Land South of Dearne Valley Parkway

Whole Lifecycle Carbon Assessment

On behalf of **Equites Newlands (Goldthorpe) Ltd**

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For and on behalf of Stantec UK Limited			

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1.1 Introduction

1.1.1 Stantec have been instructed by Equites Newlands (Goldthorpe) Ltd (the 'Applicant') to prepare Whole Lifecycle Carbon (WLC) Assessment in support of a hybrid planning application for development on land south of Dearne Valley Parkway (the 'Development').

1.1.2 The planning application is made for:

> ***"Outline permission sought for the construction of Storage and Distribution (Use Class B8) and General Employment (Use Class B2) space with ancillary offices and gatehouses on four separate, self-contained and severable plots as shown on the submitted Parameters Plan. All matters reserved except for site access. Full permission sought for engineering infrastructure works to support the employment development comprising: the access roads; earthworks to create the development platform zones/bunding; drainage and culvert works; a flood compensation area; and strategic landscaping areas."***

1.1.3 The Site is located within the administrative area of Barnsley Metropolitan Borough Council (BMBC) and extends to 85.31 hectares (ha).

1.1.4 This assessment has been carried out to inform the Climate Change chapter of the Environmental Statement to determine the likely effects of the Development on the environment with respect to Climate Change.

1.2 Background to Whole Lifecycle Carbon emissions

1.2.1 It is widely recognised that global climate change is one of the most pressing challenges facing the UK and internationally. The Green Building Council reports that buildings are currently responsible for 39% of global carbon emissions[1]. These emissions are caused by the operation of the building but also by the construction, maintenance, and demolition of buildings. Embodied carbon can be defined as the carbon emissions emitted producing a building's materials, their transport and installation on site as well as their disposal at end of life, and currently contributes 11% of all global carbon emissions.

1.2.2 The UK Government has set a Net Zero Strategy[2] which will lead to a reduction in the carbon emissions of new developments to Net Zero by 2050 in line with the Climate Change Act (2008)[3]. The UK Net Zero Strategy commits to the delivery of new zero carbon building standards by 2050 which will require the reduction and offset of embodied carbon emissions.

1.2.3 Powering Up Britain[4] published in 2023 sets out how the Department for Energy Security and Net Zero aims to improve the UK's energy security, maximise economic opportunities of the net zero transition and reach net zero by 2050, this includes the aims of doubling Britain's electricity generation capacity by the late 2030s and fully decarbonising the power sector by 2035.

1.2.4 Despite the significant contribution that the embodied carbon of buildings makes to the UK's carbon emissions and global climate change, there is currently no national regulation of embodied carbon emissions, and reductions on new build developments are only legislated by planning policy.

[1] Green Building Council, Bringing Embodied Carbon Upfront - https://www.worldgbc.org/embodied-carbon
[2] Department for Business, Energy and Industrial Strategy. 2022. Build Back Greener: Net Zero Strategy - https://www.gov.uk/government/publications/net-zero-strategy
[3] Climate Change Act 2008. As Amended 2019 - https://www.legislation.gov.uk/ukpga/2008/27/contents
[4] https://www.gov.uk/government/publications/powering-up-britain

1.3 Conclusion

1.3.1 The WLC assessment for the Development has been carried out using methodology set out in European standard EN 15978[5] and the RICS professional statement 'Whole Life Carbon Assessment for the Built Environment'[6]. Table 1 below shows the CO_2 emissions associated with each module of the Development's life cycle.

Table 1: Equivalent CO_2 emissions associated with the development's life cycle modules

Stage	Baseline	Improved Design
Modules A1-A3. Product stage	19,712,498	16,874,323
Modules A4-A5. Construction process stage	3,578,117	3,399,338
Modules B1-B7. Use stage	20,155,541*	17,521,063*
Modules C1-C4. End of life stage	3,558,154	2,708,415

*Includes Module B6 (Unregulated Energy) in which a worst-case scenario is derived.

[5] BS EN 15978:2011 Sustainability of construction works. Assessment of environmental performance of buildings. Link: https://knowledge.bsigroup.com/products/sustainability-of-construction-works-assessment-of-environmental-performance-of-buildings-calculation-method/standard

[6] https://www.rics.org/profession-standards/rics-standards-and-guidance/sector-standards/building-surveying-standards/whole-life-carbon-assessment-for-the-built-environment

2 Introduction

2.1 Overview

2.1.1 Stantec have been instructed by Equites Newlands (Goldthorpe) Ltd (the 'Applicant') to prepare Whole Lifecycle Carbon (WLC) Assessment in support of a hybrid planning application for development on land south of Dearne Valley Parkway (the 'Development').

2.2 Site and surroundings

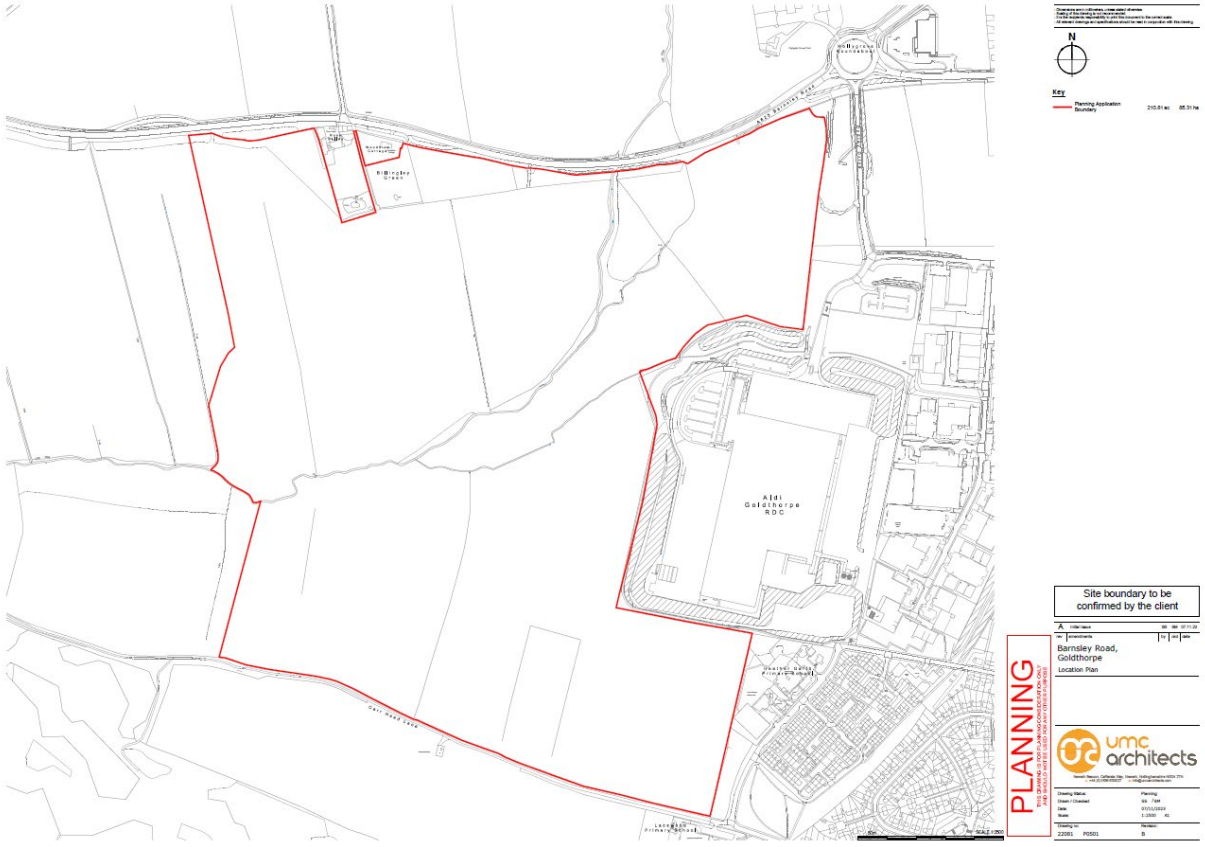
2.2.1 The Site is located within the administrative area of Barnsley Metropolitan Borough Council (BMBC) and extends to 85.31 hectares (ha).

2.2.2 The Site is located to the south of Dearne Valley Parkway and is located to the north west of Bolton upon Dearne: a village located between Barnsley (9.5km to the west of the site) and Doncaster (12.5km to the east) in South Yorkshire, within the administrative boundary of BMBC.

2.2.3 The north of the Site is bound by the A635 Dearne Valley Parkway (along which lies a residential dwelling, external to the Site boundary) and the south of the Site is bound by Carr Head Lane. To the east the Site is bound by the ALDI Goldthorpe Distribution Centre, with Goldthorpe Industrial Estate beyond; and to the west, the Site is bound by open fields. Dearne Community Children's Centre and residential development of Bolton upon Dearne are situated to the southeast. To the south, the Site borders Green Belt, beyond which lies the Royal Society for the Protection of Birds (RSPB) Dearne Valley Old Moor and Bolton Ings Reserves site.

2.2.4 The Site Location Plan is shown in Figure 1.

Figure 1 - Site Location Plan



2.3 The Development

2.3.1 The planning application is made for:

> ***"Outline permission sought for the construction of Storage and Distribution (Use Class B8) and General Employment (Use Class B2) space with ancillary offices and gatehouses on four separate, self-contained and severable plots as shown on the submitted Parameters Plan. All matters reserved except for site access. Full permission sought for engineering infrastructure works to support the employment development comprising: the access roads; earthworks to create the development platform zones/bunding; drainage and culvert works; a flood compensation area; and strategic landscaping areas."***

2.3.2 The Development will provide up to 4 industrial units totalling 204,000m^2.

2.3.3 The parameter plan is shown in Figure 2 below.

Figure 2 - Parameter Plan

2.4 Purpose of Report

2.4.1 Whole lifecycle carbon emissions relate to the carbon emissions associated with a building over its entire lifetime arising from materials, its construction, and its use. Traditionally only the carbon emissions associated with a building's operation have been assessed and regulated.

2.4.2 The RICS whole life carbon assessment for the built environment document November 2017 states that:

> ***"A whole life carbon approach identifies the overall best combined opportunities for reducing lifetime emissions, and also helps to avoid any unintended consequences of focusing on operational emissions alone. For example, the embodied carbon burden of installing triple glazing rather than double can be greater than the operational benefit resulting from the additional pane. Therefore, whole life carbon needs to be effectively integrated into the sustainability agenda in order to achieve a lower carbon future."***

2.4.3 This WLC assessment has been carried out to inform the Climate Change chapter of the Environmental Statement to determine the likely effects of the Development on the environment with respect to Climate Change.

2.4.4 The key objective of an WLC assessment is to determine the equivalent CO_2 emissions associated with a building's life cycle and is expressed within life cycle modules as defined in BS EN 15987 and the Royal Institute of Chartered Surveyors Professional Statement 'Whole Life Carbon Assessment for the Built Environment' and as set out below:

- Modules A1-A3. Product stage;
- Modules A4-A5. Construction process stage;
- Modules B1-B7. Use stage;
- Modules C1-C4. End of life stage; and
- Module D. Beyond the project life cycle.

2.4.5 The results of a WLC assessment are presented as GHG emissions per unit of the Development's gross internal area (GIA) (kg CO_2e/m^2 GIA) and can be compared to benchmarked figures derived from industry guidance and other projects.

3 Planning Policy Context

3.1 Planning Policy Context

3.1.1 The planning policy relevant to the Development is summarised below.

- National Planning Policy Framework (NPPF) 2023:
  - Paragraph 153 states *"Plans should take a proactive approach to mitigating and adapting to climate change, taking into account the long-term implications for flood risk, coastal change, water supply, biodiversity and landscapes, and the risk of overheating from rising temperatures. Policies should support appropriate measures to ensure the future resilience of communities and infrastructure to climate change impacts, such as providing space for physical protection measures, or making provision for the possible future relocation of vulnerable development and infrastructure."*

- Barnsley Local Plan (BLP) 2019:
  - Policy CC1 seeks to reduce the causes of and adapt to the future impacts of climate change by "Promoting the reduction of greenhouse gas emissions through sustainable design and construction techniques"; and
  - Policy CC2 states "Development will be expected to minimise resource and energy consumption through the inclusion of sustainable design and construction features, where this is technically feasible and viable."

- Barnsley Sustainable Construction and Climate Change Adaptation Supplementary Planning Document (SPD) adopted July 2023:
  - Paragraph 4.1 states "A whole life carbon assessment will be required for all major developments (10 dwellings or above and 1000m2 or above for commercial developments or change of developments)…
  - The whole life carbon assessment will be expected to follow the model set out in the RICS professional statement 'Whole Life Carbon Assessment for the Built Environment, 2017", or, if applicable, the latest subsequent version of this document or other recognised document setting out best practice for whole life carbon assessment."

4 Methodology

4.1 Approach

4.1.1 WLC emissions are the carbon emissions resulting from the associated materials, construction and the use of a building over its entire life, including its demolition and disposal. A WLC assessment provides a holistic overview of a building's carbon impact on the environment.

4.1.2 This WLC assessment has been prepared in accordance with BS EN 15978 and the Royal Institute of Chartered Surveyors Professional Statement 'Whole Life Carbon Assessment for the Built Environment' (1st edition, November 2017) to determine the environmental assessment across the whole project lifecycle.

4.1.3 The WLC assessment includes measures to reduce demand-side energy requirements for the Development. In order to measure the level at which these demand-reduction measures are effective, a baseline energy demand has been calculated.

4.1.4 The WLC calculations have been derived using the carbon designer tool in the OneClick LCA tool. The carbon designer tool allows a baseline building creation with minimal information about the design and allows for optioneering choices that allow their impacts to be easily compared. The results in Section 5 of this report outline the baseline analysis results and then shows a comparison option indicating how carbon emissions across the lifecycle (shown in Figure 3 below) can be reduced with design options available.

4.1.5 The baseline calculations used the GIA Areas from the warehouse and office in Plot 3 of the Development, shown in Figure 2. Plot 3 was chosen to provide a representative example for the WLC emissions from the Development. It should be noted that the warehousing as part of the Development is currently in outline and therefore Plot 3 shown on Figure 2 is indicative. The exact specifications of the warehouses will be detailed through the Reserved Matters stage.

4.2 Calculations

4.2.1 The calculation methodology is outlined below.

- Geometry
  - Based on drawings provided by the architect, UMC Architects
- Calculation methodology
  - BS EN 15978:2011
  - RICS Professional Statement 'Whole Life Carbon Assessment for the Built Environment' 2017
- Software
  - OneClick LCA
  - Carbon Designer 3D

4.2.2 Figure 3 below shows how BS EN 15978 categorises the Whole Lifecycle Carbon emissions of a building into life cycle modules A to D. The descriptions of these modules are summarised as:

- **Product (module A1 – A3) and construction stages (module A4 – A5):** The product stage includes the carbon emissions arising during the extraction of raw materials from the earth, transportation to manufacturing facility/facilities and the energy used for manufacturing into

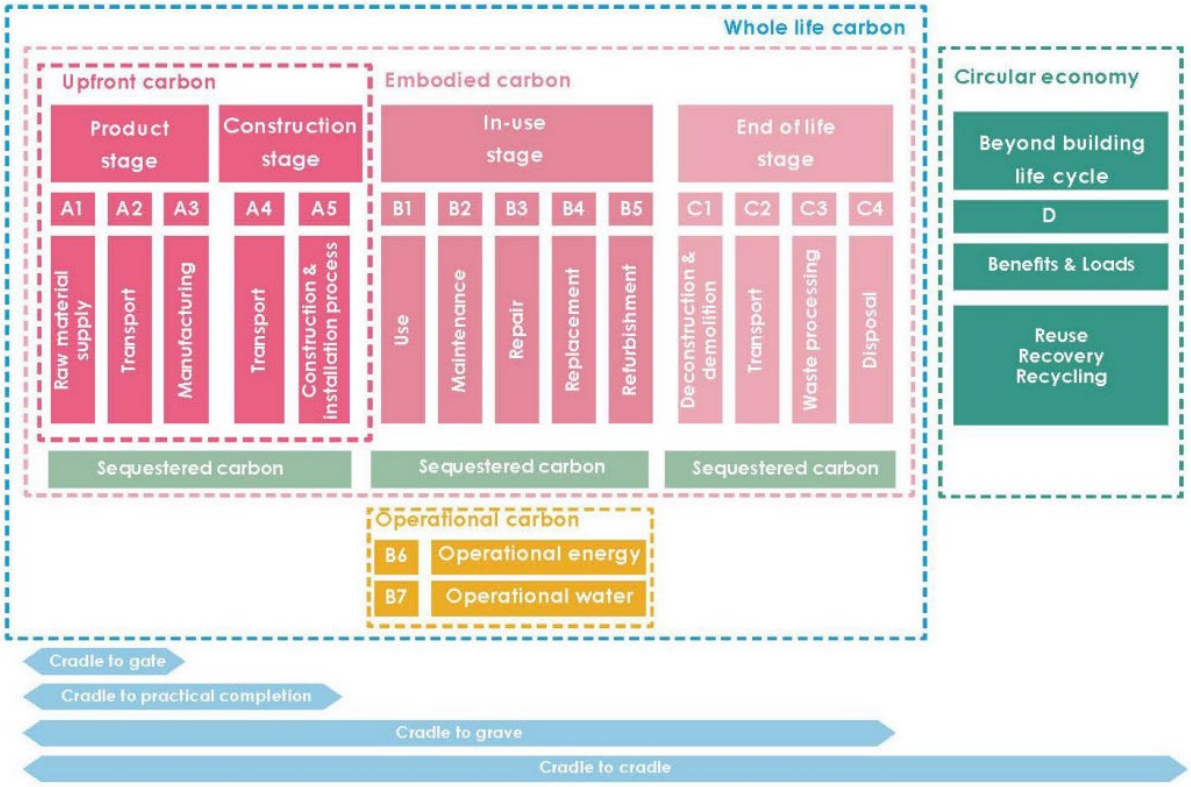
construction materials. The transportation to site, and construction of the materials into buildings make up the construction stage;

- **In-Use Stages (module B1 – B5):** Quantifies emissions arising from the operational water and energy usage and the embodied carbon associated with any maintenance, repair, replacement and refurbishment required;

- **End of Life Stages (module C1 – C5):** This covers the deconstruction and/or demolition of the building, accounting for the on-site activity of the demolition contractors and the transportation to waste processing before eventual disposal; and

- **Beyond building lifecycle (module D):** Encompasses any carbon costs or benefits achieved through any reuse, recycling or recovery potential.

Figure 3 - WLC modules as defined by BS EN 15978:2011 and interpreted by LETI



4.2.3 The WLC emissions for this Development have been calculated using OneClick LCA software (an industry standard tool) by providing an inventory of building material types and quantity and augmenting it with a database of quantified environmental impacts of these materials. The environmental impact of each material is taken from standard reference data for each material or manufacturer's certified declarations for their products. The inventory of material types and quantities has been estimated based on the building's design drawings and specification.

4.2.4 The purpose of the calculations within this assessment is to provide an indication of the carbon impact of the proposed buildings. The assessment of embodied carbon conducted in OneClick software cannot be exact as it is not feasible to track all the impacts and costs associated with a product or service back through history to complete accuracy.

4.2.5 The embodied carbon calculated through OneClick software includes the impact of all greenhouse gas emissions, including carbon dioxide (CO_2), nitrogen oxide (NO_2), and methane (CH_4). This indicator of environmental impact is measured as the Global Warming Potential (GWP) and is expressed in the total equivalent carbon dioxide emissions released, with units of kg CO_2e.

5 Results

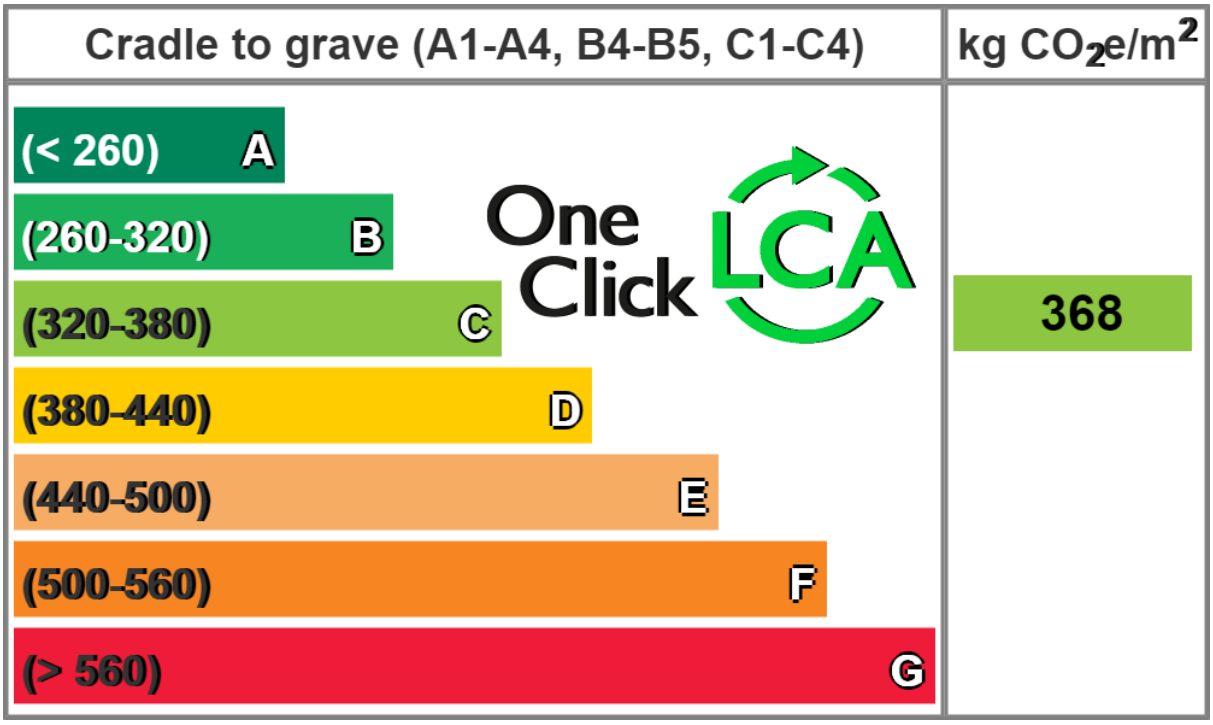
5.1.1 Based on the drawings provided, and the materials register shown in Appendix A, the total predicted WLC of the Development is a GWP of 30,518,638 kg CO_2e[7], equivalent to 438 kg CO_2e per m^2 floor space.

5.1.2 The CO_2e per m^2 floor space value provided above differs slightly from that shown in Figure 4 below. This is because the value above accounts for GHG emissions from more lifecycle modules than is provided in Figure 4 below.

5.1.3 Of this total GWP, 23,290,615 kg CO_2e is associated with the material manufacturing, transportation, and construction processes. A further 2,022,546 kg CO_2e of emissions is associated with the demolition and waste processing of the demolition materials at the building's end of life, and 5,447,886 kg CO_2e of emissions is associated with the Development's operation including energy demand, water consumption and maintenance.

5.1.4 When compared to available embodied carbon benchmarks, the Development achieves a C rating, as shown in Figure 4. This is based on similar building types within the UK.

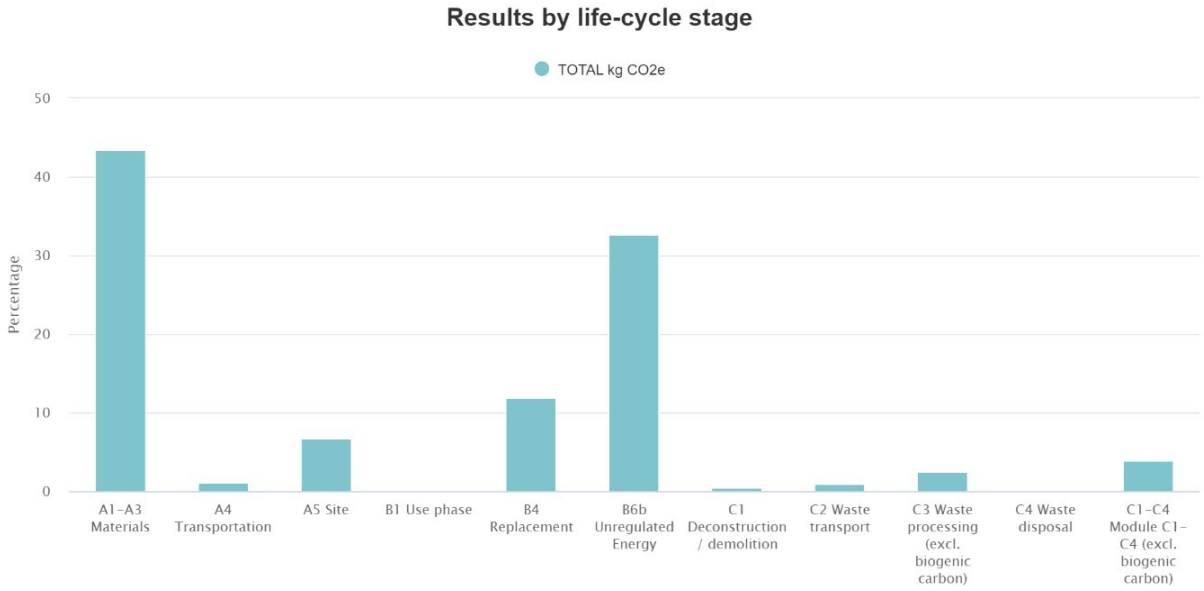
Figure 4 - Comparison with UK embodied carbon benchmarks of similar buildings



5.1.5 As typical with industrial buildings, the highest contributor to the WLC of the Development is the carbon intensity of the construction materials themselves (module A1-A3) with the remaining life cycle stages (modules A4-A5, B1-B5, and C1-C4) contributing less than 25% of total GWP as shown in Figure 5.

[7] This total figure does not include unregulated energy which has been calculated in the OneClick LCA model. Accurate unregulated energy emissions will be calculated at the detailed design stage.

Figure 5 - Proportion of GWP by life-cycle stage module



5.1.6 It should be noted that Figure 5 above includes GHG emissions for unregulated energy, in order to assume a worst-case unregulated energy scenario which includes the uses such as cooling and energy usage that is not accounted for in building regulations.

5.1.7 The actual unregulated energy emissions are anticipated to be lower and will be calculated accurately at the detailed design stage.

5.1.8 The highest proportion of embodied carbon (with the exception of unregulated energy) is associated with the lowest floor construction, accounting for approximately 35.38% of total GWP as shown in Figures 6 and 7. This is due to the high carbon intensity of concrete.

Figure 6 - GWP by RICS category

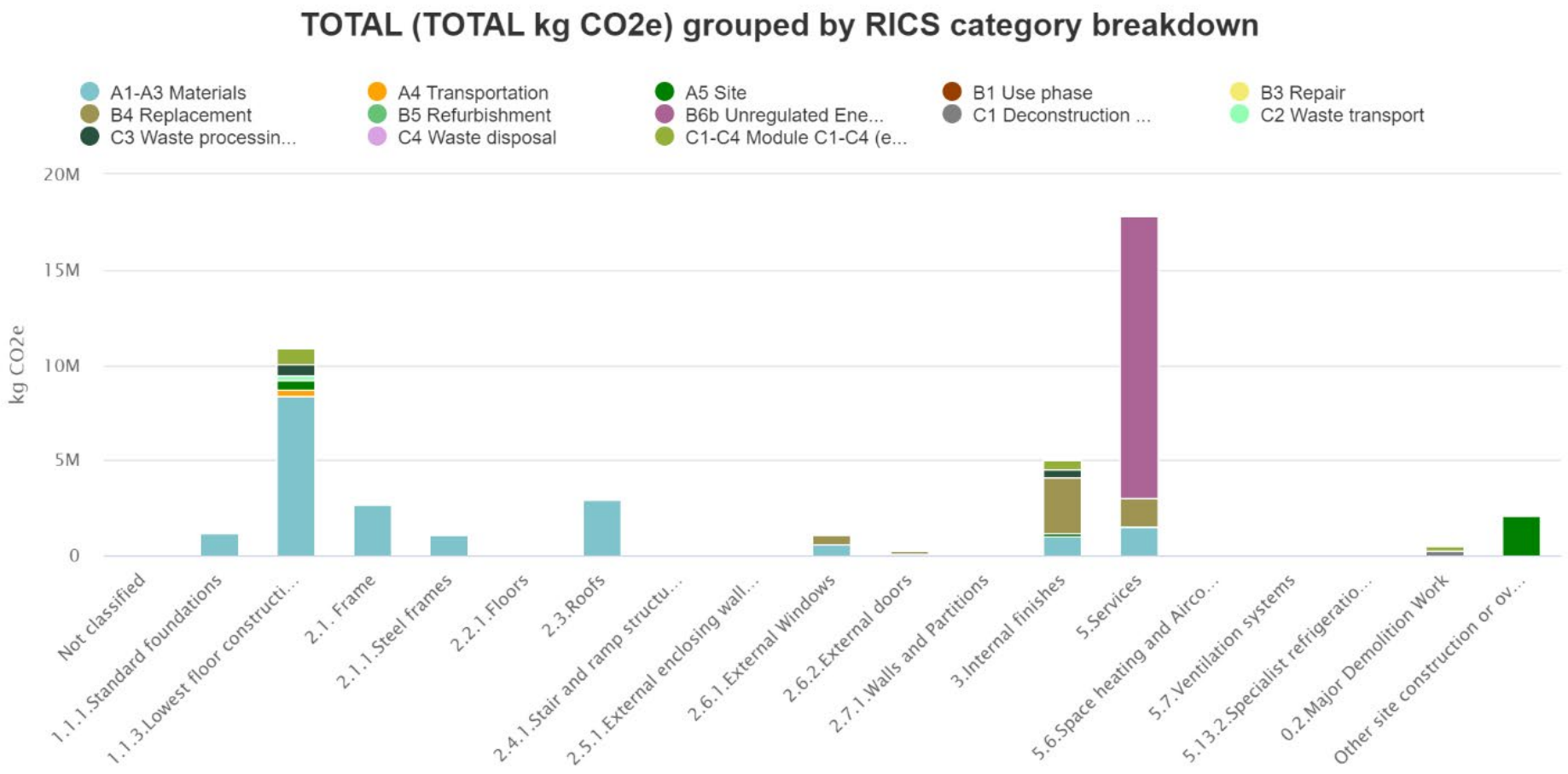
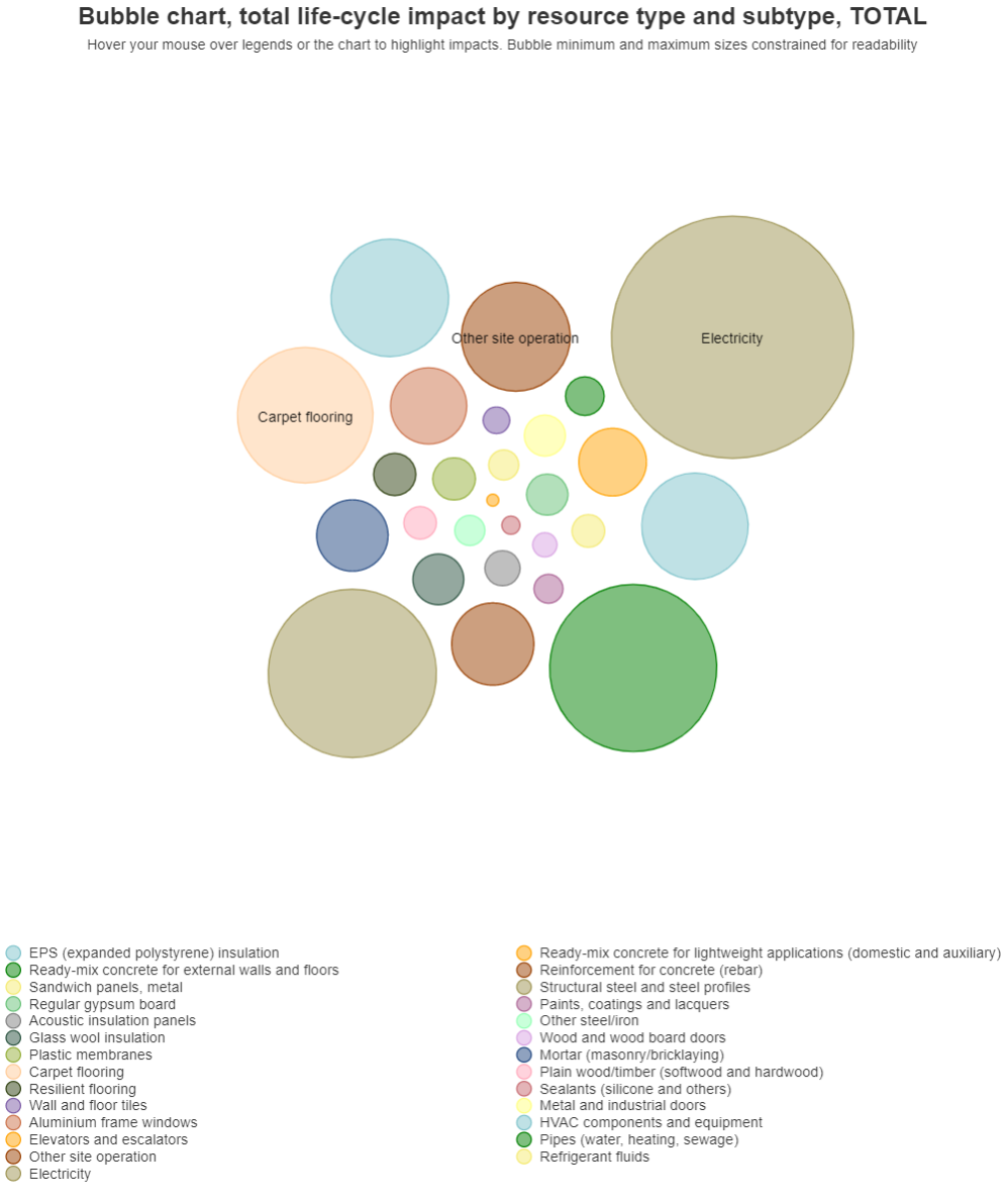


Figure 7 - Representation of most significant material types by GWP



5.2 Design Considerations

5.2.1 In order to outline different design options for the Development, an improved design has been derived from the baseline building scenario using the carbon designer in OneClick LCA. This way, calculations at the initial design phase can explore options for reducing carbon emissions across lifecycle phases. This report therefore explores an improved design taken from the baseline and will provide recommendations to the Applicant for reducing carbon emissions at specific modules in the lifecycle phase.

5.3 Considerations

5.3.1 As shown in Table 2 below, four design changes have been made to the baseline design in order to reduce the WLC emissions from the Development. These are summarised below alongside the corresponding carbon reduction.

Table 2: Summary of Design Changes to Reduce WLC emissions from the Baseline Scenario

Design Change	Classification	Potential CO_2 Saving	Carbon Reduction
Replace use of R32 refrigerants with CO_2	Systems – refrigerants	1% of total emissions	Equivalent to 472 t of CO_2e for Unit 3
Use 40% GGBS cement mixture in foundation concrete	Substructure – foundation	1% of total emissions	Equivalent to 144 t of CO_2e for Unit 3
Use 40% GGBS cement mixture in ground floor slab	Substructure – foundation	5% of total emissions	Equivalent to 2331 t of CO_2e for Unit 3
Remove carpet tiles to warehouse floor – exposed concrete finish	Finishes	7% of total emissions	Equivalent to 3600 t CO_2e

5.3.2 Figures 8 and 9 below show comparisons between the baseline design and the improved design. Indicating how WLC emissions can be reduced with design changes. Figure 8 below shows that WLC emissions have decreased by approximately 14% with the design changes implemented, with a significant (over 50%) reduction in the lowest floor construction emissions, as shown in Figure 9 below.

Figure 8 - Whole Life Carbon Assessment comparison (Baseline and Improved Design)

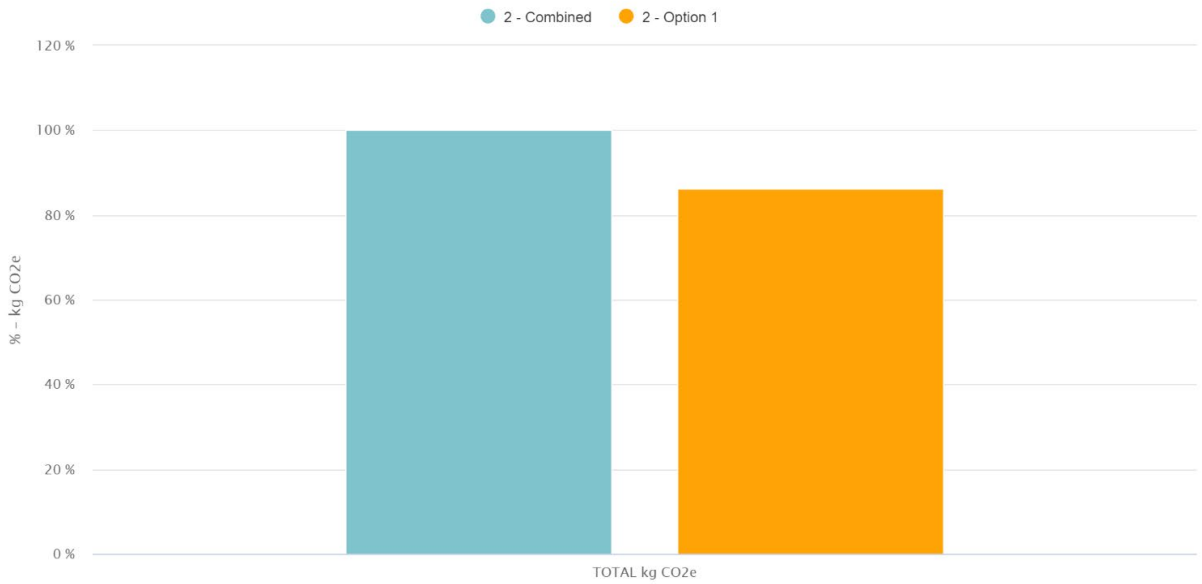
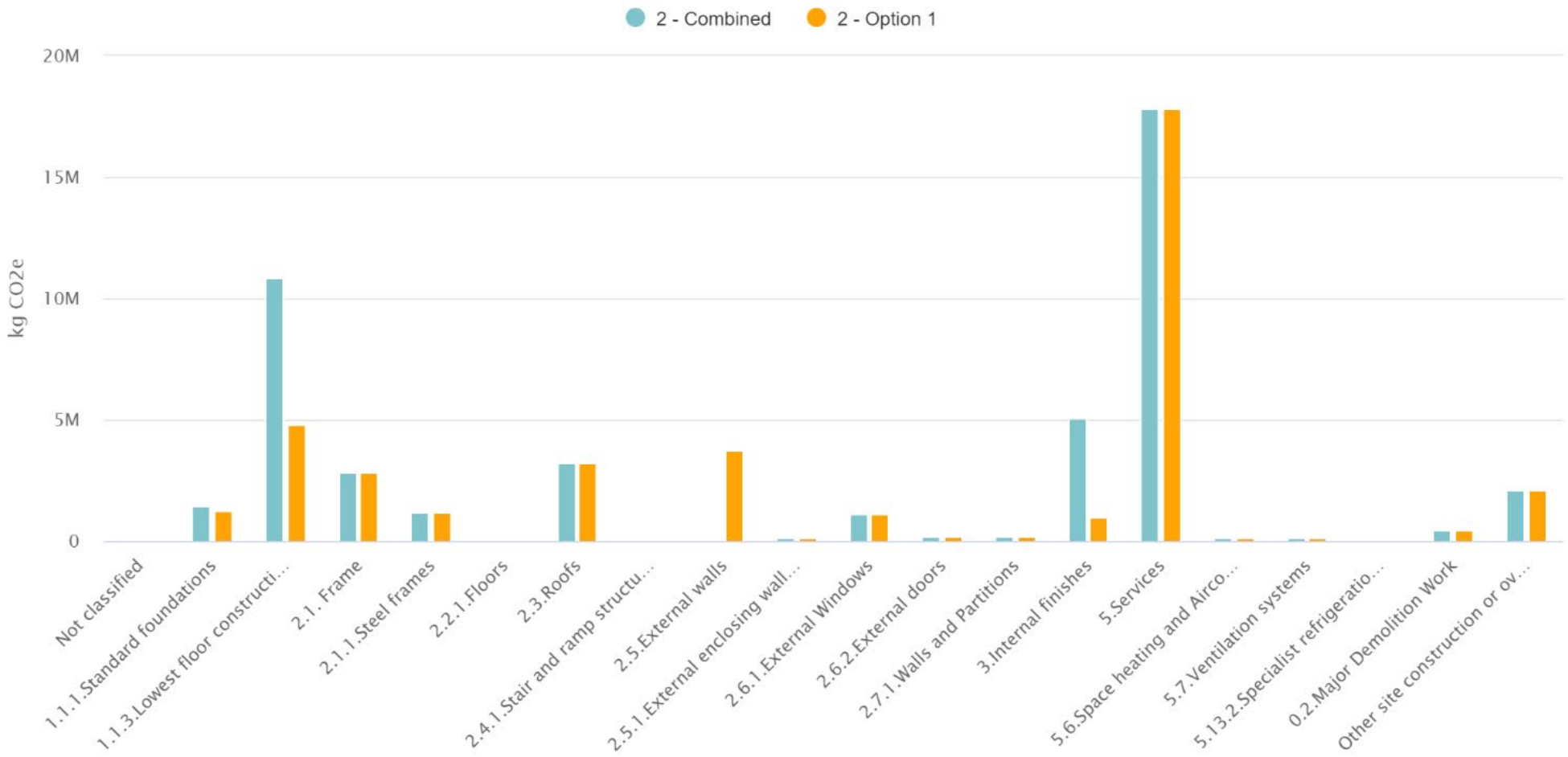


Figure 9 - Whole Life Carbon Assessment comparison across classification of materials (Baseline and Improved Design)



6 Conclusion

6.1.1 This WLC assessment has been carried out to inform the Climate Change chapter of the Environmental Statement to determine the likely effects of the Development on the environment with respect to Climate Change.

6.1.2 The WLC assessment for the Development has been carried out using methodology set out in European standard EN 15978[8] and the RICS professional statement 'Whole Life Carbon Assessment for the Built Environment'. Table 3 below shows the CO_2 emissions associated with each module of the Development's life cycle.

Table 3: Equivalent CO_2 emissions associated with the Development's life cycle modules

Stage	Baseline (CO_2e)	Improved Design (CO_2e)
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Modules A4-A5. Construction process stage	3,578,117	3,399,338
Modules B1-B7. Use stage	20,155,541*	17,521,063*
Modules C1-C4. End of life stage	3,558,154	2,708,415

*Includes Module B6 (Unregulated Energy) in which a worst-case scenario is derived.

6.1.3 The WLC assessment has highlighted that the embodied material carbon, life cycle stages A1-A3, are the main emission sources. However, at the time of writing this report, detailed design drawings and expected material type data was not available. This assessment has taken a conservative approach to determining the potential impacts of the Development on climate change. Mitigating actions could be taken however to reduce this impact by selecting materials such as those which have low embodied carbon and a high recycled content, leading to the lowering of associated emissions.

6.1.4 Managing the supply chain and opting for local products will reduce the transportation related emissions. Considering WLC at the design stage also gives guidance to the project team upon which materials selection or products will offer the most efficiency depending on their lifetimes, as well as support material circularity, decreasing end of life emissions too.

6.1.5 As this assessment was undertaken with general material information, as this scheme progresses, the design is developed, and a contractor is appointed, opportunities to further reduce the WLC emissions of the Development should be reviewed, and measures specified to reduce the building's overall carbon impact on the environment.

[8] BS EN 15978:2011 Sustainability of construction works. Assessment of environmental performance of buildings. Link: https://knowledge.bsigroup.com/products/sustainability-of-construction-works-assessment-of-environmental-performance-of-buildings-calculation-method/standard

Appendix A MATERIALS REGISTER & OPTIONS