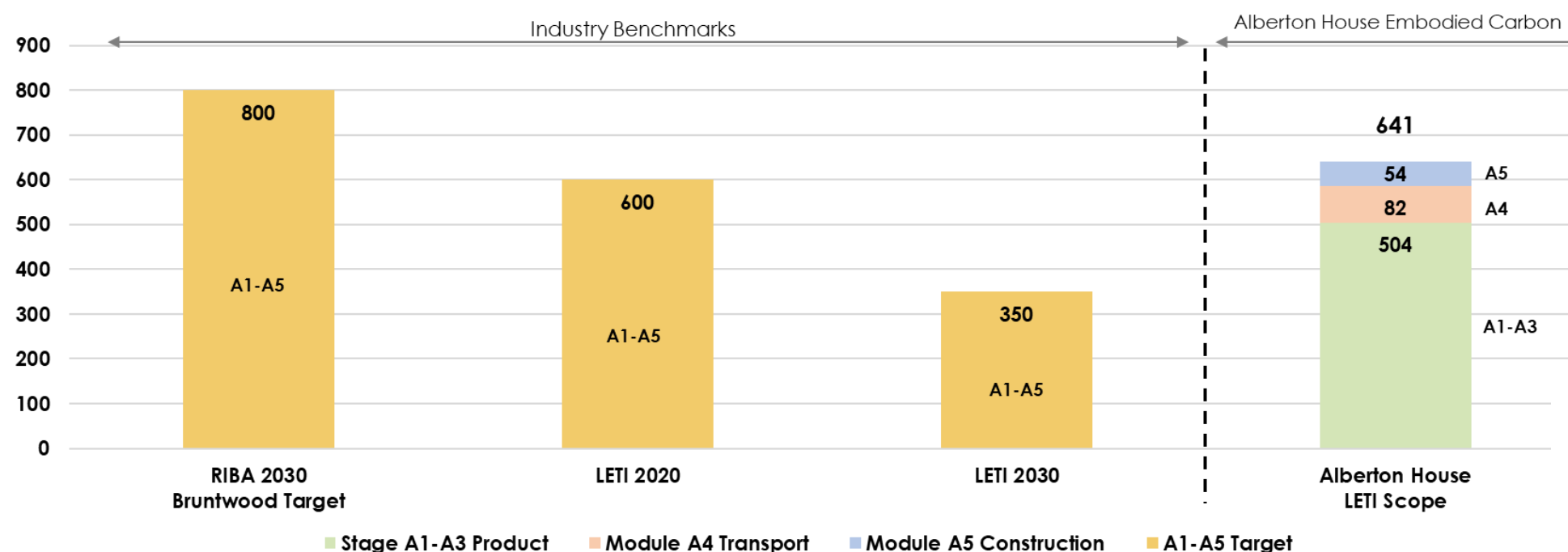


Figure 3 - Embodied carbon impacts at Practical Completion and comparison to Bruntwood targets and industry benchmarks. [EN 15978 system boundary: A1-A3 & A4-A5]

Whole Life Embodied Carbon over Life Cycle (WLC-LC, 60 years)

Total = 28,344 t CO₂e

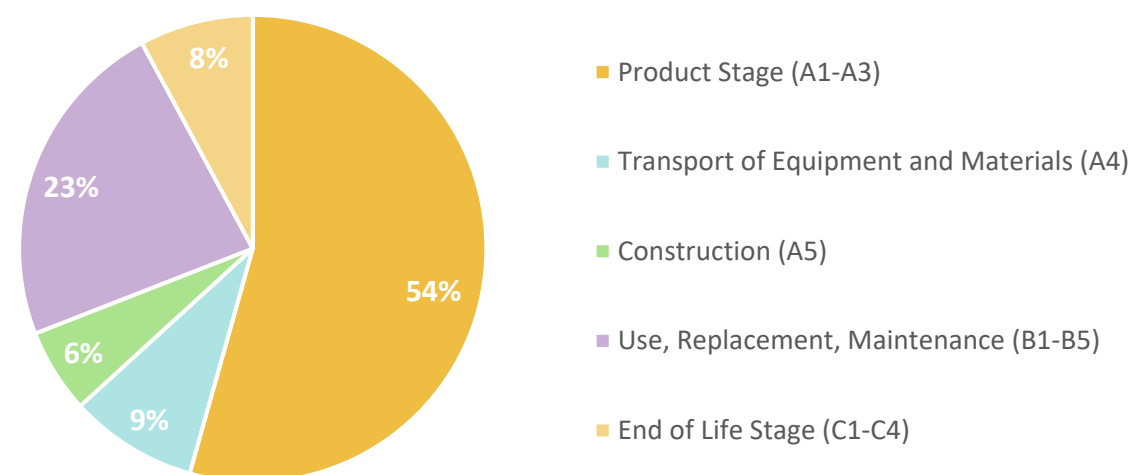


Figure 4 - Embodied Carbon over Life Cycle (EC-LC) per life cycle stages, excluding operational energy and water use (modules B6, B7). [EN 15978 system boundary: A1-A3, A4-A5 & B1-B5, C1-C4].

Embodied Carbon at Practical Completion (EC-PC, A1-A3 & A4-A5)

Total = 19,578 t CO₂e

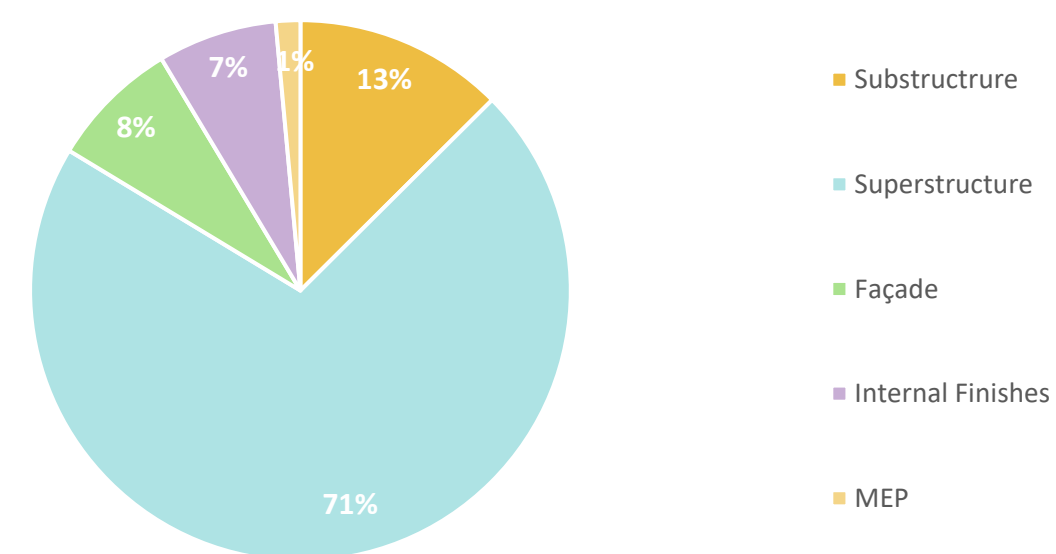


Figure 5 - Breakdown of Embodied Carbon at Practical Completion. [EN 15978 system boundary: A1-A3 & A4-A5]

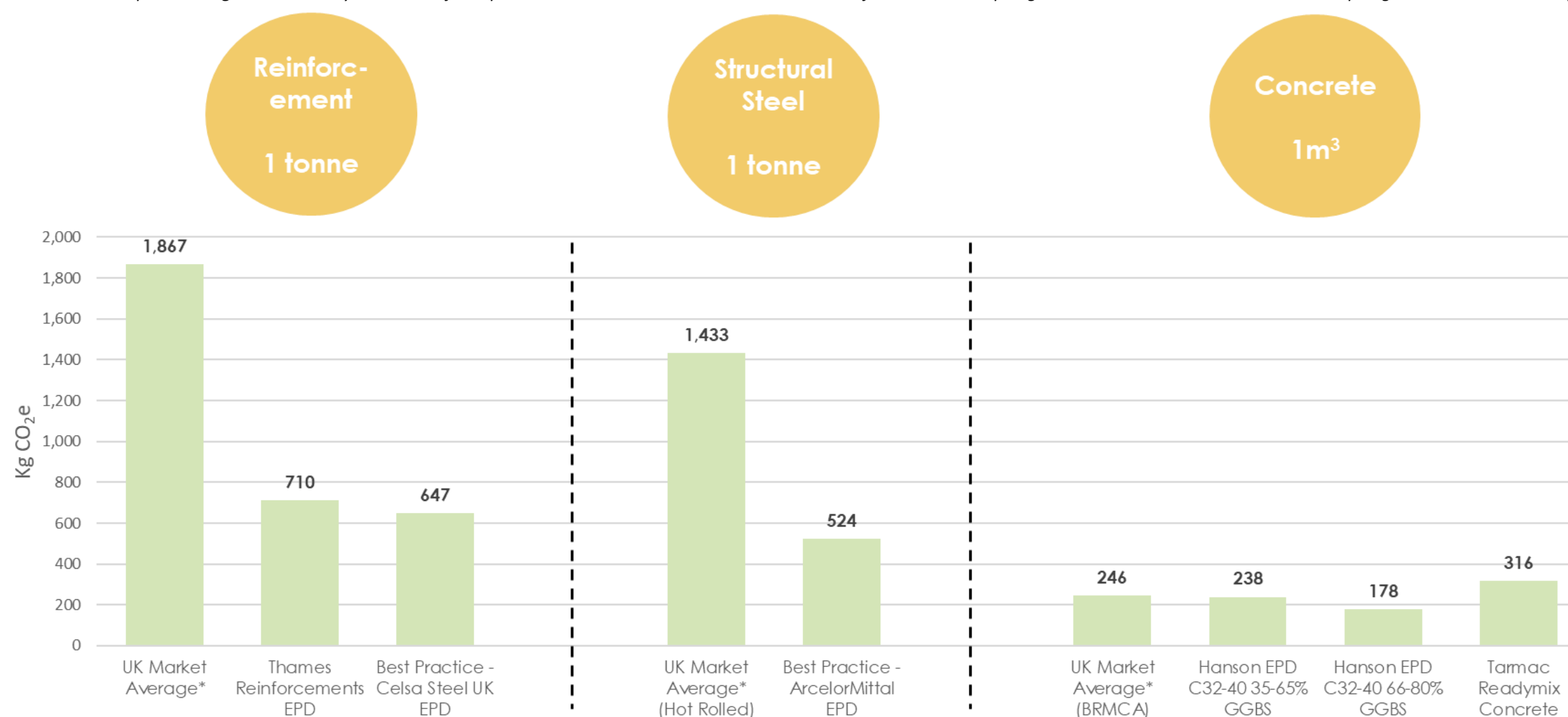
3.2. Recommendations

During Stage 3 the HM team compiled a number of recommendations to reduce the embodied carbon impact of the baseline building design. Different material alternatives were reviewed in terms of embodied carbon impact and cost implications. The following sections outline the materials options made.

3.2.1. Superstructure Recommendations

In terms of superstructure, 3 materials were reviewed: Concrete used in the frame and upper floors, reinforcement for concrete, and structural steel. These options are outlined in **Figure 6**. The impacts in **Figure 6** refer to 1 tonne of reinforcement, 1 tonne of structural steel, and 1 m³ of concrete.

Note: the material options in **Figure 6** were only considered for superstructure elements and were not considered for Substructure piling. This will need to be discussed with the piling sub-consultant once appointed.



*These values are a market average, therefore the actual embodied carbon could either be lower or higher.

Figure 6 - Different material alternatives to be considered for Reinforcement, Structural Steel and Concrete in terms of embodied carbon impact.

3.2.2. Façade Recommendations

An updated whole life embodied carbon assessment was undertaken based on the new Façade structure that was provided by Ramboll, where the baseline façade steel structure was replaced with Precast Concrete. Due to this change in façade structure, the total embodied carbon impacts at Practical Completion [A1-A5] increased slightly to 644 kg CO₂/m² GIA, as shown in **Figure 7**, equating to an increase of **3 kg CO₂/m² GIA**, equivalent to **90 tCO₂e** at Practical Completion. Following this assessment, seeing as the potential to reduce precast concrete impacts were limited, a number of alternative products were reviewed for the façade cladding elements, i.e., Glazed Terracotta Tiles and Brick Slips. These material options based on EPDs are outlined in **Figure 8** and **Figure 9** respectively.

Note: This assessment does now consider any other changes made to the building as a result of this change in façade structure. It is anticipated that the weight of the façade will increase, therefore requiring extra reinforcement.

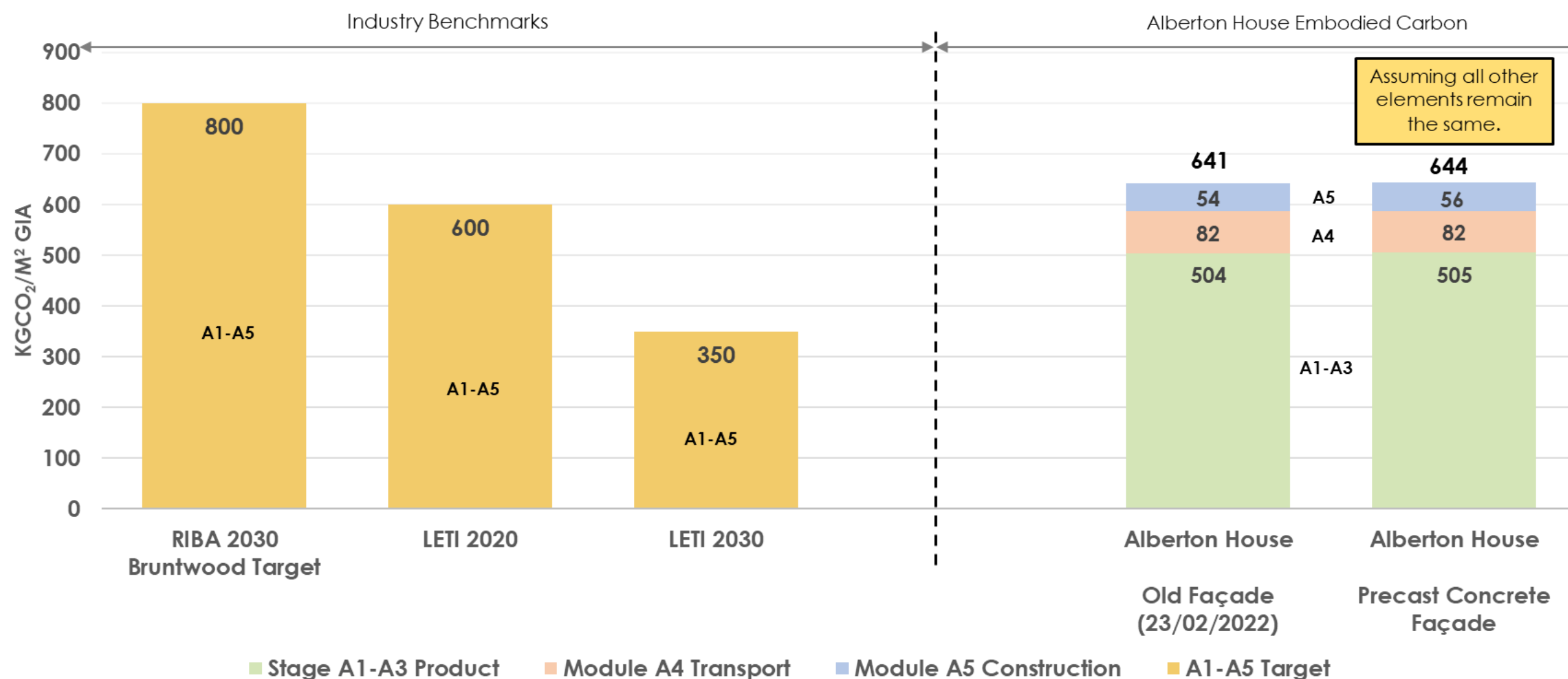


Figure 7 – Updated façade review embodied carbon impacts at Practical Completion based on the new Precast concrete facade structure. This assessment does now consider any other changes made to the building as a result of this change in façade structure.

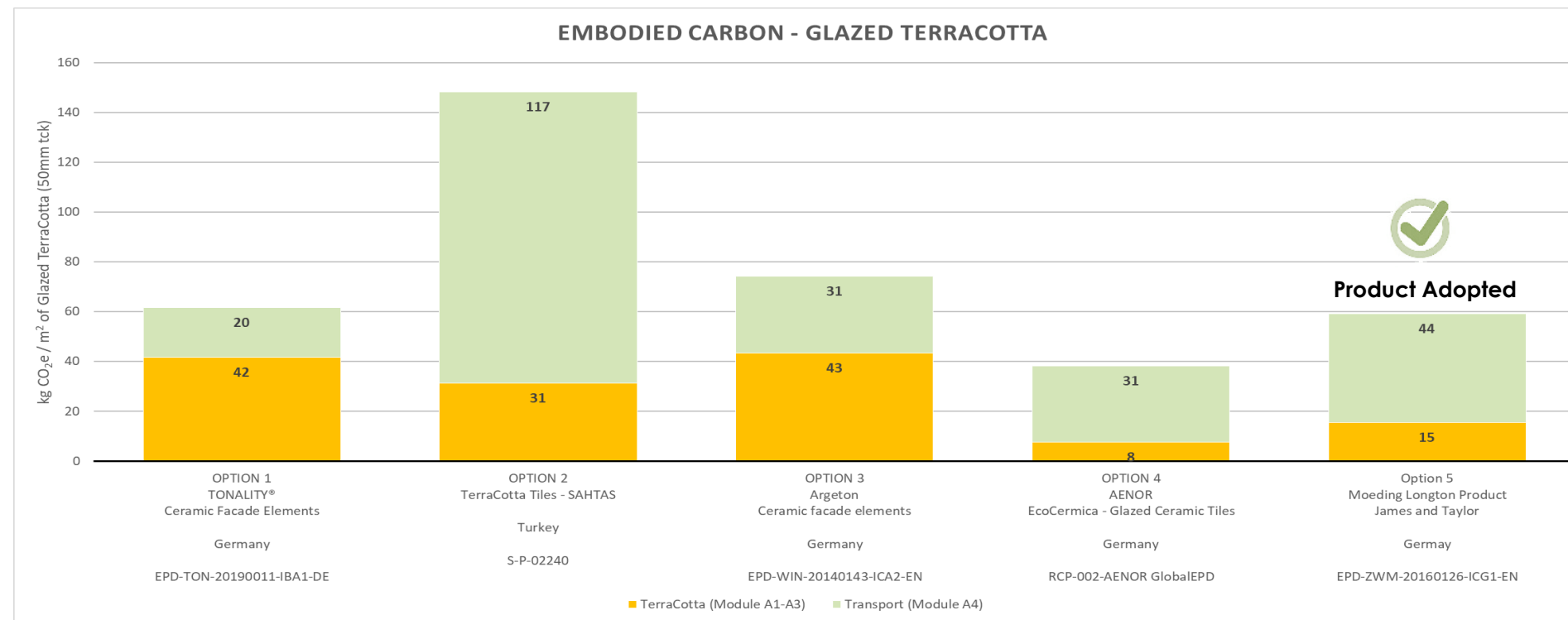


Figure 8 - Material options for glazed terracotta tiles.

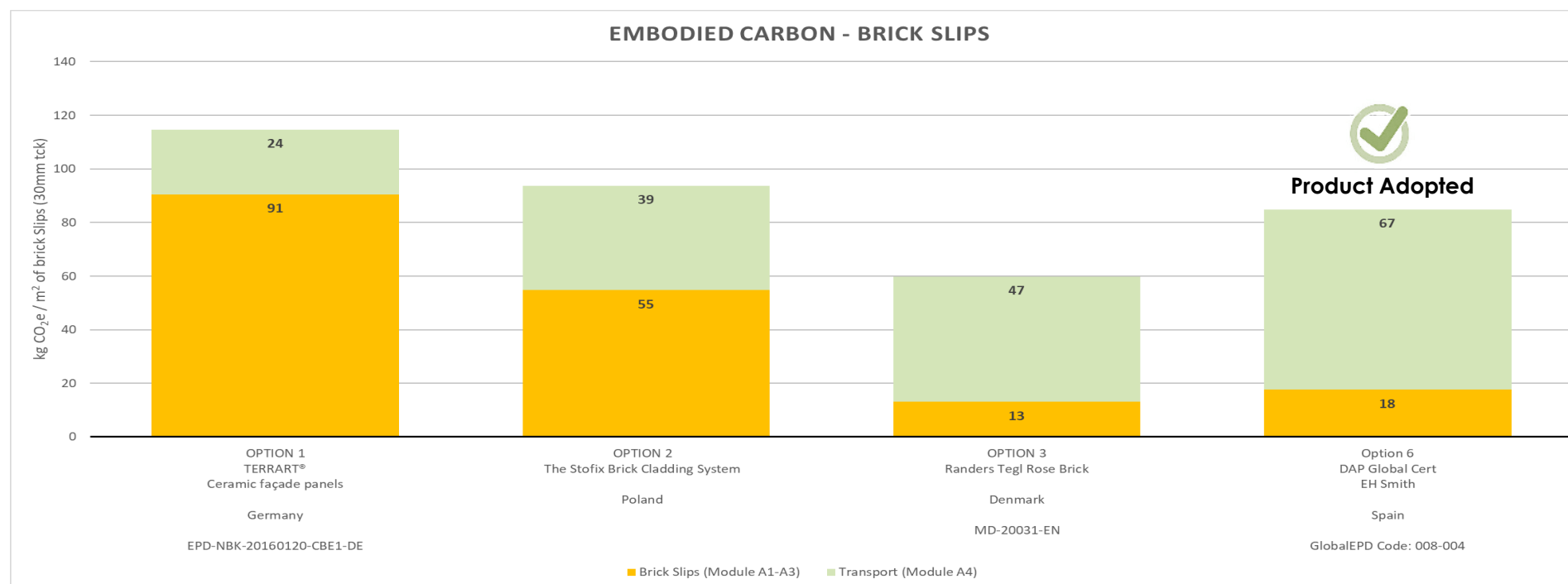


Figure 9 - Material options for Brick Slips.

3.2.3. Screed Recommendations

In order to understand the embodied carbon impacts related to screed, 3 screed options were considered and compared to generic market averages. These options were also compared in terms of costing. These options were based on assumptions outlined below:

- Screed Thickness = 40mm
- Flowcrete density = 800 kg/m²
- Topflow screed density = 2100 kg/m²

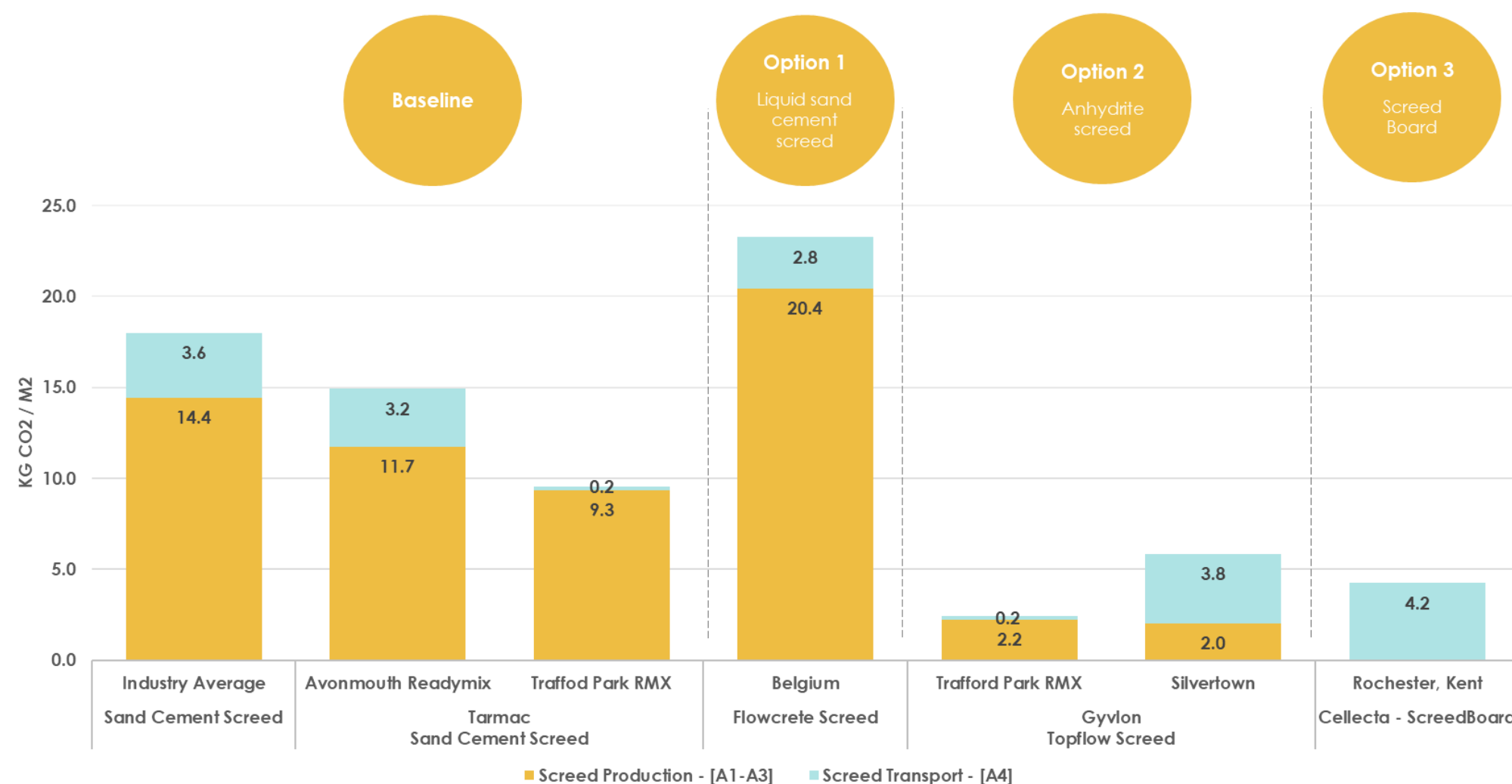


Figure 10 - Different screed options provided for the scheme based on EPDs and self-declared embodied carbon data provided by manufacturers

Despite having the highest impact, option 1: Flowcrete Screed will be adopted for Stage 3 based on SRM's preference, but the other options will still be considered for their lower embodied carbon impacts at later stages. The screed impacts will be updated in the Stage 3 final embodied carbon assessment once the Cost Plan is provided to the HM team.

4. Conclusion

The report provides the summary of the embodied carbon results based on the **Stage 2 materials information provided by the QS RLB, along with supplementary information provided by the project design team** which includes the core relocation but excludes other changes such as those made to levels 17 & 18. This report then builds on those results to provide elemental carbon reduction strategies during Stage 3. this accounts for different materials options and EPD selections and outlines their effect on the overall building embodied carbon emissions. It should be noted that these recommendations look at individual elements in isolation and don't currently consider the cumulative effect of the changes, e.g., the effect of façade choice on the structure.

As agreed with Bruntwood and the design team, the final Stage 3 embodied carbon report will be issued following release of Stage 3 cost plan by RLB, expected at the end of May 2022.

The baseline embodied carbon assessment resulting in an impact of **19,578 t CO₂e (641 kg CO₂e/m² GIA)** will be updated once the final Stage 3 cost plan is provided.

Based on the Bruntwood offset cost the current impact would be **£1,419,458** worth in offset to declare Net Zero in Construction. This is based on an offset cost of £72.5 per tonne of CO₂ (mid-range between £60-£85 as provided by Bruntwood).

Note: this figure assumes none of the carbon effective recommendations provided by HM are implemented and is based on the Stage 2 baseline carbon assessment. After these recommendations are implemented into the design, the total embodied carbon is bound to go down.

4.1. Stage 2 assessment

An embodied carbon assessment was carried out for the proposed development at Stage 2 following the core relocation scheme. The latter identifies a carbon footprint represented by the baseline carbon model, outlined in **Table 5**.

Table 5 – Baseline Embodied Carbon over Life Cycle per life cycle stage, excluding operational energy and water use (B6, B7).

Modules	Description	Impact tCO ₂ e	Impact Kg CO ₂ e/m ² GIA	Percentage %
A1-A3	Production	15,407	504	54%
A4	Transport to Site	2,515	83	9%
A5	Construction	1,657	54	6%
A1-A3, A4 & A5	Practical Completion	19,578	641	69%
B1-B5	Use, Replacement, Maintenance	6,534	214	23%
C1-C4	End of Life, Disposal	2,232	73	8%
Total A1-A5, B1-B5, C1-C4	Whole Life Carbon (Excluding Operational Energy)	28,344	928	100%

- The embodied carbon footprint of the proposed Alberton House development at Practical Completion is **19,578 t CO₂e (641 kg CO₂e/m² GIA)** [EN 15978 system boundary: A1-A3, A4-A5]. This is lower than Bruntwood's target of **800 kg CO₂e/m² GIA**, which is equivalent to the RIBA 2030 target, but is slightly higher than the LETI target of **600 kg CO₂e/m² GIA**.
- The embodied carbon over the lifespan of the building (60 years) is **28,344 t CO₂e (928 kg CO₂e/m² GIA)**. This excludes the operational embodied carbon emissions (EN 15978 system boundary: A1-A3, A4-A5, B1-B5, C1-C4, excluding modules B6 & B7).

At practical Completion, the embodied carbon impacts are separated as shown in **Figure 12**, with superstructure being responsible for 71% of the total embodied carbon impacts.

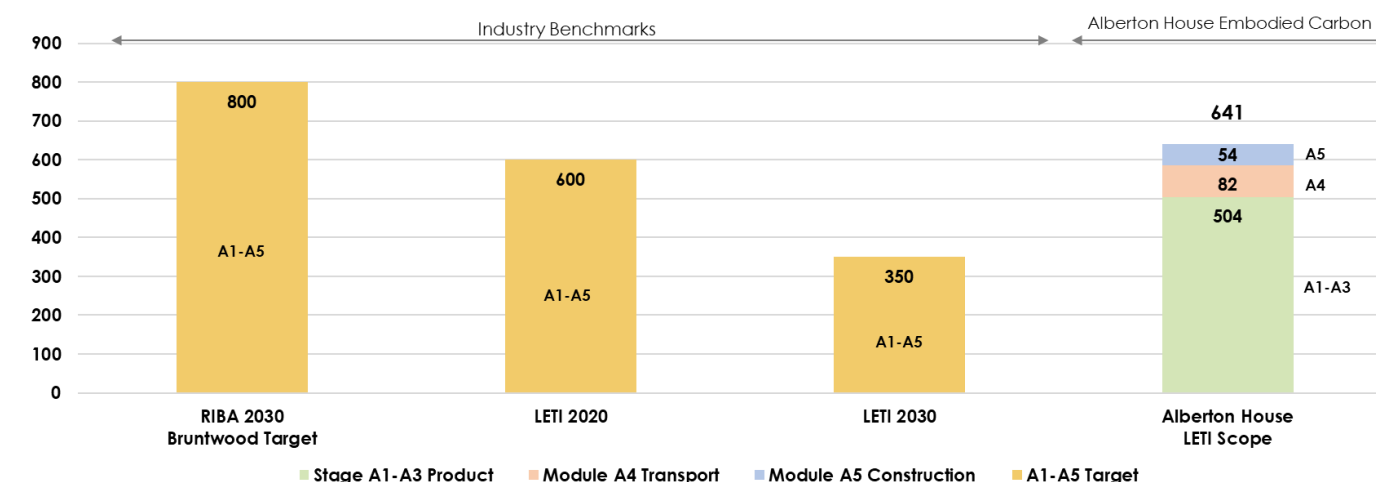


Figure 11 - Embodied carbon impacts at Practical Completion and comparison to Bruntwood targets and industry benchmarks. [EN 15978 system boundary: A1-A3 & A4-A5].

Embodied Carbon at Practical Completion (EC-PC, A1-A3 & A4-A5)
Total = 19,578 t CO₂e

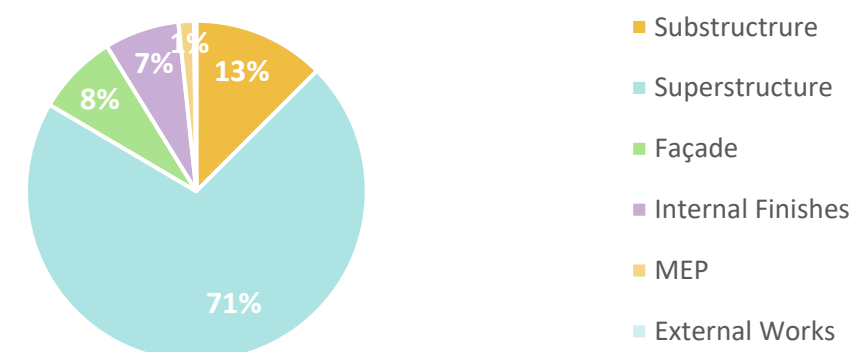


Figure 12 - Breakdown of Embodied Carbon at Practical Completion. [A1-A3 & A4-A5]

4.2. Recommendations

A series of recommendations and materials optioneering have been considered for each of the high impact elements of the development. These recommendations focus on:

- Concrete in superstructure.
- Reinforcement in Superstructure.
- Structural Steel
- Façade Cladding – Glazed terracotta and Brick Slips
- Screed.

4.3. Next steps:

The materials options and recommendations previously outlined will be taken into consideration by the design team, and the final decisions will be incorporated into the Final Stage 3 Embodied Carbon assessment to understand the impacts these changes have. The Final Stage 3 assessment will follow this report once the final Stage 3 cost plan is provided to the HM team.

It should be noted that at a high level, Hilson Moran believe the new roof design will have a negative impact on the carbon performance of the building, mainly due to the structural changes. It is therefore important that the design team incorporate the lower carbon recommendations provided by the Hilson Moran team in order to mitigate these changes.

It should also be noted that the procurement stage will now be critical to carbon performance. Bruntwood therefore need to ensure the team incorporate recommendations to reduce their carbon impact and ensure that contracts are in place for both carbon performance and material quantity data (and associated information) to enable as built analysis to be undertaken. It is recommended these requirements are added to employer's requirements, specifications and Principal Contractor preliminaries.

Appendix A - Life Cycle Assessment Method

An LCA study provides quantified environmental information to assess the environmental performance of a building over its life. In this study, the CO₂eq relates to the development and is based on a **60-year** reporting period.

According to EN 15804:20128 all greenhouse gases that cause damage to the atmosphere (including carbon dioxide, methane, nitrous oxide etc.) can be expressed as a carbon dioxide equivalent (CO₂eq) over 100 years. This environmental impact indicator is known as the Global Warming Potential (GWP). In a whole life cycle assessment of a building the CO₂eq include all these emission sources associated with the construction and the use of the building over its life.

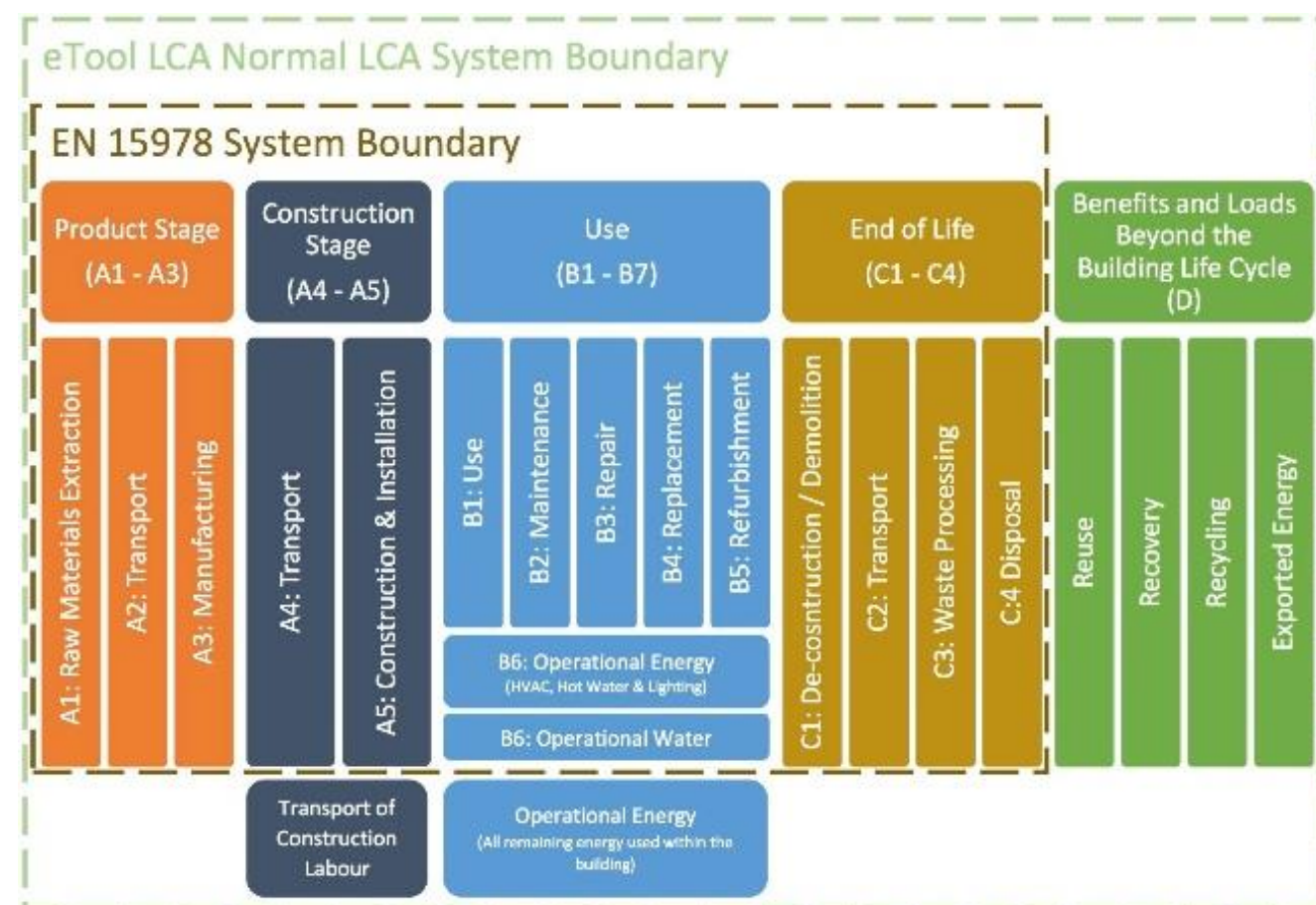


Figure 13 - Life Cycle stages (EN 15978) illustrating the stages within the embodied carbon assessment scope.

Emissions are attributed to four main categories as specified in EN 15978:2011⁹. The categories are:

1. Construction process stages (A1 - A5)

- Product Manufacture (A1 - A3)**
Carbon emissions generated from extracting the raw materials from the ground, their transport to a point of manufacture and then the primary energy used (and the associated carbon impacts that arise) from transforming the raw materials into construction products.
- Construction (A4 - A5)**
Carbon emissions generated from transporting the construction products to site, and their subsequent processing and assembly into the building.

2. In Use stage (B1 - B7)

This covers a wide range of sources from the carbon emissions associated with the operation of the building.

B1-B5 covers a range of estimated emissions from maintenance, repair, and replacement over a 60-year assessment period.

B6 referring to operational energy, refers to heating, domestic hot water, cooling, ventilation, lighting, auxiliary energy used for pumps, control, and automation.

B7 covers estimated carbon from operational water use.

3. End of Life stage (C1 – C4)

The eventual deconstruction and disposal of the existing building at the end of its life takes account of the on-site activities of the deconstruction contractors.