

Aputura Energy - P108 Currie – Wester Hermiston

Stage 2 Whole Life Embodied Carbon Assessment Report

Aputura Energy

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Executive summary

A Whole Life Embodied Carbon Assessment has been carried out for the proposed Data Centre in West Hermiston development in the outskirts of Edinburgh. Primarily, the report seeks to assess the current carbon footprint position against the client's aspiration and current industry benchmarks.

The assessment was carried out according to the recent British Standard BS EN15978:2011 (Sustainability of construction works - Assessment of environmental performance of buildings - Calculation method), and the RICS Professional Statement 'Whole life carbon assessment for the built environment 2023' 2nd Edition.

Embodied Carbon Summary

The total representative embodied carbon emissions of Aputura Energy - P108 Currie – Wester Hermiston development for both Upfront Embodied Carbon (excluding sequestration) and Whole Life Embodied Carbon (including sequestration) over a period of 60 years are shown in the table below. This is based on the latest design information received. These results show the project would benefit from upfront embodied carbon reductions to achieve a more successful whole life embodied carbon outcome.

Embodied Carbon Emissions	Upfront Embodied Carbon (A1-A5)	Whole Life Embodied Carbon (A-C)
Tonnes CO ₂ e	65,278	92,877
kgCO ₂ e/m ² (GIA)	1,423	2,025

Embodied Carbon Summary (current design)

The development's Whole Life Embodied Carbon is the equivalent to:



30,907

Personal Return flights
London - Hong Kong



8,164

Laps around the globe by car



Energy to make

1,523,608,844

Cups of tea



901,469

Trees to absorb

Embodied Carbon Equivalent

Carbon Hotspots

The carbon hot spots will arise from the steel frame primarily. The MEP services will be main contributors due to the extent required for a data centre. The concrete used in both the slab and substructure will also be in the top 10 as concrete as high carbon material. The acoustic louvres made from aluminium will also be a main contributor due to aluminium also being an energy intensive material to manufacture.

Potential Reduction Opportunities

The assessment has identified a series of material alternatives that could be applied to the development to reduce its carbon footprint. To achieve this, we recommend the following changes to the current design be considered:

- Use of reclaimed steel or EAF steel in the steel frame
- Cement replacement in the concrete such as GGBS or equivalent

- High recycled content in the aluminium used in the louvres and window framing
- Minimise concrete strengths to reduce cement requirements
- Use of low carbon composite cladding such as Kingspan Quadcore LEC.
- Consider low carbon studwork and alternative boarding for internal walls

The following reduction options were quantified based on elements that were measured as part of the assessment.

- Insulated Cladding Panels using Quadcore LEC product
- Curtain walling with high recycled aluminium content (Hydro Circal)
- High recycled content in aluminium louvres (Hydro Circal)
- Low Carbon Purlins, i.e Metsec Decarb or similar
- Low Carbon drylining studs, i.e Metsec Decarb or similar
- External hardstanding: PAV2 50% GGBS content
- Plant Slabs: PAV2 50% GGBS content

With the above reductions applied the potential embodied carbon is:

- Upfront Embodied Carbon = 1,363 kg CO₂e/m² (62,526 tonnes CO₂e)
- Whole Life Embodied Carbon = 1,951 kg CO₂e/m² (89,476 tonnes CO₂e)

There are many more reduction options that could be pursued once the detailed design is developed and we will continually engage with the design team to promote low carbon design and materials following the IStructE Design Hierarchy

Next Steps

The reduction options discussed will be reviewed by the design team and client in the coming design stage. The carbon cost will be reviewed alongside technical, cost and programme requirements.

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1.0

Introduction

1.0 Introduction

Cundall have been commissioned by Aputura Energy to conduct a Whole Life Embodied Carbon Assessment (WLECA) of the proposed design of a Data Centre on the outskirts of Edinburgh. This report summarises the findings. This report was undertaken at RIBA Stage 2.

The assessment was carried out in accordance with the British Standard BS EN15978:2011 (Sustainability of construction works - Assessment of environmental performance of buildings - Calculation method), and the RICS Professional Statement 'Whole life carbon assessment for the built environment 2023' 2nd Edition.

1.1 Project Details

The site is in West Hermiston near Heriot Watt on the outskirts of West Edinburgh. The site will contain three data centre halls with associated plant requirements. There will also be a substation, guardhouse and associated external works.

As shown in Figure 1-2, the proposed development will include two identical two-storey 48 MW data centre buildings (DC01 and DC02, coloured purple on the plan) and one single-storey 36 MW data centre building (DC03, coloured orange). The buildings will also include office facilities, covering a total floor area of approximately 6,300 m².

Substructure: Likely Pad foundations with a ground bearing slab. To be confirmed with further site investigations

Superstructure: Steel Frame construction with composite slabs internally. There will be an external gantry level which will be steel grating to house MEP equipment.

Façade: Weather tight layer will composite cladding with curtain walling elements for the office space. There are external acoustic louvres that surround the external plant areas. These are assumed to be aluminium louvres with steel frame support.

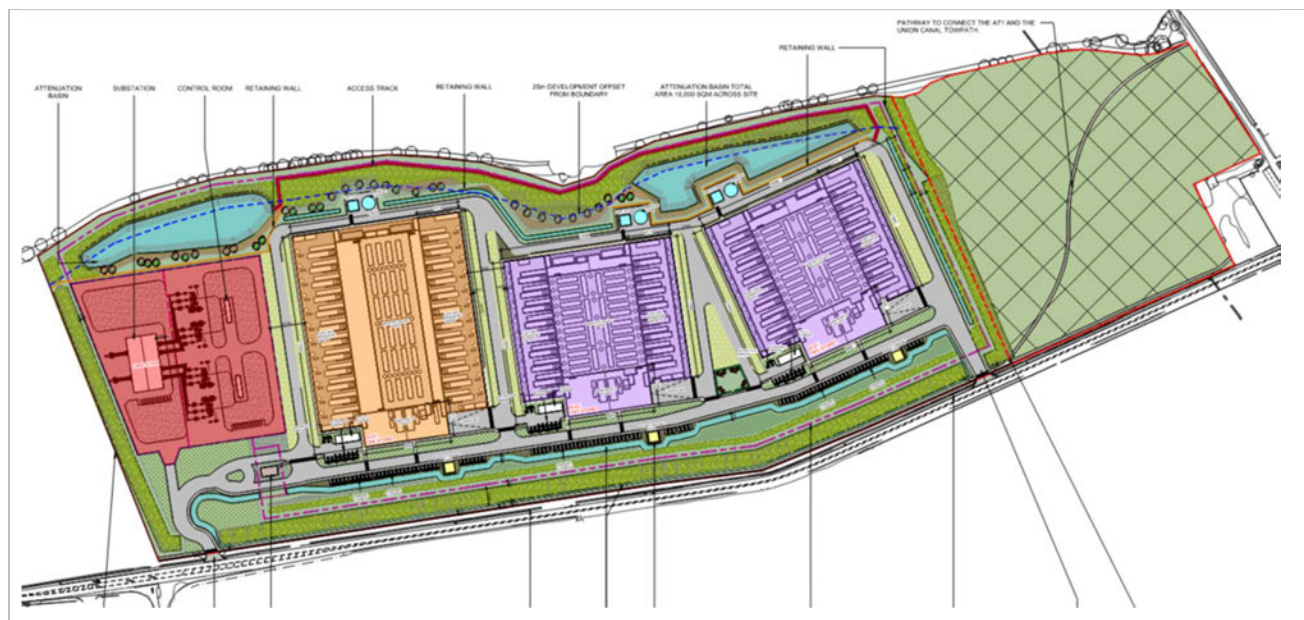


Figure 1-1: Site View- Aputura Energy - P108 Currie – Wester Hermiston

Detailed key information and details on the project used for the WLEC assessment can be found in Appendix A.

1.2 Study Background and Targets

Whole life-cycle carbon emissions are the total greenhouse gas emissions arising from development over its lifetime, from the emissions associated with raw material extraction, the manufacture and transport of building materials, to installation/construction, operation, maintenance, and eventual material disposal.

1.2.1 Life-cycle modules

The WLEC assessment covered all modules A, B, C and D as set out in BS EN 15978 and the RICS Professional Statement: Whole Life Carbon assessment for the built environment 2023 2nd Edition (referred to as the RICS PS V2 for the remainder of this document) in the life of a typical project described as life-cycle modules. The reference study period (i.e., the assumed building life expectancy) for the purposes of the assessment is 60 years.

To provide a holistic view of the GWP, the whole life carbon assessment accounts for all components relating to the project during all life stages. Embodied Carbon emissions are attributed to four main categories taken from BS EN 15978. The categories are:

- **Pre-construction Stage (module A0):** covers non-physical pre-construction activities, such as surveys and activities associated with the design of the asset. These can be a significant economic cost, but buildings do not normally have a significant environmental impact. However, for infrastructure projects or where the design team uses air travel or sets up a project-specific office, A0 may be more significant. Emissions associated with module A0 have not been included in the assessment as they are deemed negligible for this type of project.
- **Product Stages (modules A1 to A3):** The carbon emissions generated at this stage arise from extracting the raw materials from the ground, their transport to the 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 (modules A4 to A5):** These carbon impacts arise from the transportation of construction products and all construction processes, including wastage, up to project completion. Module A5 also includes any on-site demolition or strip-out works required at the beginning of the project. It also includes emissions of site workers travelling to and from the site (A5.4), however, this has not been included in the assessment as documentation of this element is optional.
- **In-Use Stages (modules B1 to B5):** This covers a wide range of sources from the embodied carbon emissions associated with the operation of the building, including the materials used during maintenance (B2), repair (B3), and replacement (B4). Module B5 covers any refurbishment or change in the asset's performance (e.g., retrofit/refurbishment or extension) planned at the outset of the project, which will occur at some point after construction is completed. Module B6 and B7 refer to operational emissions and Module B8 refer to any user activities, which were not currently included in this assessment.
- **End of Life Stages (modules C1 to 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 demolition contractors. No 'credit' is taken for any future carbon benefit associated with the reuse or recycling of a material into new products.
- **Benefits and loads beyond the system boundary (modules D1 and D2):** Any potential benefit from the reuse, recovery and recycling potential of a building or a building product, as well as any potential carbon benefits of any utilities exported from the asset. Module D1 has been included within the assessment scope of this study but excluded in the final results. Module D2 has not been included in the assessment.

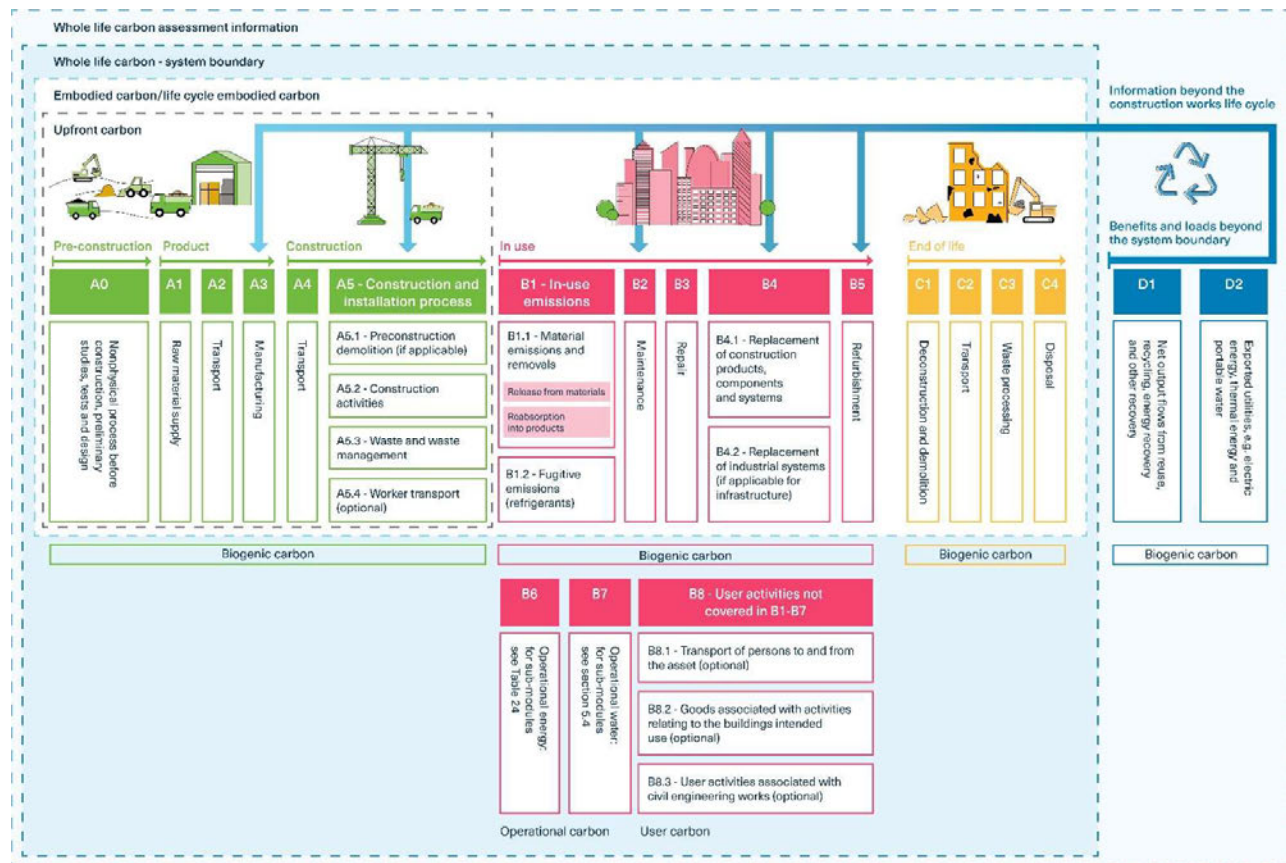


Figure 1-2: Life Cycle Modules as per BS EN 15978 and RICS PS V2

1.2.2 Whole Life Carbon and RICS Professional Statement 2nd Edition Update

The Royal Institution of Chartered Surveyors (RICS) launched the second edition in September 2023 of its Whole Life Carbon Assessment for the Built Environment (WLCA) standard. First published in 2017 for the UK's built environment sector, this 2023 edition is a global version of the standard that provides a considerably more developed understanding of the carbon costs and benefits of design choices in construction and infrastructure projects and assets. The standard has taken effect in July 2024, ensuring that all assessments for the built environment adhere to and align with the standard.

1.2.3 Embodied Carbon Targets

There is growing awareness of the importance of embodied carbon (EC) across the built environment. As a result, there is more shared data that is being used to establish EC targets for building typologies such as schools or offices. Data Centres are an emerging building typology so there is very little data on typical embodied carbon figures. Often data centres have restrictive Non-disclosure agreements that limit the ability of the industry to share knowledge on embodied carbon figures that would help establish benchmarks and targets.

Data centres differ from other building typologies as they are critical infrastructure and require much greater redundancy in design. They require much greater servicing than a typical building due to the server cooling requirement and generators for power back up. They have structural heavy loading allowances for data halls that require a heavier structural frame to support these loads on suspended slabs. Data halls can have loading allowance up to 200-250% of a typical office floor load. There is more space required for plant loading that is 150% of typical office floor loading which requires a heavier structure.

The UK Net Zero Carbon Building Standard has a range of embodied carbon targets for different building typologies including data centres. The 2025 target is 745 kgCO₂e/m² dropping to 600 kgCO₂e/m² by 2030. As a comparison, office

buildings targets start at 735 and drop to 590 kgCO₂e/m² in 2030 so they are very similar. The Standard is in pilot and feedback has been given to the authors from Cundall that the Datacentre target is not a realistic target due to the design requirements for the data centres as noted above.

Cundall has undertaken EC assessments on the three datacentres previously and the comparison is noted in section 2 to show how this data centre compares to our other assessments. Cundall has been appointed for sustainability services and will support the design team in minimising the embodied carbon in the design. There is scope within the procurement of materials and design to reduce the embodied carbon. These reduction options will be discussed in the report further on. We will promote low carbon design approaches also that follow the Low Carbon design hierarchy from the IStructE.

1.3 Assessment Scope

1.3.1 Methodology

The assessment follows a nationally recognised assessment methodology, namely, BS EN 15978: 2011: (Sustainability of construction works — Assessment of environmental performance of buildings — Calculation method).

Underpinning BS EN 15978 is the RICS Professional Statement: Whole Life Carbon assessment for the built environment 2023 2nd Edition (RICS PS V2). The RICS PS V2 serves as a guide to the practical implementation of the BS EN 15978 principles. It sets out technical details and calculation details and so was used as the methodology for the assessment.

This study covers the following,

- Upfront Embodied Carbon (A0-A5).
- Life cycle Embodied Carbon (B-C).
- Carbon reduction options.

The building components included in the assessment are illustrated in Figure 1-3.

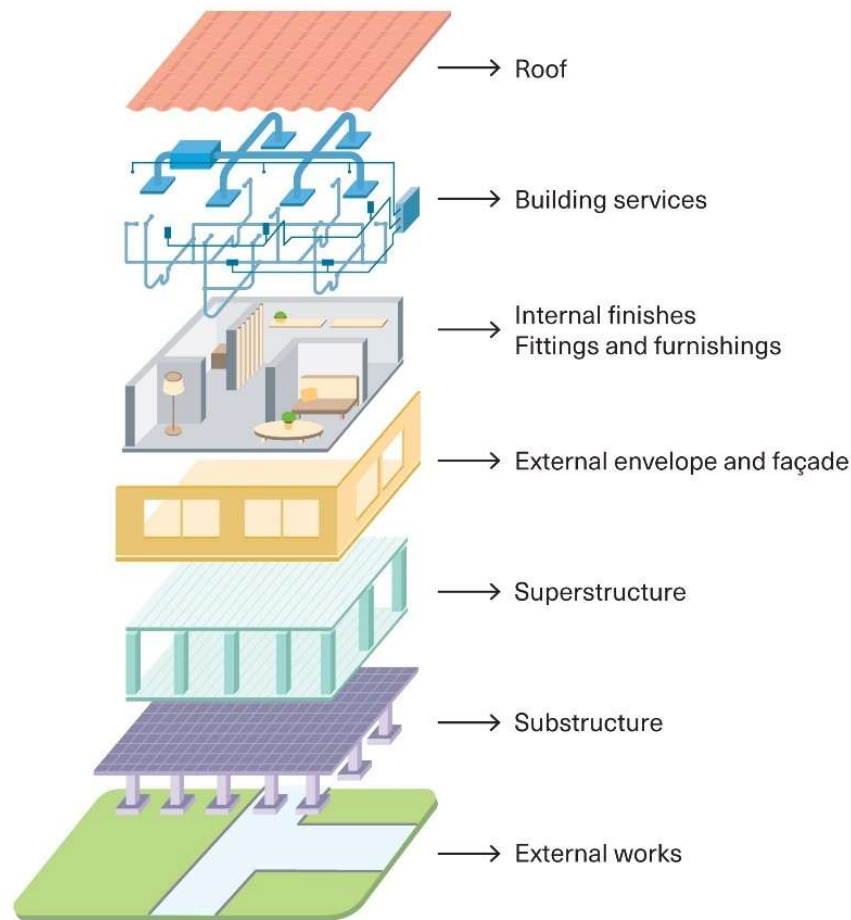


Figure 1-3: Indicative 3D Model of the scope of elements analysed for embodied carbon impact.

1.3.2 WLCA Uncertainty Factors

When estimating project costs, it is common practice to include contingencies to account for uncertainties. Similarly, whole life carbon assessments (WLCA) face comparable uncertainties, especially in the early design phase when there is limited information about the final design and materials. For the project being assessed, this uncertainty is managed by establishing a WLCA uncertainty factor, consisting of three key components:

1.3.2.1 Contingency Factor

The contingency factor reflects the uncertainty in the design and material quantities at differing points in the projects design.

RICS PS V2 provides default contingency factors to apply the embodied carbon calculations. Given that the project is at RIBA Stage 2 the contingency factor applied is **15%**.

1.3.3 Assumptions and Clarifications

At this early stage there are some design team members yet to start their design process. To complete the assessment assumptions have been made based on benchmarks established from Cundall's experience in Embodied carbon assessments on other data centres. The following benchmark assessments have been made:

Substructure: Data centres have high loading requirements so foundations will be larger than equivalent industrial buildings. The external plant slabs have been measured from the Revit models.

- Allowance: 115 kgCO₂e/m²

Superstructure: This GIA allowance covers all steel work, secondary steelwork and internal slabs. The roof gantry has been measured from the Revit model.

- Two storeys: 400 kgCO₂e/m²
- Single Storey: 350 kgCO₂e/m²

Building Services: Data centres require large amounts of Mechanical and electrical equipment as they are energy intensive, require large amounts of cooling and also have back up generators. there will also be an allowance for Module B carbon to account for replacement events as MEP systems are typically 20-30 years.

- Allowance: 350 kgCO₂e/m²

Building Element	Assumption
Stairs	• Concrete Stairs: 6 tonnes/flight • Steel: 1500 kg/flight
Curtain Walling	Assume 20% of external façade is curtain walling
Cladding panel	Kingspan Quadcore, 150mm
Cladding rails	4kg/m ² on elevation
Acoustic Louvres	Assume 15kg/m ² , aluminium fins
Acoustic louvre support	Assume 15kg/m ² galvanised steel support
Roof Build up	• VCL Layer • 275mm PIR insulation • Bitumen membrane, 4.5 kg/m²
Steel Grating	Assume 50kg/m ²
Internal Walls	4kg/m ² Drylining Stud + 2x15mm Duraline board
Ceilings	• Data Halls: Tate Structural Ceiling • Office: Metal ceiling • BOH: Mineral fibre infill/ None
Floor Finish	• Data Hall: Concrete Silicone Hardener • Office: Carpet tiles • BOH: Surface hardener or Vinyl
External Works	• Hardstanding area: 200mm PAV2 concrete • Access roads: 230mm asphalt + subbase • Footpath: 70mm asphalt • Fencing: 5kg/m², 4m height • 30 PCC manholes @ 2 tonnes each • 4500m of PVC pipe • Geotextile allowance
Substation	• Substructure: 80 kgCO₂e/m² • Superstructure: 300 kgCO₂e/m²

	• Facade: 75 kgCO₂e/m² • MEP: 25 kgCO₂e/m²
Site Activities	40 kgCO ₂ e/m ² as per RICS PS v2 guidance.

Table 1-1 - Material Assumptions for carbon modelling

1.3.4 Exclusions

In addition to the exclusions from the cost plan, additional information provided on stage 2 was excluded from the assessment as quantities or more data was needed, or impact was de minimis. Exclusions can be found in Table 1-2, where these can be considered as the design progresses.

Main Exclusions from assessment	
1	Temporary Works
2	Data Hall server equipment
3	Fuel use for generators
4	F,F&E
5	Work out with the site boundary
6	Soft Landscaping
7	Any landfill from material offsite (assumed balance cut and fill)

Table 1-2: Exclusions made for the Whole Life Embodied Carbon Assessment

1.3.5 Data sources

The main data source has been the high level Revit models from the architect. These have had material quantities extracted for building elements.

Information	Consultant	Reference
Architectural	Corgan	Revit models: CUR_COR_B1_XX_M3_A_000001.rvt CUR_COR_B3_XX_M3_A_000001.rvt
Structural	Cundall	Embodied carbon database for equivalent data centres
Building Services	Cundall	Embodied carbon database for equivalent data centres
Civil	Cundall	Site Masterplan: CUR-COR-XX-XX-D-SK1104 – Proposed Masterplan_REV4 with input from equivalent project build ups
GIA (area) Unit- m ²		Room Schedules, Revit model: Two storeys: 16,680 m ² One storey: 11,442 m ² Substation: 1060 m ²

Table 1-3: Data Sources

2.0

Whole Life Embodied Carbon Assessment

2.0 Whole Life Embodied Carbon Assessment

2.1 Assessment Result

2.1.1 Overview

The total embodied carbon emissions for both Upfront Embodied Carbon (excluding sequestration) and Life Cycle Embodied Carbon (including sequestration) over a period of 60 years are shown in Table 2-1.

Embodied Carbon Emissions	Upfront Embodied Carbon (Module A1-A5)	Carbon Sequestration (Module A1-A5)	Life Cycle Embodied Carbon (Module B to C excl. B6 to B8)	Whole Life Embodied Carbon (Module A-C)	Benefits beyond boundary (Module D)
Tonnes CO ₂ e	65,278	-234	27,833	92,877	-12,399
kgCO ₂ e/m ² GIA	1,423	-5	607	2,025	-270

Table 2-1: Embodied Carbon Summary- excluding operational emissions.

2.1.2 Embodied Carbon Breakdown

Graph below, Figure 2-1, shows the proportional contribution of the different building element groups to both the upfront and whole-life embodied carbon of the development.

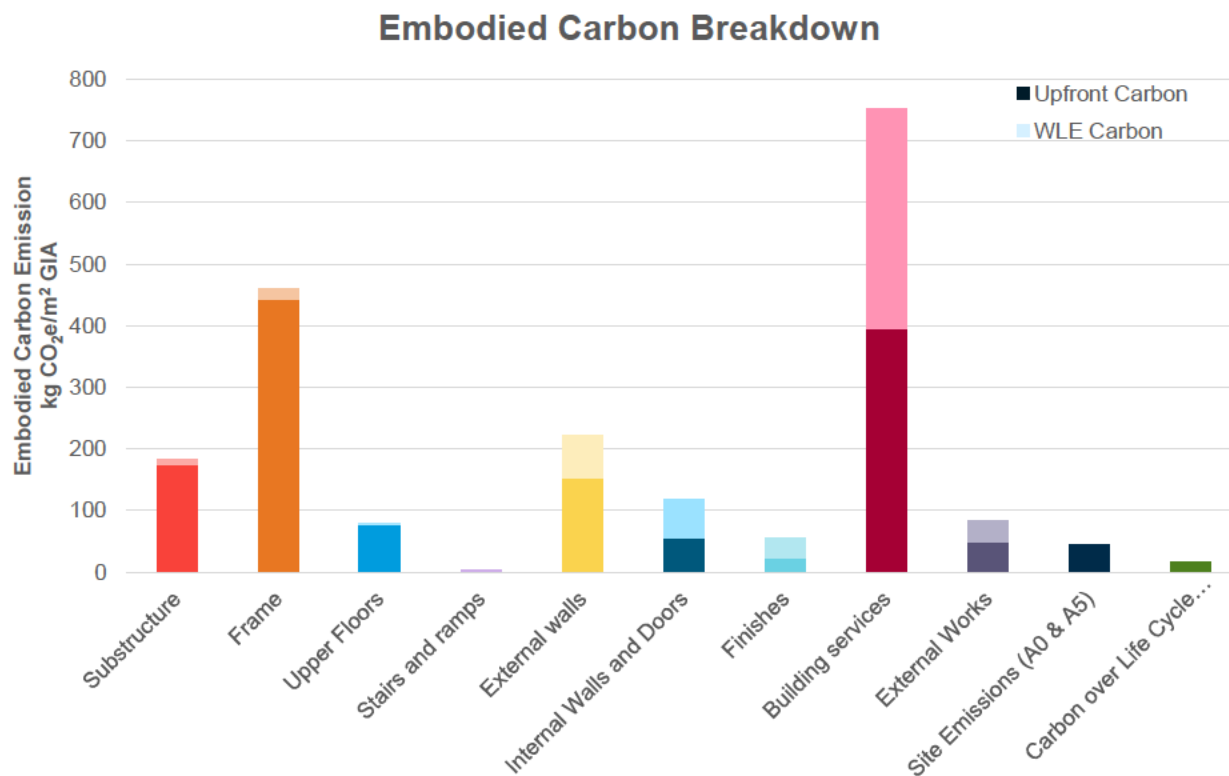


Figure 2-1: Embodied carbon breakdown by Building Element group (Upfront and WL Embodied Carbon)

2.1.3 Key findings

The carbon emissions occurring from the upfront embodied carbon is

2.1.3.1 Upfront Embodied Carbon:

- Substructure ~ 12%
- Building Structure contributes ~ 37%
- Internal Walls and finishes contribute ~ 6%
- Building Services ~ 28%

2.1.3.2 Whole Life Embodied Carbon:

- Substructure, frame, and upper floors contribute ~ 34%
- Internal walls and finishes contribute ~ 9%
- Building Services contribute ~ 37%

It should be noted that there are parts of the building that are external such as roof gantries and external plant areas at ground floor. They have associated materials such as acoustic screens and metal grating floors that contribute to the overall carbon totals, but the associated area isn't accounted for in the GIA. Therefore this increases the contribution of the façade and upper floors.

2.2 Comparison with recent Cundall Datacentre Projects

In the following figure (Figure 2-2), the plotted results of Apatura against various recent Cundall projects for similar buildings. The building is line with other data centre projects but there is a limited data pool to draw firm conclusions from. Some results from Apatura are also skewed due to the design of the building with external areas not contributing to the GIA but adding the overall carbon of the project.

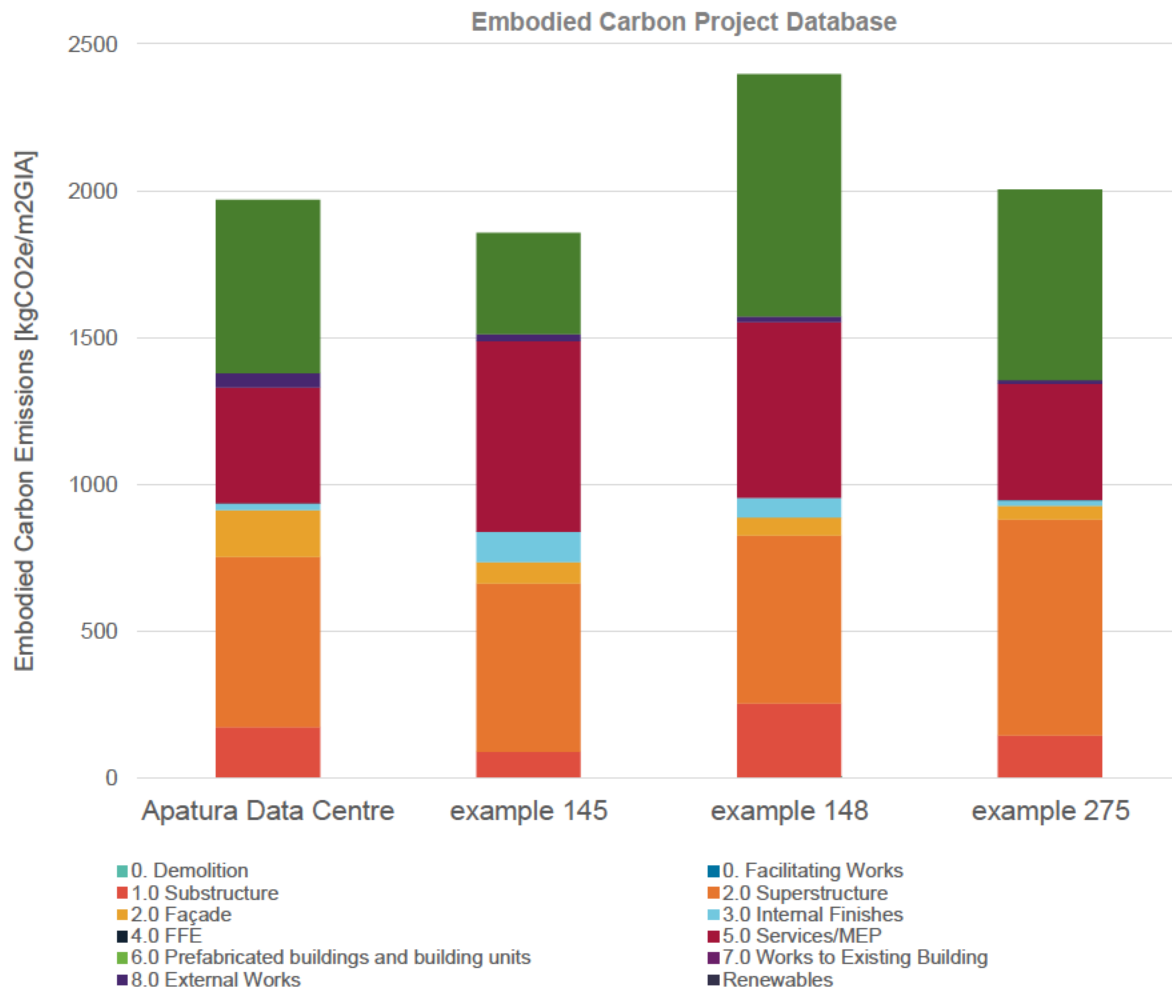


Figure 2-2: Upfront carbon breakdown by Building Element group from past Cundall projects.

3.0

Whole Life Embodied Carbon Reductions

3.0 Whole Life Embodied Carbon Reductions

3.1 Overview

There are a range of ways that embodied carbon could potentially be saved. It should be noted that these carbon reduction material suggestions have been considered about carbon embodiment only, and other influencing factors, such as fire safety, costs and aesthetics must be taken into account and assessed by suitably qualified team members before adoption in the design.

3.2 Steel

Steel is widely used as a construction material within the built environment. In 2021, nearly 2 billions tonnes of steel was produced worldwide, of which approximately half went into construction. The carbon impact of steel is significant and is dominated by the consequence of manufacturing, accounting for 86% of the emissions breakdown of structural steel. Steel is produced through two main methods: Blast Furnace-Basic Oxygen Furnace (BF-BOF) and Electric Arc Furnace (EAF), which account for 71% and 29% of global steel production respectively. Efforts to reduce the carbon footprint of steel include increasing its recycled content. Steel produced from 100% recycled scrap using Electric Arc Furnace (EAF) technology has a carbon footprint that is approximately 20% of that of primary steel. A more impactful way to reduce carbon emissions is by reusing reclaimed steel, which can potentially reduce carbon emissions by up to 95% compared to using new primary or secondary steel. Reclaimed structural steel elements is the cheapest (and most sustainable) option in the current market.

Reclaimed steel doesn't necessarily mean using solely reclaimed steel throughout a project but highlights the opportunity to integrate reclaimed sections where available. Many London-based suppliers offer reclaimed steel sections, and by sourcing and incorporating these materials, projects benefit from a significant reduction in embodied carbon while supporting a cyclical economy. This win-win approach not only aligns with sustainability goals but also helps mitigate practical and logistical challenges associated with steel reuse, such as availability and safe deconstruction.

Building Element	Measure	Background/ comments
Superstructure	Use reclaimed steel	Suppliers such as EMR and Cleveland Steel can provide reclaimed structural steel. Reclaimed steel is tested, cut to length prior to being shot-blasted and delivered for incorporation into the final structure.
Substructure/ Superstructure	Use highly recycled, EAF-manufactured steel	EAF-manufactured reinforcement steel bars from CELSA Group or MEGASA can reduce up to 55% carbon against current market versions. XCarb steel sections from ArcelorMittal is manufactured through the EAF route using high levels of scrap steel and uses 100% renewable energy. EAF-produced steel is more likely to come from mainland European countries, however, the carbon saved in production significantly outweighs any carbon increase from transportation to the UK.

Steel carbon reduction measures

Considering the sourcing of the steel can have the biggest impact on the project as it will be the main carbon contributor. Even small percentages of reclaimed steel and sourcing EAF still can lower the carbon totals drastically. There are important design decisions that should also be promoted that can drive down the embodied carbon through design choices that are then enhanced through low carbon sourcing.

- Work towards high utilisation as close as 1.0 as possible
- Be realistic with deflection criteria for building use
- Consider S460 for column sections
- Consider cellular beams

3.3 Aluminium

After cement and steel, aluminium manufacturing is the third highest source of greenhouse gas emissions in the construction materials sector. Aluminium is an essential construction material with unique properties, including light weight, ease of extrusion to any shape, and excellent durability. It can typically be found in façade, cladding, windows, panels, and partition walls. The current assumption is that all the acoustic louvers are aluminium therefore due to the extent they are a large contributor to the embodied carbon.



Figure 3-1: Aluminium specifications, made from Hydro Power

Building Element	Measure	Background/ comments
Façade and envelope	Use of aluminium with a high recycled content	Aluminium with a high recycled content significantly reduces the need for raw bauxite mining, which is energy-intensive and environmentally harmful. Recycled aluminium requires up to 95% less energy to produce compared to virgin aluminium. Choosing high-recycled-content aluminium helps minimise the carbon footprint of façade and envelope components.
Façade and envelope	Use of Hydro CIRCAL or Reduxa Aluminium	Hydro CIRCAL is an aluminium product containing at least 75% recycled post-consumer scrap. Hydro REDUXA is a low-carbon aluminium made with renewable energy, such as hydropower, during its production process. It guarantees a carbon footprint of less than 4 kg of CO ₂ e per kilogram of aluminium produced

Table 3-1 Brickwork carbon reduction measures

The primary recommendation for carbon reduction should focus on sourcing materials with a high recycled content, specifically tailored to meet the functional requirements of the intended application.

The UK produces approximately 10 million tonnes of recycled metal annually. Aluminium is almost infinitely recyclable, with no loss of material quantities, and currently aluminium products with up to 75% recycled content are available (with a carbon footprint of 1.5-2.3 kgCO₂e per kilogram). An alternative to recycled material is offered by a number of aluminium producers, who provide a low carbon primary smelted product. Most of these products are manufactured using renewable energy, especially hydro power (i.e. Hydro CIRCAL, Hydro REDUXA). Furthermore, Aluminium should be specified from a source that uses less carbon-intensive production methods, i.e. has a high recycled content and/or is produced using renewable energy.

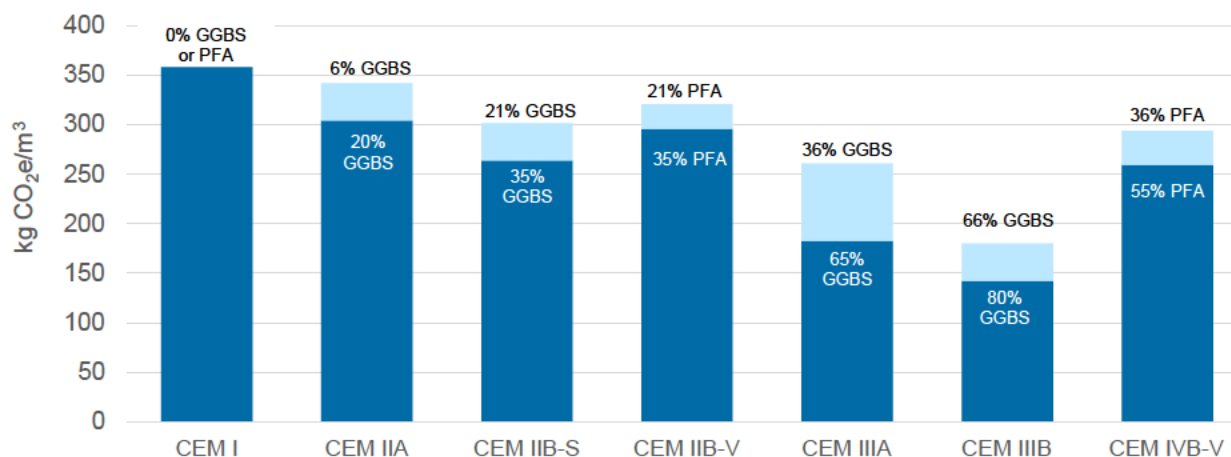
However, an issue arises that around 75% of all aluminium ever produced is still in use today. Consequently, the current supply of recycled aluminium is insufficient to meet the demand, leading to challenges in sourcing enough recycled material to fulfil market needs.

3.4 Concrete

Concrete is a highly durable and versatile material, but its production, primarily driven by the manufacturing of Portland cement, contributes significantly to carbon emissions. Given its widespread use, responsible design and specification are

key to reducing concrete's environmental impact. Reducing concrete's carbon impact can be achieved by minimising its use in buildings as much as possible, substituting cement with secondary cementitious materials (SCMs), adopting innovative design strategies such as alternative slab systems to reduce concrete volume, and sourcing from local manufacturers to minimise transportation emissions.

Embodied Carbon (BS EN 15974 Stage A1-A3) of Concrete 32/40 designations according to BS 8500



Embodied carbon of concrete with different cement replacement

Since some low carbon solutions may have an impact on the construction programme, client support may be required to align carbon objectives with other project requirements, such as cost and time on site. Early and ongoing collaboration with manufacturers and contractors will help determine the lowest carbon solutions available in concrete for that project.

Building Element	Measure	Background/ comments
Substructure	Supplementary cementitious replacement High Cement replacement content	SCMs such as GGBS (Ground Granulated Blast-furnace Slag) or FA (Fly Ash) may be used to replace Portland cement. However, avoid over-reliance on it as the global supply is fully utilised, which may eventually lead to minimal to no overall reduction in global greenhouse gas emissions.
Superstructure	Supplementary cementitious replacement High Cement replacement content	

Concrete carbon reduction measures

In the UK market, products like EFC, ECOPACT, Virtua Abs Zero, and LoCem are already available. However, these products heavily rely on Ground Granulated Blast-furnace Slag (GGBS), which is in limited supply and high demand.

To address this, the industry is increasingly turning to alternative supplementary cementitious materials (SCMs) such as limestone, calcined clay, and volcanic ash. This trend indicates a shift away from the exclusive use of GGBS as the primary Portland cement replacement. With the right market incentives, the industry is likely to invest further in reducing the carbon footprint of new concrete formulations.

There are design choices and collaboration with the local supply chain that should also be done to lower the design requirements of the concrete.

Set carbon targets for concrete

- Use concrete efficiently so minimising thicknesses of slabs.
- Minimising concrete grades.
- Consider 56 day strength concrete.
- Avoid reliance on constrained cement replacement materials such as GGBS.
- Consider benchmarking targets based on Low Carbon Concrete Group (LCCG) Market Benchmark.
- Minimise reinforcement and consider EAF sourcing products such as CELSA or XCarb Products.

3.5 External Windows

Due to its manufacturing process, aluminium can hold an especially high embodied carbon value. Overall consideration ought to be given into ensuring the extent to which aluminium is used within the project is minimised. The building elevations feature extensive curtain walling with aluminium framing, presenting a significant opportunity for reducing the embodied carbon of the project. The primary options when looking to reduce the impact of curtain walling are by specifying combined aluminium/timber framed windows or sole aluminium framed windows with a higher recycled content.

Building Element	Measure	Background/ comments
External Windows/Curtain Walling	Use combi timber/ aluminium framed windows	Timber has the added benefit of sequestering carbon through its growing phase, thus lowering the overall embodied carbon. However, it must be sourced from sustainable forestry practices and be reused/ repurposed at the end-of-life if carbon sequestration is to be included in embodied carbon calculations.
External Windows/Curtain Walling	Use highly recycled aluminium framed windows	Suppliers who provide high recycled content (up to 75%) aluminium framed windows include Aluprof and WICONA (who offers Hydro's hydropower based CIRCAL® or REDUXA® products).

Aluminium framed window carbon reduction measures



Figure 3-2: HYDRO Circal Aluminium Windows



Figure 3-3: Example of timber and aluminium combi window

The glazed portion of the curtain walling should also be targeted for carbon reduction. Glass is 100% recyclable, but this quality has been largely underexploited and requires deployment on a global scale. Pilkington Glass have a low carbon product range called Mirai™ that should be prioritised for procurement. Other low-carbon glass product options include Saint-Gobain's ORAE range.

Finally, designers should focus on the glazed facades as kits of parts, with a demountable system to facilitate the reuse and recycling of the frame and glass. Façade components and connections should allow for easy installation, adaptation, and disassembly by using accessible, reversible, and mechanical connections and adequately scaled components.

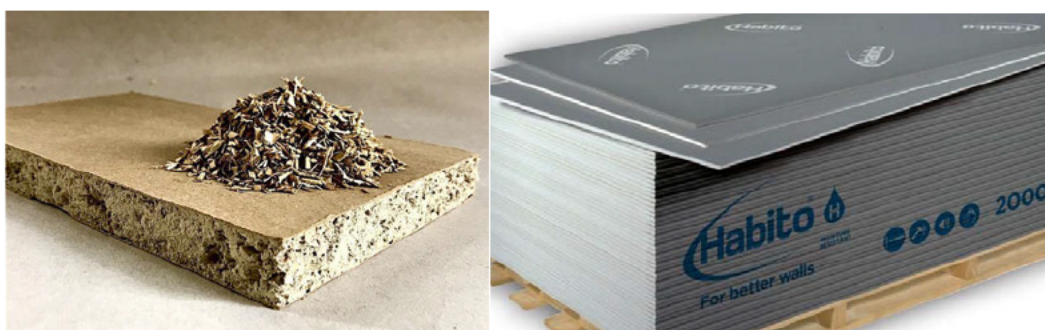
3.6 Internal Walls (Metal Studs and Plasterboard)

The current project design features internal walls constructed with metal studs, acoustic partition rolls, and plasterboard layers, either wallboard or acoustic boards. To reduce the overall embodied carbon associated with this building element, a timber stud construction should be considered instead of metal. Additionally, incorporating plasterboards with high recycled content, such as Habito board, Hempboard, or Breathaboard, should be considered in the design process design making.

Timber stud construction offers a significantly lower embodied carbon impact compared to traditional metal stud systems, as timber naturally sequesters carbon throughout its lifecycle. Additionally, using plasterboards with a high percentage of recycled or bio-based content, such as Habito board, Hempboard, or Breathaboard, not only reduces carbon emissions but also supports a circular economy by repurposing waste materials.

Beyond material selection, further reductions in embodied carbon can be achieved by optimising the wall system's design for material efficiency. This could involve reducing unnecessary layers, specifying lightweight yet durable alternatives, or considering prefabricated panel systems to minimize construction waste. Moreover, the use of natural or low-impact insulation materials, such as wood fibre or hemp insulation, can improve thermal and acoustic performance while decreasing reliance on high-carbon synthetic products.

There should also be lower carbon options explored for the composite panels in the data hall. There are lower carbon composite panels that use low carbon steel from EAF sourcing to reduce the embodied carbon.



Alternative plasterboards (Breathaboard on the left and Habito board on the right)

Building Element	Measure	Background/ comments
Internal Walls – Stud/ framing components	Use timber framing components	The use of steel can be avoided by employing a timber stud internal wall construction, which has a lower environmental impact compared to steel and provide biogenic benefits. Timber may also provide sufficient strength for most residential and light commercial internal wall constructions.
	Use high-recycled steel framing components	If timber cannot be an option, consider the use of lighter steel with high recycled content. For example, the Gypframe® low carbon profiles offer 58% less embodied carbon than the standard steel version.

Internal Walls - Plasterboard	Use plasterboard alternatives with high recycled content	Reduces the need for virgin materials. Prioritise plasterboards that have high recycled content or more innovative products such as Hempboard, Breathaboard-Breathable Plasterboard, or Habito board.
Composite panels	Low Carbon product alternatives	Use low carbon equivalent products that utilise EAF steel for the steel layer.

Internal wall carbon reduction measures

3.7 Quantified Reduction Options

Where elements were measured reduction options were applied to explore the potential carbon savings associated with alternative low carbon materials.

Option	Material	Building Element	Specification	Potential carbon saving	
				(Upfront Embodied Carbon)	
				tCO ₂ e	kgCO ₂ e/m ²
BASELINE				65,278	1,423
1	Insulated Panels	2.5 External envelope including roof finishes	Insulated Panels using Quadcore LEC product	-239	-5
2	Curtain walling	2.5 External envelope including roof finishes	Curtain walling with high recycled content (Hydro Circal)	-480	-10
3	Aluminium	2.5 External envelope including roof finishes	High recycled content in louvres (Hydro Circal)	-1248	-27
4	SFS	2.5 External envelope including roof finishes	Low Carbon Purlins, i.e Metsec Decarb or similar	-108	-2
5	Metal Studs	2.7 Internal Walls and Partitions	Low Carbon studs, i.e Metsec Decarb	-214	-5
6	Concrete	8.1a Roads, paths, pavings, surfaces, Fencing, railings	PAV2 50% GGBS content	-79	-2
7	Concrete	1.2 Basement retaining walls and lowest slab	PAV2 50% GGBS content	-350	-8
POTENTIAL				63,039	1,364
Total Upfront Embodied Carbon saving				2,717	59
Additional Life-cycle Embodied Carbon saving				684	15
Total Whole-life carbon savings				3,401	74

Table 3-2 - Reduction options applied

Reduction Potential by Upfront Carbon Savings

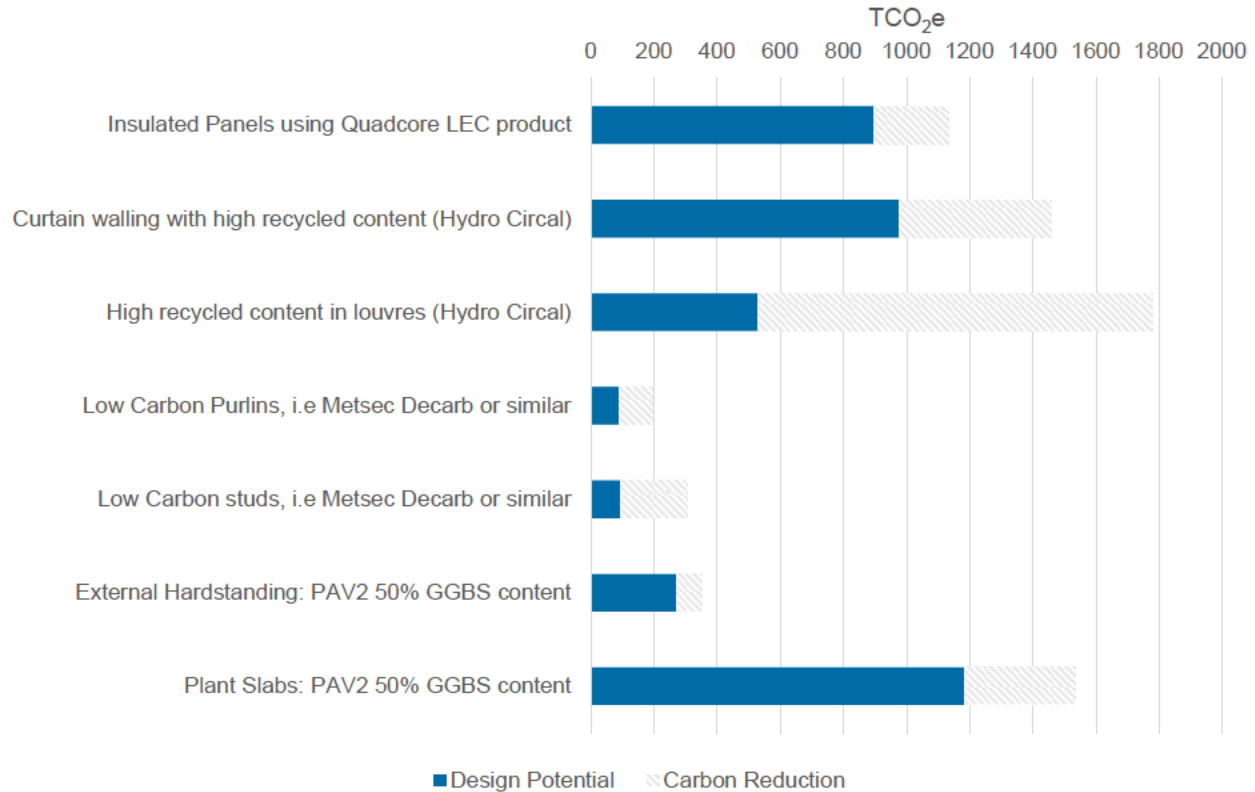


Figure 3-4 - Baseline design with reduction options

The reduction options applied above are limited to the elements measured from the architects model. There will be greater savings possible by looking at the material specification and design of the sub and superstructure when the design is developed and this work will continue with the design team.



If all the options could be adopted, the life cycle emissions (A-C) of the project could be reduced by about ,3401 tonne CO₂e, which is an 5% reduction from the current position. The reductions would lead to an upfront embodied carbon value saving of 59 kgCO₂e/m².

4.0

Conclusion

4.0 Conclusion

4.1 Summary

This assessment reviewed the representative carbon footprint data for the proposed Data Centre at West Hermiston. The total embodied carbon emissions for both Upfront Embodied Carbon and Whole Life Embodied Carbon over a period of 60 years were found to be:

- Upfront Embodied Carbon = 1,478 kg CO₂e/m² (65,278 tonnes CO₂e)
- Whole Life Embodied Carbon = 2,025 kg CO₂e/m² (92,877 tonnes CO₂e)

4.2 Reduction Options

The assessment has discussed the main contributing materials and building elements to the Embodied carbon and reductions options that could be applied to reduce its carbon footprint. We recommend the following be reviewed as the design develops.

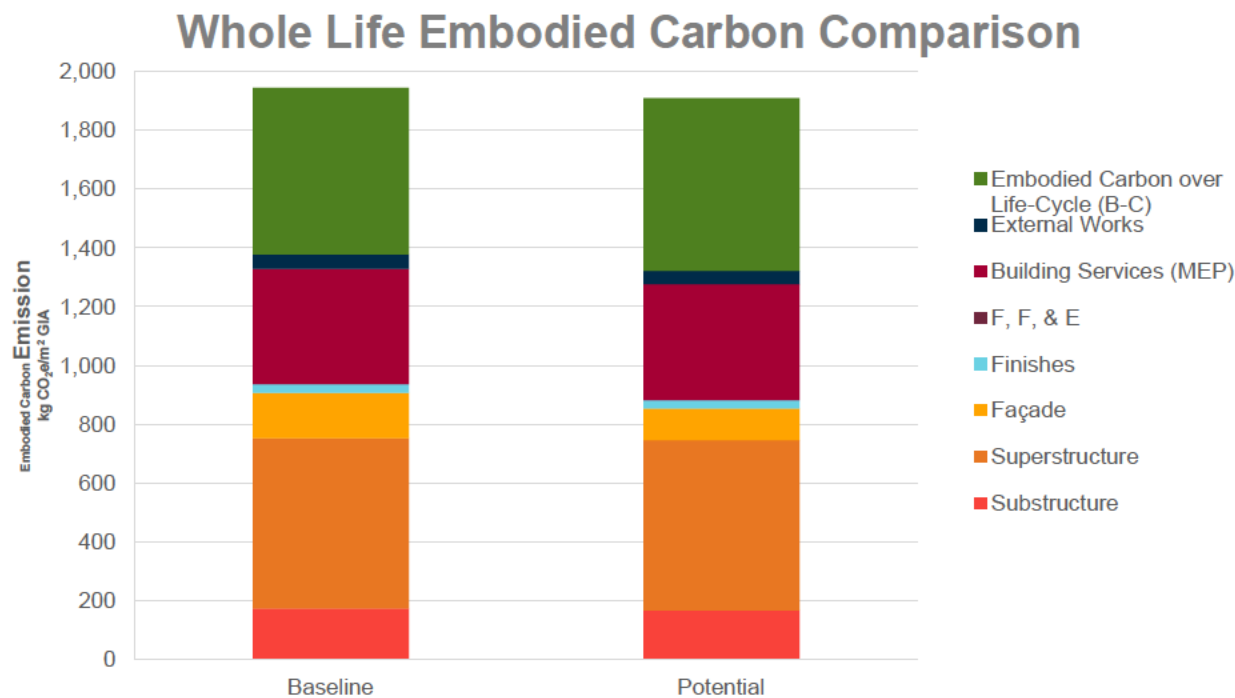
- Use of reclaimed steel or EAF steel in the steel frame
- Cement replacement in the concrete such as GGBS or equivalent
- High recycled content in the aluminium used in the louvres and window framing
- Minimise concrete strengths to reduce cement requirements
- Use of low carbon composite cladding such as Kingspan Quadcore LEC.
- Consider low carbon studwork and alternative boarding for internal walls

Where elements were measured there is scope quantify reduction options. A range of options were calculated that are noted above.

Potential figures

- Upfront Embodied Carbon = 1,363 kg CO₂e/m² (62,526 tonnes CO₂e)
- Whole Life Embodied Carbon = 1,951 kg CO₂e/m² (89,476 tonnes CO₂e)

There will be much greater opportunities to explore reduction options once the detailed design of the structure and MEP services have progressed. We will continue to engage with the design team to support low carbon options that follow the IStructE Design hierarchy for low carbon design.



It's important to note that integrating circular economy principles into the project has the potential to significantly reduce carbon emissions and help achieve the aspirational targets. A circular economy strategy can substantially cut both upfront and embodied carbon emissions for the project.

Appendices

Appendices

Appendix A Project Key Information and Details

Information	Detail
Project Name	Aputura Data Centre
Location	West Hermiston, Edinburgh
Asset type	Data Centre
Project phase	RIBA 2
Anticipated start-on-site date	2029/30
Anticipated completion date	2032

Project details - Aputura Energy - P108 Currie – Wester Hermiston

Building Characteristics and Area

Building Main Characteristics		
Primary normalisation unit	m ²	
Total building GIA (m ²)	45,862 (over three buildings)	
Building above ground	Number of storeys	Varies
	Total height (m)	Varies

Main building characteristics - Aputura Energy - P108 Currie – Wester Hermiston

Area breakdown per floor and use type - Aputura Energy - P108 Currie – Wester Hermiston

Building Materials

Building Element	Brief Description
Substructure	Reinforced concrete, assumed spread foundations
Superstructure	Steel frame with composite slabs and steel grating decks
Façade	Composite panel and curtain walling
Walls and Finishes	Composite panels and drylining studwork
Landscaping	Asphalt and hardstanding

Description of building materials- Aputura Energy - P108 Currie – Wester Hermiston

WLC Uncertainty Factors = 15%

Appendix B RICS Professional Statement (2nd Edition) Guidance Information

Where information has otherwise not been provided or is unavailable, the assumptions taken from the RICS professional statement guidance were adopted, as displayed in the tables below.

Material	Details	Specification
Concrete, cast in situ (ready-mix concrete) Assumptions for reinforcement provided separately	Piling and foundations	Reinforced concrete, C32/40, 25% cement replacement
	Vertical structural elements, e.g., columns, walls	Reinforced concrete, up to 20 storeys (in situ, C32/40, 25% cement replacement, excluding reinforcement) Structure, concrete, over 20 storeys (in situ, C40/50, 25% cement replacement)
	Horizontal structural elements, e.g., beams, slabs	Reinforced concrete (C32/40, 25% cement replacement)
	Facilitating/auxiliary works	Reinforced concrete (C16/20, 25% cement replacement)
	Backfill	Reinforced concrete (C8/10, 25% cement replacement)
Concrete, precast	Structural elements: beams, segments, slabs, etc. pours of <25m ³	Reinforced concrete (C40/50, 0% cement replacement)
	Structural elements: beams, segments, slabs, etc. pours of >25m ³	Reinforced concrete (C40/50, 25% cement replacement, excluding reinforcement)
	Cladding panels	C16/20, 0% cement replacement
Concrete, sprayed	Tunnel/shaft linings curved surfaces: roof shells, domes, etc.	Fibre reinforced concrete, (C32/40, 0% cement replacement)
Concrete reinforcement	Reinforcement bars	UK CARES sector average (EAF production, typically 96% recycled content in UK)
Steel	Sheet piling	Blended EAF/BOF
	Structural steel sections ▪ rolled sections	Blended market rate of 60% BOF/40% EAF production
	Structural steel Sections ▪ plate and closed sections	100% BOF production
	Studwork/support frames	Galvanised steel, 15% recycled content
	Galvanised profiled sheet	UK TATA ComFlor
Masonry	Precast concrete blocks	Lightweight aerated autoclaved concrete (AAC, such as Aircrete) blocks for non-structural uses (600kg/m ³) Medium-density blocks for structural uses (1425kg/m ³)
	Brickwork	Generic UK clay brick, dry brick weight 2.13kg

Material	Details	Specification
Timber	Manufactured structural timber: cross-laminated timber (CLT), Glulam, laminated veneered lumber (LVL), etc	Engineered wood, sustainably sourced
	Studwork (e.g., secondary members such as internal partitions)	Softwood, C16, sustainably sourced
	Framing (e.g., primary members such as joists)	Softwood, C24, sustainably sourced
	Formwork	Plywood, sustainably sourced
Aluminium	Sheet	Aluminium sheet, 31% recycled content
	Extruded profiles	Aluminium extrusions, 31% recycled content
Plasterboard	Partitioning/Ceilings	FGD gypsum plasterboard (approximately 10% recycled content)
Insulation	For floors and external walls	Mineral wool
	For roof – polyisocyanurate (PIR) / rigid polyurethane (PU)	Polyurethane (PU) rigid foam
Aggregates/granular material	Fill material	Aggregates and sand, general UK fill material, mixture of land won, marine, secondary, and recycled, bulk, loose
Glass	Glass: general, glazing, toughened, multi-layer safety, skylight, fibreglass, expanded glass	Relevant generic datasets
Plastics	Plastics (various)	Relevant generic datasets
Coatings	Paints: general, waterborne, solvent-borne	Relevant generic datasets
	Intumescent coating for steel	Amotherm steel WB
	Cementitious spray	Isolatek international product average
Asphalt	For highway and pavement construction	Asphalt, 5% binder content
Bitumen	For road construction, roofing, waterproofing and other applications	Straight run bitumen

Default specifications for main building materials

Transport scenario	km by road	km by sea
Locally manufactured (ready-mixed Concrete)	20	-
Locally manufactured (general). e.g., aggregate, earth, asphalt	50	-
Regionally manufactured, e.g., plasterboard, blockwork, insulation, carpet, glass	80	-
Nationally manufactured, e.g., structural timber, structural steelwork, reinforcement, precast concrete	120	-
European manufactured, e.g., cross-laminated timber (CLT), facade modules	1,500	100
Globally manufactured, e.g., specialist stone cladding	500	10,000

Default transport scenarios for UK projects

Building part	Building elements/components	Expected lifespan
Substructure	Piling and foundations Lowest ground floor	60 years (or building lifespan)
Superstructure: frame, upper floor, and roof structure	Structural elements. e.g., columns, walls, beams, upper floor, and roof structure	60 years (or building lifespan)
Facade	Rain screens, timber panels	30 years
	Brick, stone, block, and precast concrete panels	60 years
	Glazed cladded/curtain walling	35 years
	Hardwood/steel/aluminium windows Doors	30 years 20 years
Roof	Single-ply membrane	30 years
	Standing seam metal	30 years
	Tiles, clay, and concrete	60 years
Superstructure	Studwork	30 years
	Blockwork	60 years
Finishes	<i>Wall finishes:</i> Render/Paint	30/5 years respectively
	<i>Floor finishes:</i> Carpet/vinyl Stone tiles Raised access floor (RAF) pedestal/tile	7 years 25 years 50/30 years respectively
	<i>Ceiling finishes:</i> Substrate/Paint Suspended grid (ceiling system)	10 years 25 years
FF&E	Loose furniture and fittings	10 years
Services/MEP	Heat source, e.g., boilers, calorifiers	20 years
	Heat source, e.g., heat pumps (except ground source)	15 years (20 years)
	Space heating and air treatment	20 years
	Central cooling systems (cooling only). e.g., fan coil systems, variable air volume, variable refrigerant volume	15 years
	Ductwork: Galvanised Plastic or flexible	40 years 15 years
	Electrical installations	30 years
	Lighting fittings	15 years
	Communications installations and controls	15 years
	Water and disposal installations	25 years
	Rainwater harvesting and grey water collection	30 years
	Sanitaryware	20 years
	Lift and conveyor installations	20 years

Building part	Building elements/components	Expected lifespan
Hard Landscaping	Asphalt	35 years
	Concrete and stone paving	60 years
	Timber decking	15 years

Default life span assumptions

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