Hydrock

Land At the Former Sipson Garden Centre

Whole Life Carbon Assessment

For *Lewdown Holdings Ltd*

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Executive Summary

The study provides a whole life carbon assessment for both the embodied and operational carbon emissions for the proposed development on the Land at the former Sipson Garden Centre in the London Borough of Hillingdon.

The project consists of the demolition of the former Sipson Garden Centre, including the hardstanding and dilapidate structures associated with the previous use. The site will be redeveloped to provide a vehicle service building, a two-storey office building and use of site for maintenance of airside support vehicles.

Key materials used in this development include steel frame superstructure, concrete substructure and foundations and a composite steel insulation panel/concrete façade.

The energy hierarchy has been followed to reduce operational carbon, with an all-electric system within the proposed development. Renewable energy from solar photovoltaic panels and a green roof have been included within the design of the proposed development.

The overall whole life carbon assessment result from the initial proposed development is shown in Table 1, which are in line with the benchmark targets for an office building.

A breakdown into the modules of the whole life carbon assessment can be seen in Table 2.

Key suggestions for reducing the whole life carbon of this building include:

- Utilising existing hardstanding materials as part of the new hardstanding subbase
- Using timber framework for wall systems instead of steel
- Using recycled glass insulation underslab
- Utilising different window construction than aluminium framing, such as Velfac windows that are a mix of timber and aluminium.
- Reducing the operational carbon through the use of low energy systems and renewable energy generation

Table 1 - Overall whole life carbon results for the Sipson Development

	Whole Life Carbon Emissions (excluding B6-B7) (Tons CO_2e)	**Whole Life Carbon Emissions (excluding B6-B7)** ($kgCO_2e/m_2$ GIA)
Sipson Development	1652	1210

Table 2 – Summary of whole life carbon breakdown for the Sipson development

Whole Life Carbon Scope	**Model Design ($kgCO_2e/m_2$ GIA)**	**WLC Benchmark ($kgCO_2e/m_2$ GIA)**
A1-A5 (Product Stage + Construction Stage)	899	<950
B1-B5 (In-Use Stage)	273	<450
C1-C4 (End of Life Stage)	38	
B6 (Operational Energy)	700	
B7 (Operational Water)	9	

The Former Sipson Garden Centre

1. Introduction

Hydrock have been appointed by Lewdown Holdings Ltd to produce a Whole life Carbon (WLC) Assessment to demonstrate that the proposed development at the former Sipson Garden Centre in the London Borough of Hillingdon has considered reducing carbon across all life stages in embodied and operational carbon, minimising the impact of the construction of this development on local and national carbon budgets.

2. Site and Proposed Development

The proposed development on-site on Sipson Road, UB7 0HW, will see the demolition of the former Sipson Garden Centre, including the hardstanding and dilapidate structures associated with the previous use. The site will be redeveloped to provide a vehicle service building, a two-storey office building and use of site for maintenance of airside support vehicles.

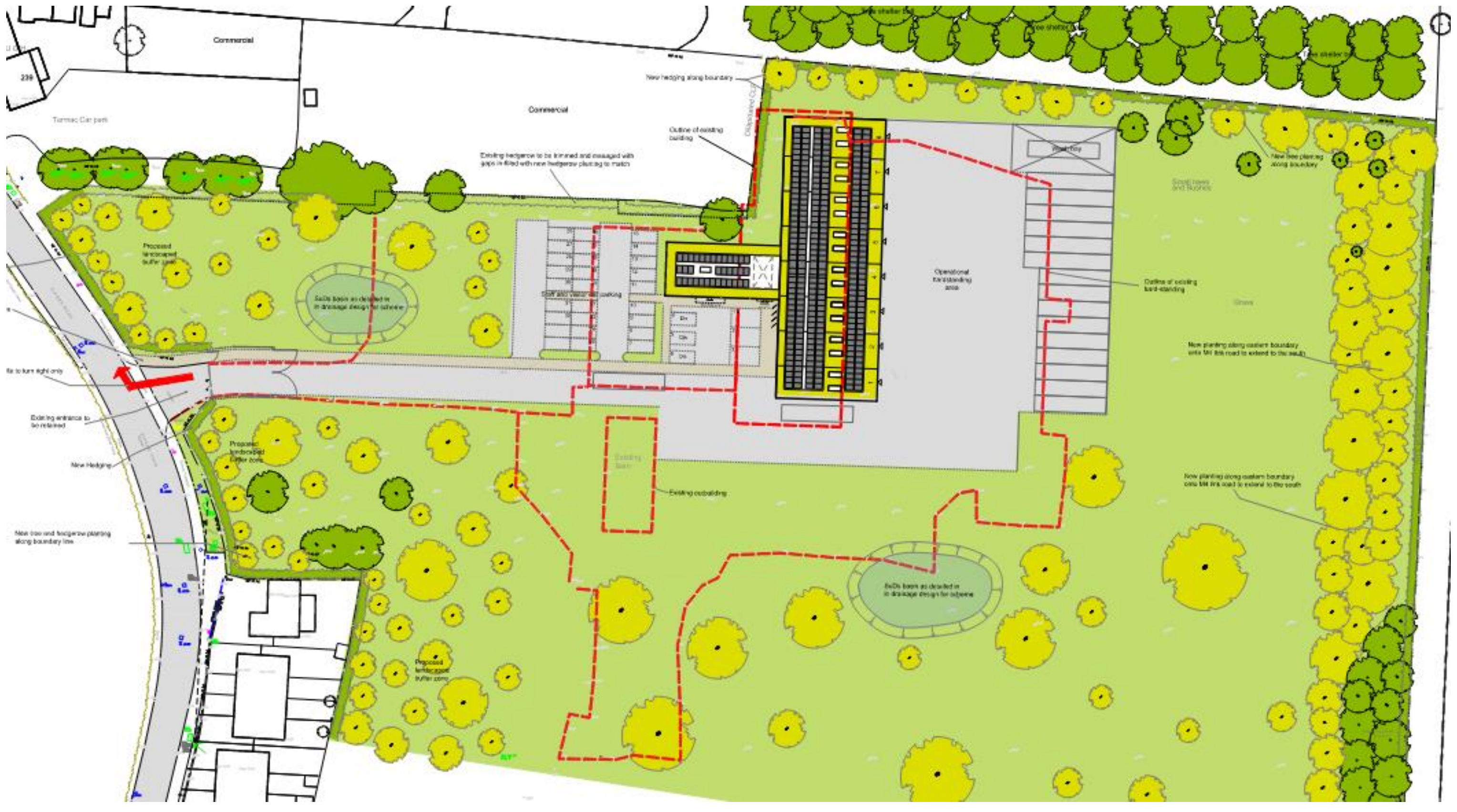


Figure 1 - Pre-Application Site Plan

Introduction to Whole Life Carbon

This section explores the importance of whole life carbon assessments as well as the planning policy requirement that must be satisfied to gain planning approval.

3. Importance of Assessing Whole Life Carbon

As efforts accelerate to reduce carbon across both the UK and the wider world to meet climate change and net-zero commitments, the building and construction industry is feeling the pressure to rapidly reduce its impact.

Whole Life Carbon (WLC) assessments provide an opportunity to calculate the total carbon emissions over a building's entire life, from the raw supply of materials and construction through to demolition and disposal at end of life.

Carbon emissions with a WLC are reported and assessed in two different categories:

- **Embodied Carbon:** the emissions associated with materials and construction processes (A1-C4)
- **Operational Carbon:** the emissions associated with energy and water used (B6 & B7 in figure 2) to operate the building

The WLC assessment assumes a 60-year study period.

3.1 Scope of WLC

There are three stages to the WLC assessment:

- A pre-planning edition covers the proposed principles which will be adopted on site
- A second phase includes full modelling of the carbon emissions across the building, including options for improving the results
- A third, post-construction version provides results using project specific construction data and compares these results against a target

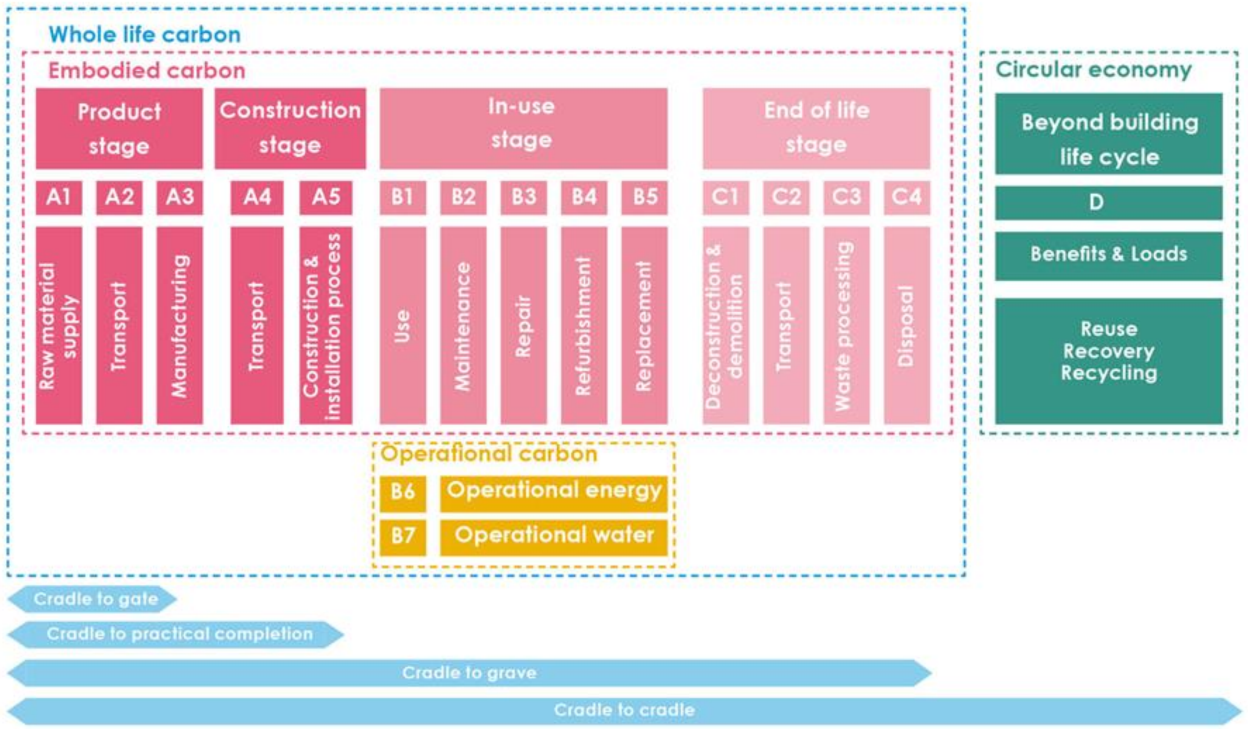
This study is an initial analysis within the pre-planning stage that uses the latest interim RIBA Stage 2 information and accounts for at least 95% of the capital cost. Please note this is subject to change as the design progresses. The analysis provides initial insight into the potential embodied environmental impact of the materials proposed for the Sipson development.

Figure 2 shows the different lifecycle modules included in a whole life carbon study, as well as the differences between embodied carbon, operational carbon, the circular economy and whole life carbon.

This assessment will include both operational energy use intensity, and upfront embodied carbon targets, which together, will help shape the whole life carbon of the whole development. This analysis then assesses, the carbon emitted at each of the life cycle stage:

- A1 to A3 Product: extraction and processing of materials, energy and water consumption used by the factory or in constructing the product or building, and transport of materials and products A4 to A5 Construction: building the development
- B1 to B7 Use: maintenance, replacement and emissions associated with refrigerant leakage.
- C1 to C4 End of Life: demolition, disassembly waste processing and disposal of any part of product or building and any transportation relating to the above.
- Module D benefits and loads beyond the system boundary

Figure 2 - Display of modular information for the different stages of the building assessment (Source: LETI Embodied Carbon Primer).



4. National Carbon Target, Polices and Guidance

The undertaking of a WLC assessment is influenced by a variety of both national and local policies and guidance, which is summarised below.

4.1 UK Climate Change Act 2008

Although there are no national polices directly laying out WLC guidance, the UK government amended the Climate Change Act 2008 in June 2019 to target net zero carbon emissions by 2050, compared with the previous target of at least 80% reduction from 1990 levels.

Any emissions must be balanced by schemes to offset an equivalent amount of greenhouse gases.

4.2 UK Net Zero Strategy

In May 2019, the UK Government introduced a commitment to reach net zero carbon emissions by 2050. This includes all emissions (Scopes 1-3) across all industries and sectors.

Prior to the net zero carbon target, the Climate Change Act (2008) committed the UK government to reduce emissions by 80% by 2050, compared to 1990 levels. A report by the Climate Change Committee (CC) has confirmed that the net zero by 2050 commitment will go beyond what is necessary to limit temperature rise to well-below 2°C.

In order to meet these targets, the government has set five-yearly carbon budgets which currently until 2050. The budgets restrict the amount of greenhouse gas that the UK can legally emit in a five-year period. The UK is currently in the 4th carbon budget period (2023-2027).

4.3 Grid Carbon Intensity & Energy Reform

When the Climate Change Act was enacted in 2008, nearly 80% of the UK's electricity came from fossil fuels. Since then, there has been a considerable shift toward electrification, resulting in over 50% of the UK's electricity now being sourced from low and zero-carbon technologies.

As the National Grid moves further away from fossil fuels, and with future carbon budgets requiring an even greater contribution from the renewables sector, the changes to UK grid carbon intensity will be drastic.

At present, the department for Business, Energy & Industrial Strategy (BEIS) estimated emissions intensity for the national grid in 2030 to be roughly 100g CO_2e/kWh. This is a further 61% lower than the BEIS 2019 carbon factor used by many Local Authorities for carbon impact assessments today. Between 2040-2050, the National Grid aims to operate entirely using zero-carbon technologies.

In the coming decades, it is expected that there will be further transformations across other sector, including the electrification of transport and industry, the digitalisation of legacy infrastructure, as well as the decarbonisation of the gas grid through the increased use of hydrogen and bio-gases.

There are still many unknowns as to how to exactly the UK will meet their 2050 net zero target, however, it is imperative that industry actors take action now to help to drive the much-needed change.

4.4 The London Plan

The London Plan was adopted in March 2021 and is the Mayor of London's statement on London planning policy and provides 'regional' level material considerations determining planning applications in London Boroughs. The policies are overseen by the Greater London Authority (GLA).

The GLA London Plan has specific requirements in carbon emissions reduction and whole-life carbon practices required for major developments or those referable to the Mayor.

4.4.1 Policy SI2 Minimising Greenhouse Gas Emissions

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.

Embodied Carbon

The emissions associated with a building's materials, including its transport to site, installation and disposal at the end of the building's life. Embodied carbon approaches are integrated into the proposed design.

5. Assessing Embodied Carbon

Embodied carbon refers to the emissions associated with a building's materials. This includes the carbon emitted in producing a building's materials, their transport, installation on site, and disposal at the end of life.

Historically, there has been little regulation with regards to embodied carbon. In the past, operational emissions have far outweighed the embodied emissions. However, as the efficiency of buildings improve and the grid decarbonises, considerations of embodied carbon impacts related to the product and construction stages of a building become increasingly important and can account for more than half of a building's WLC, as seen in Figure 3.

5.1 Considering Embodied Carbon in a new development

The development will aim to provide a better understanding of sourcing and processing of material and products. This includes an understanding of long-term, post-completion considerations such as maintenance, durability, adaptability and also capitalise on the carbon savings value of retaining existing built fabric.

This will be achieved through entrenching embodied carbon at the core of the projects design philosophy. Focusing on lean design, materials sourcing, longevity and reusability will have the most significant impact on the whole life carbon emissions of the development.

For this analysis the team have conducted the analysis in line with BS EN 15978, utilising the RICS Whole life carbon assessment for the built environment, to be a guide to the implementation of practical implementation of the BS EN 15978 principles.

One click LCA software has been used, using the Carbon assessment, GLA/ RICS/ Green Mark tool.

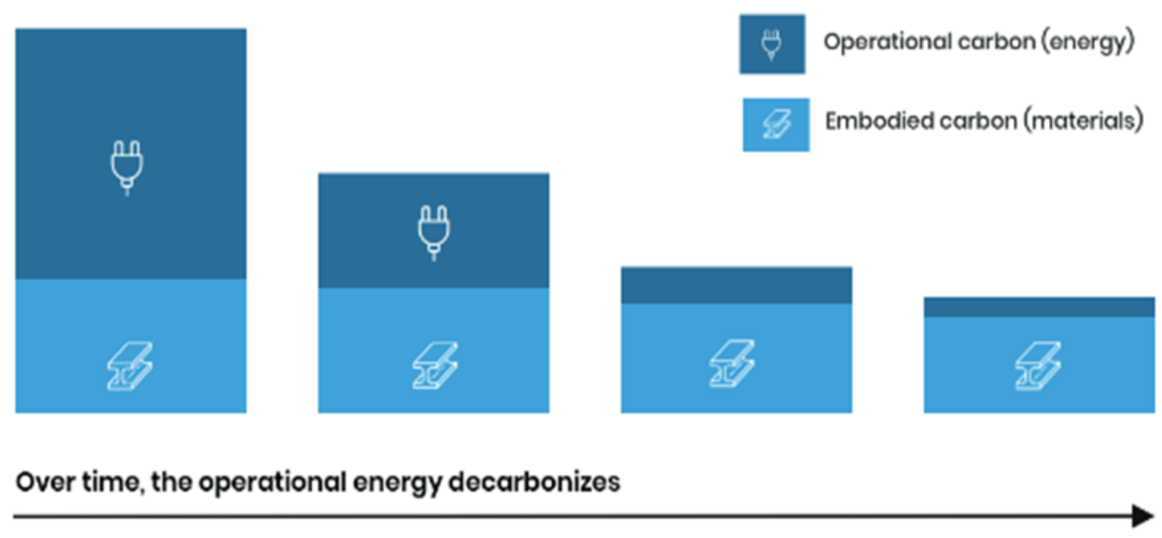


Figure 3 - Operational carbon emissions will decrease over time as the grid decarbonises.

5.2 Building Elements to Assess for Embodied Carbon

Following RICS elemental methodology, embodied carbon analysis within the built environment is broken down into the following elements:

- **Substructure**: transfers the load of a building to the ground and isolates it horizontally from the ground. Substructures range from strip foundations through to large underground basements and are usually made from concrete, a highly emissive material. The substructure of a building is generally the element where structural performance is the largest design driver.
- **Superstructure**: the frame of the building required to support the suspended slabs, roof and internal finishes, providing stability.
- **Façade**: the external faces of a building, this can include the roof.
- **Building Services**: these comprise the lighting, heating, cooling, ventilation and air conditioning plant. Building services have a relatively short lifespan compared to the building itself. Embodied carbon needs to be considered in parallel with operational carbon, lifespan, maintenance, comfort, health and safety etc.
- **Internal Fittings and Finishes**: the materials used on all exposed interior surfaces, such as floors, walls and ceilings. These are replaced more frequently and can require significant maintenance.
- **Furniture, fixtures and equipment** covers the movable or fixed furniture that doesn't have a permanent fixture to the building or utilities
- **External Works**: this covers hard and soft landscaping on the ground floor level, terraces, roofs and below-ground items such as irrigation tanks.

6. Material Selection for the Proposed Development

The BRE 'Green Guide to Specification' will be used when selecting the construction materials for the proposed development to encourage the use of materials which have been produced with minimal impact to the environment in line with good-practice methodology. The guide promotes the use of sustainable materials with low embodied energy, low ecotoxicity and a long life-span.

Additionally, the materials selected will be responsibly sourced and where practicable meet the following guidelines.

- ISO14001
- BES6001
- PEFC/ FSC
- Chain of Custody

Figure 4 illustrates that it is during the design stage that embodied carbon can be reduced the most, which is why it is integral that the materials used from the proposed development are explored as early as possible.

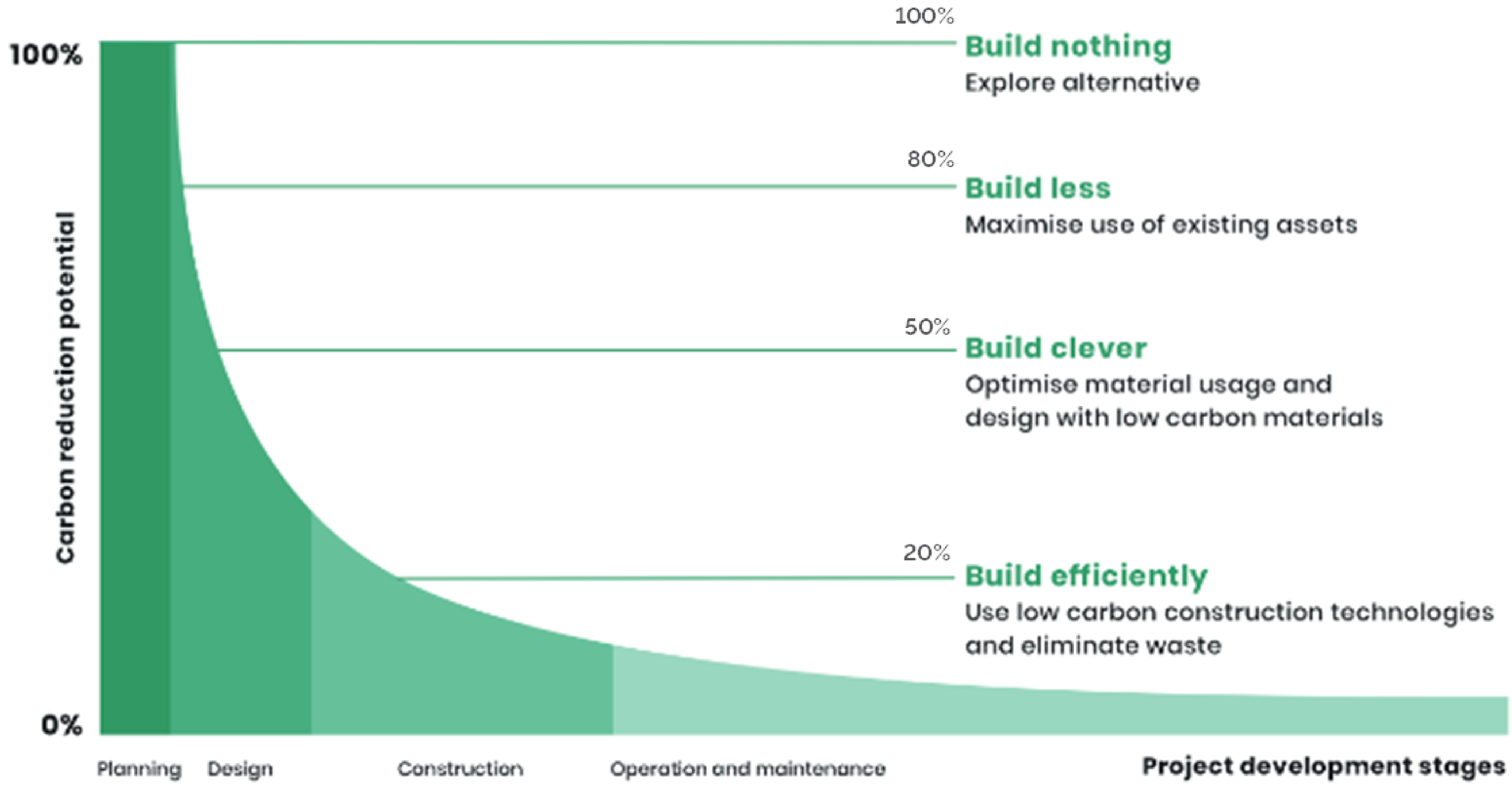


Figure 4- Embodied carbon reduction potential in different stages of a building project (adapted from LCA WLC Ebook)

Operational Carbon

Operational carbon refers to the emissions associated with the energy consumed by a building during its use, outlining operational emission reduction measures to be considered within the proposed development.

7. Assessing Operational Carbon

Operational carbon refers to the emissions associated with the energy and water consumed by a building during its use (B6 and B7). This includes the energy consumed by heating, hot water, cooling, ventilation and lighting systems. Any plug-in devices such as fridges, washing machines, TVs, IT facilities, lifts, cooking and process loads are also accounted for.

In order to reduce and minimise the need for energy use, in particular space heating, the design philosophy in the first instance will focus on building form and fabric. Passive design measures will be incorporated to maximise daylight availability, minimising the need for artificial lighting. Additionally, natural ventilation and building shading devices can be employed to reduce the need for comfort cooling.

7.1 Regulated and Unregulated Carbon

Operational energy consumption is often categorised into two key components:

- **Regulated carbon emissions** are those associated with heating, cooling, hot water, lighting and any other fixed building services equipment. These are the emissions that are regulated under Part L of the Building Regulations.
- **Unregulated carbon emissions** are associated with small power and plug-in items and any other process or plant equipment that is not covered under Part L of the Buildings Regulations.

One of the well-documented shortcomings of the currently Part L calculated methodology is it omission of unregulated energy loads. Therefore, the design team have calculated expected unregulated energy consumption as well.

7.2 Energy Strategies for the proposed Sipson Development.

7.2.1 Implementing the Energy Hierarchy

The energy hierarchy is a classification of energy strategies, prioritised to assist progress towards a more sustainable energy system. The energy hierarchy is used in accordance with the London Local Plan (Policy SI2) to reduce greenhouse gas emissions in operations and minimise both annual and peak energy demand. The energy hierarchy recognises that there is no single solution to achieve net-zero carbon and that a portfolio of resources must be deployed in order to achieve an affordable and sustainable way forward.

The proposed development will operate on an all-electric system powered by an Air Source Heat Pump (ASHP).

Reducing Energy Demand

Minimising a building's potential CO_2 emissions can be achieved through reducing energy demand ('Be Lean'), using passive design measures. Passive design options are those that utilise some of the following methods to help reduce the need for energy consumption by exploiting the natural surroundings.

- **Building Fabric**; the materials that make up walls, floors, roofs windows and doors of the building. The more insulation contained within these elements, the better their thermal performance.
- **Building Form and Orientation:** the greater the building form ratio (external area: internal area), the less efficient the building and the greater the energy demand. The quantity of south-facing glazing should also be considered for overheating risks.

Use of Renewables

Solar photovoltaic panels are required to meet GLA requirements and are proposed for the roof of this development. They will provide zero-carbon electricity and reduce overall operational carbon emissions.

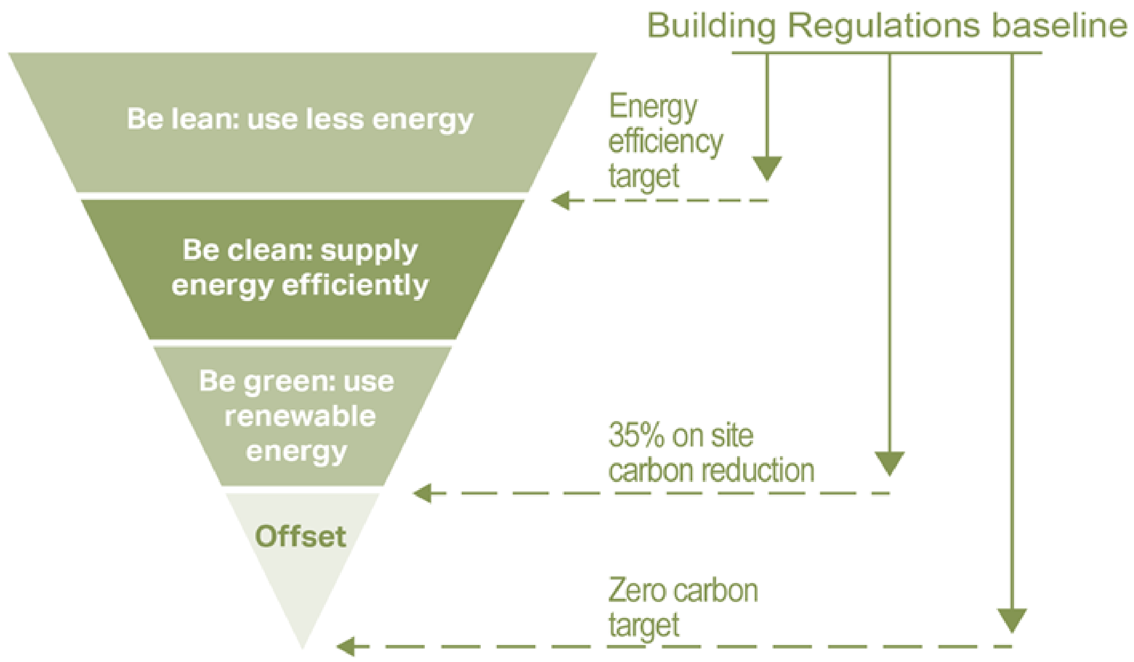


Figure 5 The London Plan energy hierarchy

Methodology of WLC calculation

The methods and programs used to create WLC assessment results.

8. Embodied Carbon

For this analysis, the team have conducted the analysis in line with BS EN 15978 utilising the RICS Professional Statement: Whole Life Carbon assessment for the built environment (The RICS PS), to be a guide to the implementation of practical implementation of the BS EN 15978 principles.

The OneClick LCA tool has been used to calculate the embodied carbon for the lifetime of the building. This included data such as pre-determined water use volumes, construction emissions, pre-determined energy use and volumes of building materials.

Within the OneClick LCA tools, materials and components have been selected from EPD certificates where available, where this is not possible, similar materials have been selected from the database. As material selection has not yet been finalised, typical EPDs have been selected where possible.

The lifespan of the building has been agreed as 60 years.

9. Operational Carbon

In addition to following the London Plan Energy Hierarchy to ensure efficient energy use for the proposed development. This ensures that carbon emissions produced through unregulated energy consumption are offset as well as the regulated energy as shown within an Approved Document Part L2 2021 (ADL2 2021) simulation.

The operational carbon methodology has been calculated by Hydrock, found in the document Energy Statement accompanying this document.

10. Material Data Sources and Quantities

Estimates of the types and quantities of materials for the assessment are from a combination of the following sources:

- **Architectural drawings-** including floor layouts, elevations/facades, ceiling and floor finishes, internal wall layouts
- **Architect confirmations** - where possible the architect has confirmed the materials of construction
- **Benchmarks –** The FF&E have not yet been included in the design, the carbon for the FF&E has therefore been taken from the GLA benchmarks
- Renewables have been excluded from the analysis

From these data sources the team has accounted for 95% of the cost allocated to each building element.

11. Carbon Emissions Factors

In line with the guidance given in the GLA guidance to Whole Life Carbon assessments, the assessment has been undertaken based on the following carbon emissions.

- For materials manufactured in the UK, SAP 10 emission factors are used in line with GLA's Energy Assessment Guidance.
- Products sourced from outside the UK use data appropriate to the local energy grid at that location.

12. GLA WLC Benchmarks

The GLA has provided minimum and aspirational benchmark figures for a number of building types for the WLC assessment. It should be noted that these do not include operational carbon emissions (B6-B7).

The 'Office Building' WLC benchmarks are displayed in table 3.

Table 3 - GLA Office Building WLC benchmarks

Modules	WLC Benchmark ($kgCO_2e/m^2$ GIA)	Aspirational WLC Benchmark ($kgCO_2e/m^2$ GIA)
A1-A5 (excluding sequestration)	<950	<600
B-C (excluding B6 + B7)	<450	<370
A-C (excl. B6 + B7, incl. sequestration)	<1400	<970

Whole Life Carbon Assessment Results

Results from the GLA OneClick whole life-cycle assessment of carbon based on the proposed design at Sipson Garden Centre.

13. Operational Energy

The total operational carbon emissions have been calculated over a 60-year study period in line with the draft GLA guidance.

The total operational carbon emission for the site (total estimated emissions from regulated and unregulated energy uses) have been calculated to be:

955 tCO_2

14. OneClick Model Results

The approximate whole-life-cycle carbon emissions (excluding operational energy + water) for the proposed design is:

1652 tCO_2

A breakdown and summary of the embodied carbon and operational energy carbon emissions can be seen in Table 4.

14.1 Breakdown of Embodied Carbon

The study demonstrates that for the proposed development at Sipson Garden Centre, the largest share of embodied carbon will be contained within the product stage containing life cycle stages A1-A3, also known as cradle to gate stages.

This demonstrates that in order to consider reducing the embodied carbon, it is imperative to focus on the materials being selected and reducing the quantities and mass of materials required.

Smaller proportions of embodied carbon arise as a consequence of the transport of materials to site (life cycle stage A4). Whilst this might not need to be the focus of a future optioneering exercise to reduce embodied carbon attributed to a development, it is still important to reduce transport emissions through sourcing materials locally wherever possible.

Table 4 - Breakdown of OneClick WLC emission results

Whole Life Carbon Scope	Model Design ($kgCO_2e/m^2$ GIA)	WLC Benchmark	Aspirational WLC Benchmark
A1-A5 (Product Stage + Construction Stage)	899	<950	<600
B1-B5 (In-Use Stage)	273	<450	<370
C1-C4 (End of Life Stage)	38		
B6 (Operational Energy)	700		
B7 (Operational Water)	9		

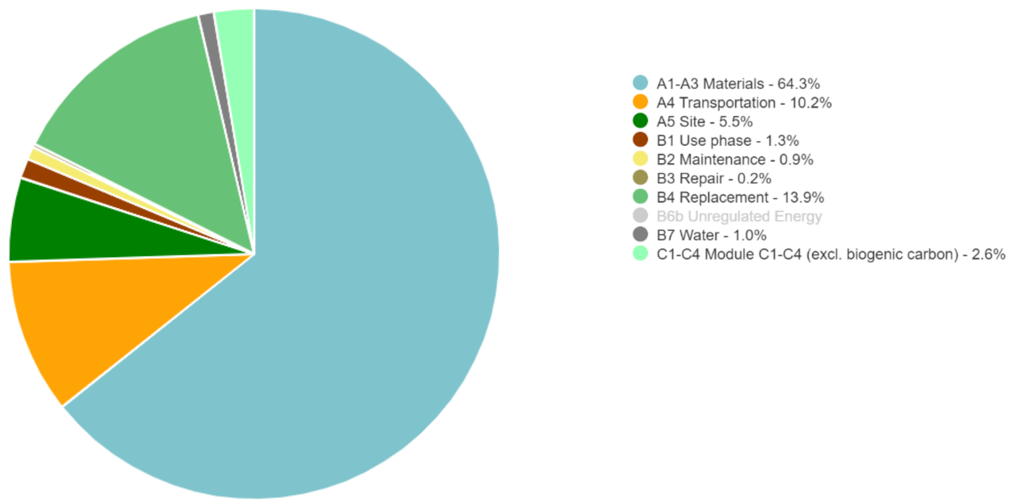


Figure 6 Breakdown of carbon per lifecycle stage