Whole Life Carbon Assessment

UP4

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1 Executive Summary

A Whole Life Cycle Assessment (WLCA) has been undertaken in accordance with the GLA requirements (WLC guidance, March 2022) on behalf of Ark UP4 Ltd for the proposed development of UP4, Land at Bulls Bridge Industrial Estate, Hayes, UB3 4QQ.

The project consists of the redevelopment of site to deliver extension to existing data centre campus consisting of (a) data centre building (b) energy, power, and water infrastructure (c) internal roads (d) site security arrangements (e) hard and soft, green landscaping and (f) other ancillary and auxiliary forms of development.

The WLCA has been run for the entire building envelope, in line with the GLA requirements which follow the methodology set out in the Professional Statement: Whole Life Carbon assessment for the built environment, 1st Edition 2017. This assessment has been based on materials data provided by the project design team for applicable building elements required by the GLA methodology. The building is being built to a Shell & Core fit-out. Therefore, in line with guidance set out in the GLA Whole Life Carbon methodology, only building related MEP and FFE have been included in this assessment. Items related to Category B fit out, including servers and IT equipment have been excluded from the assessment scope.

This WLCA seeks compliance with policies as set out in section 3.0 of this report and has been undertaken using OneClick LCA software and in accordance with BS EN 15978 and the RICS Professional Statement: Whole Life Carbon assessment for the built environment, 1st Edition 2017.

This WLCA has assessed the following modules for the development.

- Module A1 – A5 (Product sourcing and construction stage)
- Module B1 – B7 (Use stage)
- Module C1 – C4 (End of life stage)
- Module D (Benefits and loads beyond the system boundary)

The development consists of a datacentre with attached energy centre. No GLA benchmarks are available for this type of development. GLA WLC benchmarks are only available for office, residential, education and retail buildings.

Therefore, benchmarks for an Office development have been used for comparison as listed in the GLA 'Whole Life-Cycle Carbon Assessments Guidance' March 2022 and are compared to results at this stage for the development at Union Park Block 4. These benchmarks are not considered representative of datacentres due to design differences between offices and datacentres in terms of the extent of MEP and structural build-up. Therefore, any comparison of carbon intensity of the proposed development to the benchmarks should be taken as indicative and for reference purposes only.

	WLC Benchmark ($kgCO_2e/m^2$)	Aspirational WLC Benchmark ($kgCO_2e/m^2$)	**Proposed Development ($kgCO_2e/m^2$)**
Modules A1-A5 (excluding sequestered carbon)	< 950	< 600	**1,217**
Modules B-C (excluding B6 & B7)	< 450	< 370	**685**
Modules A-C (excluding B6 & B7; including sequestered carbon)	< 1,400	< 970	**1,900**

Table 1 WLC benchmarks for office buildings compared to results of the Proposed Development

The following actions have been taken by the project team to reduce the whole life-cycle carbon emissions and will be reviewed as the project and the design develops.

- Selecting a prefabricated structure over a non-prefabricated structure
- Selecting a composite deck over reinforced concrete
- Use of rainwater harvesting

The following action has been identified as a further potential measure that will be considered in detailed design:

- Increase in recycled content in structural steel

2 Introduction

This RIBA Stage 2 Whole Life Carbon Assessment (WLCA) is submitted on behalf of Sweet Projects Ltd to accompany an application for full planning permission for redevelopment of the site UP4, Land at Bulls Bridge Industrial Estate. The design intent and scope will be revised and evolve in later stages through discussions with the Client, Architect, Tenants, Professional Team, and Statutory Authorities

2.1 Site Description

The development is located at Union Park, Land at Bulls Bridge Industrial Estate, Hayes, UB3 4QQ in the London Borough of Hillingdon. It is located on the Project Union development site and part of a wider development site for a number of data centres. The first data centre block (UP1) and associated energy centre (EC1) is complete and occupied with the other two data centres (UP2 and UP3) and energy centres (EC2 and EC3) under construction.

There is an existing building on site, which has a total area of circa 3,500sqm of floorspace and was formerly occupied by Addison Lee for the repair, maintenance, and replacement of private hire vehicles, sits centrally within the Site. Addison Lee has vacated the site and the building is currently used by Ark and their contractors as a construction base whilst the adjacent permitted scheme is being delivered. The building is surrounded by hardstanding which is currently used for car parking and storage. An area of trees is located in the western corner of the site.

The site is to be redeveloped to deliver an extension to the existing campus consisting of:

(a) data centre building

(b) energy, power, and water infrastructure

(c) internal roads

(d) site security arrangements

(e) hard and soft, green landscaping

(f) other ancillary and auxiliary forms of development.

The site area is 1.26ha.

Figure 1 Existing Site & Indicative Boundary

2.2 Development Description

The existing building is being demolished because it no longer fills the functional role required of the new development plan, which seeks to redevelop the site to accommodate a data centre.

The proposed development will include the following:

a) Data Centre Building The proposed fourth block will connect directly onto the western edge of Data Centre Block 3. The intention is for the data centre to have a maximum height of 35m, mirroring that of Data Centre Block 3. The intention for the façade is to draw on the approach for Data Centre Block 2, using cladding panels connected to each other at right angles to create a point that sticks out. Three sets of these will be located vertically above one another with the angle of each set differing to that of the ones above and below it;

b) Ancillary Block – This is conjoined and immediately west of the Data Centre Building. It provides the required support and office space. It is to be glazed with glazing panels separated with dark vertical fins on the southern elevation to reduce solar glare. It is envisaged that roof space will be used for PV panels and brown / green roofing;

c) Energy Centre - An energy centre is proposed to be physically connected to the western edge of the ancillary block. The energy centre will have a maximum height of 28m. The intention is to draw upon the design approach of the three already permitted energy centres, using vertical fins with perforations and orientated in a way to allow views through the façade in some areas (with the use of back lighting adding interest). Darker cladding is to be used then for the Data Centre Building, extending the 'light-dark' pattern across all of the data centre buildings and contrasting with the lighter colour ;

d) Security Measures - Clearly ensuring a high level of security is key for the successful operation of a data centre (and designation of data centres at Critical National Infrastructure only increases these requirements) and the intention is that the permitted fence lines will effectively be extended around the proposed development. No visitor reception centre is required to serve this block whilst the permitted western vehicular lock entrance will be used;

e) Car Parking and Access - The proposal is for the permitted circulation road, which runs around the western edge of Data Centre Block 3, to be extended further westwards to that it continues around the proposed fourth data centre and energy centre before turning back eastwards and re-connecting to the main access and egress into the wider site at North Hyde Gardens Road Bridge.

f) Landscaping – Conjoining Data Centre Block 4 with Data Centre Block 3 and pushing development as close to the railway line as possible leaves two primary areas of Data Centre Block 4 landscaping. Due to the security requirements of Ark and their future occupier, these areas of land are to be located within the secure fence line.

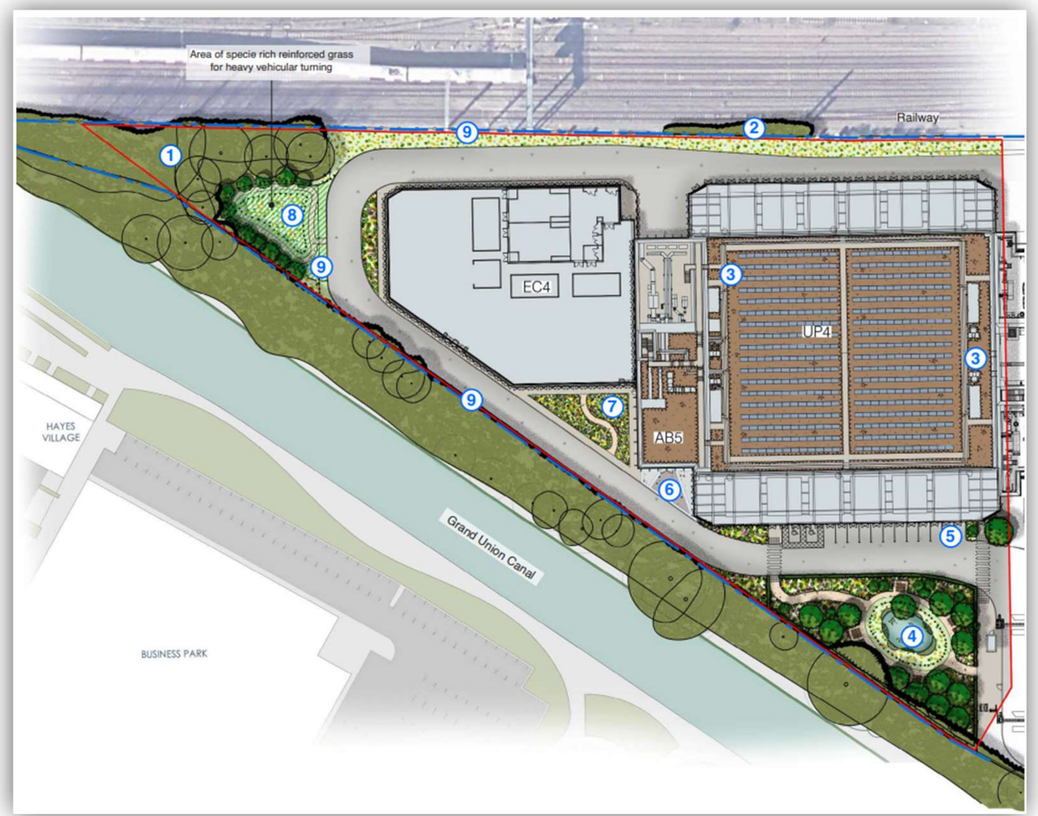

Figure 2 Block 4 site plan

The site area is 1.26ha and includes a floorspace of **18,910m²** (within thermal line). The floorspaces are broken down across several floors:

Ground Floor:
- UP4 3,008 m², AB5 439 m², EC4 320 m²

First Floor
- UP4 3,008 m², AB5 537 m², EC4 320 m²

Second Floor
- UP4 3,008 m², AB5 537 m², EC4 320 m²

Third Floor
- UP4 3,008 m², AB5 537 m², EC4 320 m²

Fourth Floor
- UP4 3,008 m², AB5 537 m²

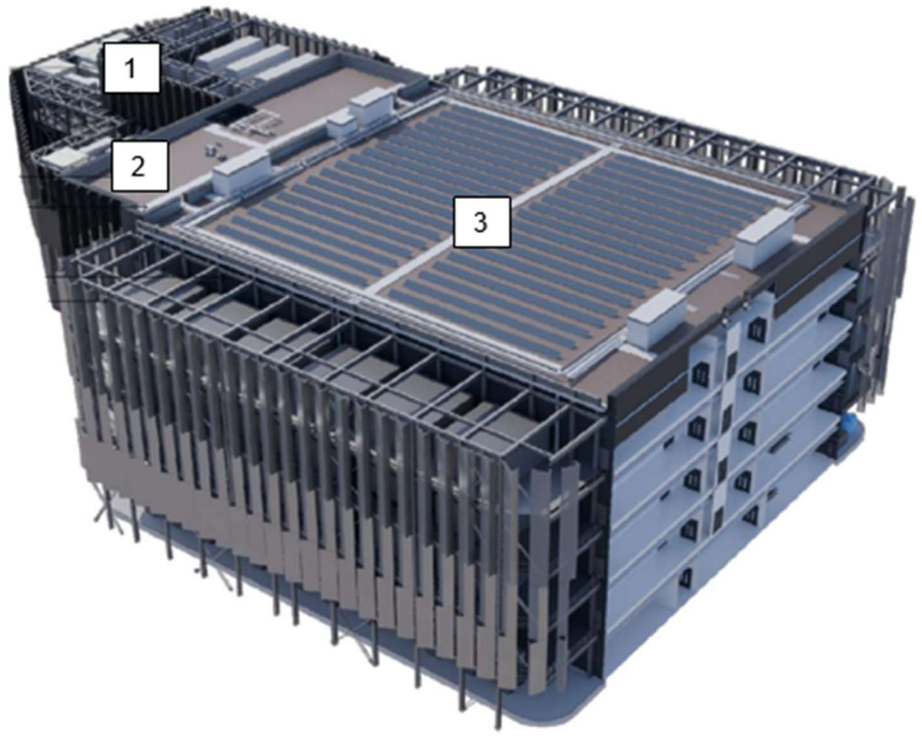

Figure 3 3D Image Showing 1) Energy Centre, 2) Admin Wing and 3) Data Hall

The above Gross Internal Area (GIA) includes areas up to the thermal line only (and thus used for the operational energy modelling – Life cycle stage B6). Due to the nature of the development, this area excludes a significant proportion of the energy centre and data halls which fall outside of the thermal line, but within the building's external perimeter walls. See section 2.3 on the adopted approach

2.3 Approach

This WLCA has been undertaken using One Click LCA and in accordance with BS EN 15978 and the RICS Professional Statement: Whole Life Carbon assessment for the built environment, 1st edition 2017.

This WLCA has assessed the following modules:

- Module A1 – A5 (Product sourcing and construction stage)
- Module B1 – B7 (Use stage)
- Module C1 – C4 (End of life stage); and
- Module D (Benefits and loads beyond the system boundary).

Workshops with key stakeholders have been undertaken during RIBA Stages 0-2 to develop the sustainability strategy for the development, notably the kick off workshop in November 2024.

18 November 2024: Whole Life Carbon & Circular Economy workshop

- Architects: Studio NWA
- Structures: HDR
- Cost Consultant: Ridge
- MEPH: HDR / Grattes Brothers
- Sustainability: HDR
- Landscape Architect: Murdoch Wickham
- Contractor: Sweet Projects
- Project Management: Ridge

A copy of the workshop presentation can be found in Appendix C.

Input data within the whole life carbon assessment is a combination of the following:

- Specific quantities and specifications of materials and structures (Studio NWA, February 2025)
- Material Outline Schedule (HDR – Structures, February 2025)
- Responses to specific information requests from consultants with responses provided during January and February 2025
- Where not available, default figures were generated through the One Click Carbon Designer software based on the building size.

See Appendix B for the Bill of Quantities table, which contains data sources for each building area.

The GIA stated in section 2.2 above includes areas up to the thermal line only. Due to the nature of the building, this area excludes a significant proportion of the energy centre and data halls which fall outside of the thermal line, but within the building's external perimeter walls.

Therefore, for the purposes of WLC it should be noted that the reported GIA includes all areas within *and outside* of the thermal line i.e. all areas of building structure including gantries or those housing generators. This is in accordance with further clarifications sought within Figure 8 of the 'RICS Whole life carbon assessment for the built environment guidance, Version 2, Aug 2024' which states "… Energy centres or utilities [in this instance gantries either side of the data halls] with substructure to be reported as a building… [and that] buildings linked by bridges or accommodation above ground are reported as one building…" It is noted that the energy centre, admin wing, and data halls are all connected as thus reported within this document as single entity.

Revised floor areas have been provided as follows:

Ground Floor:
- UP4 3,008 m^2, AB5 439 m^2, EC4 1,849 m^2

First Floor
- UP4 4,974 m^2, AB5 537 m^2, EC4 1,870 m^2

Second Floor
- UP4 4,974 m^2, AB5 537 m^2, EC4 1,866m^2

Third Floor
- UP4 4,974 m^2, AB5 537 m^2, EC4 1,862m^2

Fourth Floor
- UP4 4,974 m^2, AB5 537 m^2, EC4 (Chiller deck) 789m^2

Total floor area: **33,727 m^2** (within and outside thermal line)

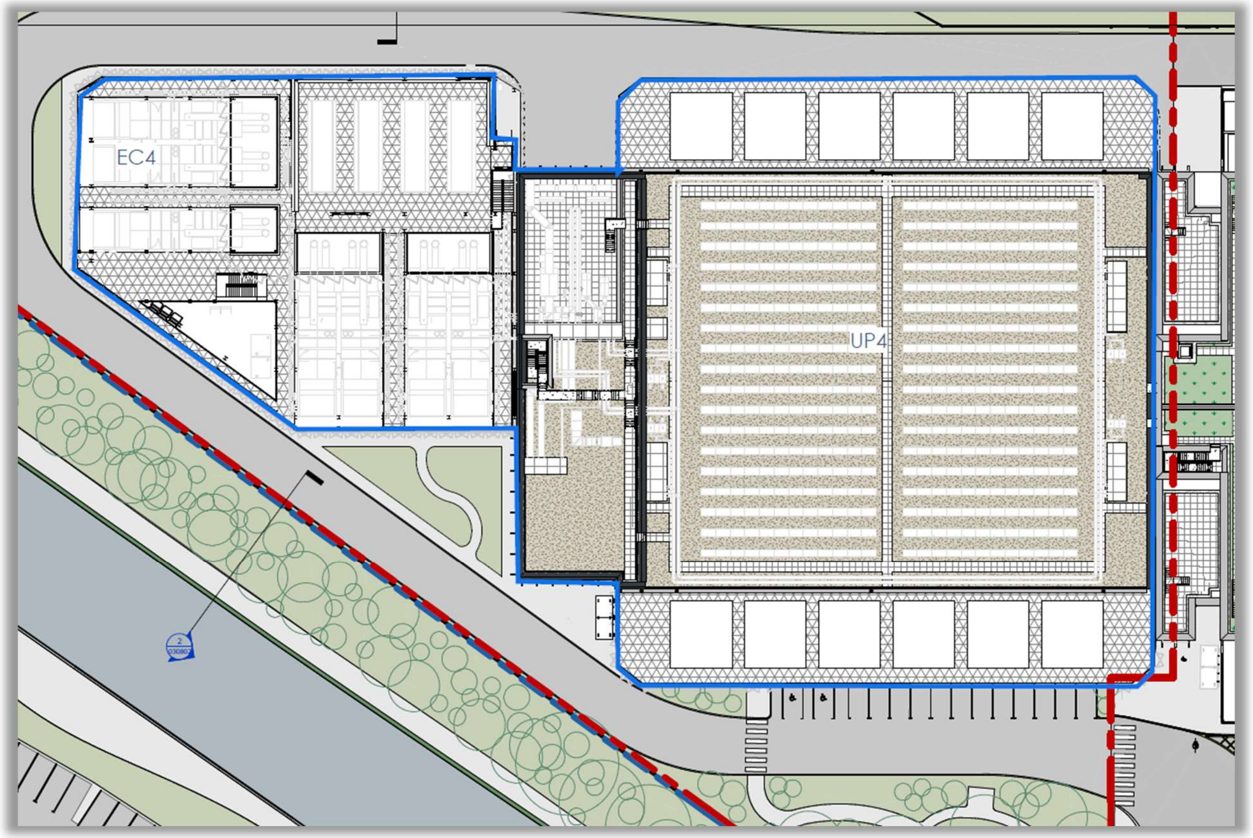

Figure 4 Site plan showing area within GIA (blue line) as defined for the WLCA, to include energy centre and gantries on floors 1-4.

3 Planning Policies

The report responds to the following policies which have been used to inform design decisions for the Proposed Development.

3.1 National Planning Policy Framework and Planning Policy Statements (December 2024)

The National Planning Policy Framework (2024) sets out the challenges presented by climate change.

Paragraph 161 states:

"The planning system should support the transition to net zero by 2050 and take full account of all climate impacts including overheating, water scarcity, storm and flood risks and coastal change. It should help to: shape places in ways that contribute to radical reductions in greenhouse gas emissions, minimise vulnerability and improve resilience; encourage the reuse of existing resources, including the conversion of existing buildings; and support renewable and low carbon energy and associated infrastructure."

Paragraph 164a and 164b states:

"New development should be planned for in ways that: a) avoid increased vulnerability to the range of impacts arising from climate change. When new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through incorporating green infrastructure and sustainable drainage systems; and b) help to reduce greenhouse gas emissions, such as through its location, orientation and design. Any local requirements for the sustainability of buildings in plans should reflect the Government's policy for national technical standards."

3.2 London Plan 2021

The adopted version of the London Plan shows all the mayor's updated policies such as the following:

- Policy GG2 Making the best use of land
- Policy GG3 Creating a healthy city
- Policy GG6 Increasing efficiency and resilience
- Policy D1A Infrastructure requirements for sustainable densities
- Policy D1B Optimising site capacity through the design-led approach
- Policy D13 Noise
- Policy G5 Urban Greening
- Policy G6 Biodiversity and access to nature
- Policy G7 Trees and woodlands
- Policy G8 Food growing
- Policy SI1 Improving air quality
- Policy SI2 Minimising greenhouse gas emissions
- Policy SI3 Energy infrastructure
- Policy SI4 Managing heat risk
- Policy SI5 Water infrastructure
- Policy SI7 Reducing waste and supporting the circular economy
- Policy SI12 Flood risk management
- Policy SI13 Sustainable drainage
- Policy T1 Strategic approach to transport
- Policy T5 Cycling
- Policy T6 Car parking

3.3 GLA Whole Life Carbon Assessments Guidance March 2022

The Whole Life-Cycle Carbon Assessments London Plan Guidance document includes the following policy background.

WLC emissions are the total carbon emissions resulting from the construction and the use of a building over its entire life, including its demolition and disposal. They capture a building's operational carbon emissions from both regulated and unregulated energy use, as well as its embodied carbon emissions - that is, emissions associated with raw material extraction, the manufacture and transport of building materials, and construction; and the emissions associated with maintenance, repair, and replacement, as well as dismantling, demolition, and eventual material disposal. A WLC assessment also includes an assessment of the potential savings from the reuse or recycling of components after the end of a building's useful life. It provides a true picture of a building's carbon impact on the environment.

The mayor's net zero-carbon target for new development continues to apply to the operational emissions of a building. The WLC requirement is not subject to the mayor's net zero-carbon target; but planning applicants are required to calculate operational and embodied emissions and demonstrate how they can be reduced as part of the WLC assessment. Planning applicants should continue to follow the GLA's Energy Assessment Guidance to assess and reduce operational emissions and insert the relevant information into the WLC assessment, as explained in this guidance.

Designing a development that follows a WLC approach will:

- *Ensure that a significant source of emissions from the built environment is accounted for, which is necessary in achieving a net zero-carbon city*
- *Achieve resource efficiency and cost savings, by encouraging refurbishment, and the retention and reuse of existing materials and structures, instead of new construction*
- *Identify the carbon savings from using recycled material and the benefits of designing for future reuse and recycling, to reduce waste and support the circular economy*
- *Encourage a 'fabric first' approach to building design, to minimise mechanical plant and services in favour of natural ventilation*
- *Ensure operational and embodied emissions are considered at the same time to find the best solutions for the development over its lifetime*
- *Identify the impact of maintenance, repair, and replacement over a building's life cycle which, by informing the building's design and specification, improves lifetime resource efficiency and reduces life-cycle costs, contributing to the future proofing of asset value*
- *Encourage local sourcing of materials and short supply chains, with resulting carbon, social and economic benefits for the local economy*
- *Encourage durable construction and flexible design, both of which contribute to greater longevity and reduced obsolescence of buildings and avoid carbon emissions associated with demolition and new construction.*

4 Method Statement

4.1 WLCA Overview

In the UK, approximately 25% of total UK greenhouse gas emissions are attributable to the built environment.[1] A Whole Life Carbon Assessment encompasses all carbon emissions associated with a building throughout its entire lifecycle, offering a holistic view of these emissions.

Whole life carbon emissions of a building is formed of two key components:

- **Operational Carbon**: emissions of carbon dioxide during the operational or in-use phase of a building. A new building with net zero operational carbon does not burn fossil fuels, is 100% powered by renewable energy, and achieves a level of energy performance in-use in line with the UK national climate change targets.

- **Embodied Carbon**: carbon dioxide emitted during the manufacture, transport, and construction of building materials, together with end-of-life emissions.

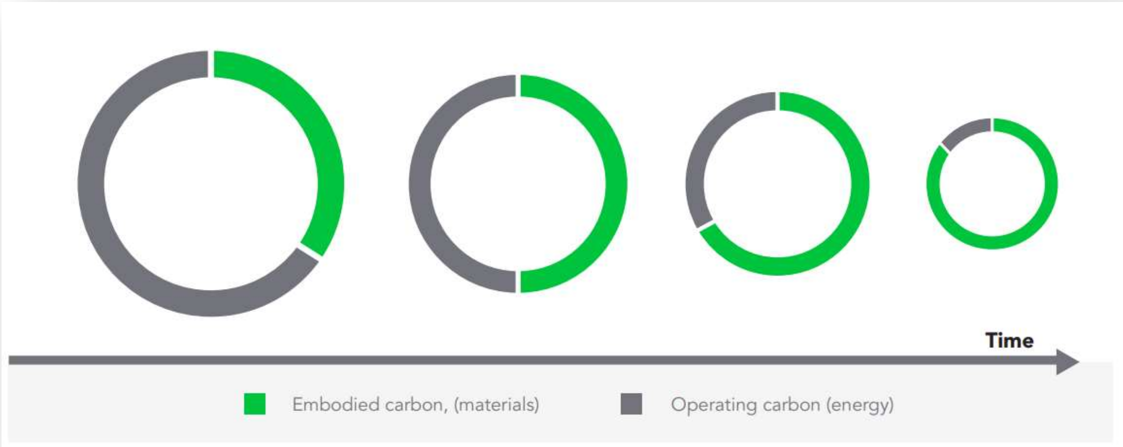

Figure 5 Embodied and Operational Carbon Over Time. Source: The Embodied Carbon Review, Bionova Ltd, 2018

The use of construction products leads to a wide range of environmental and social impacts across the life cycle of a building project, through initial procurement, wastage, maintenance, and replacement. Construction products make a highly significant contribution to the overall life cycle impacts of a building. In some cases, they may even outweigh operational impacts. The introduction of Part L into the Building Regulations for England and Wales has led to reductions in the operational energy consumption of buildings and these regulations are being progressively tightened. As a result, greenhouse gas emissions from other aspects of buildings, such as embodied emissions, are becoming increasingly important in terms of reducing the overall emissions that lead to climate change over the building's lifetime. The graph above highlights the anticipated changing balance between the impact of embodied carbon and operating carbon over time.

To stay within the IPCC's[2] 1.5 degrees scenario, significant embodied carbon reductions are necessary. The World Green Building Council believes that to meet our climate change targets all new buildings must operate at net zero carbon by 2030 and all buildings operate at net zero carbon by 2050.

Life cycle assessment (LCA) is one of the best methodologies to allow building professionals to understand the energy use and other environmental impact associated with all the phases of a building's life cycle. This is often known as embodied carbon or energy assessment. The embodied energy of a building is the energy required to make, deliver, assemble, and dispose of all the materials used in its construction, refurbishment, and demolition. Embodied carbon is the CO_2 emissions released due to the embodied energy plus any process emissions, such as the CO_2 released by the chemical reaction when cement is produced.

The embodied carbon of a building is calculated by measuring the quantity of every material used over the life of the building and multiplying this by an emissions factor for each. To this, emissions due to delivery of materials to site, construction activities, and waste is added.

The LCA process is governed under ISO 14000, a series of international standards addressing environmental management. The framework for appraising the environmental impacts of the built environment specifically is provided by EN 15978: 2011. It is part of the EN 15643 family of standards for the sustainability assessment of buildings. It sets out the principles for whole life assessment of the environmental impacts from built projects based on LCA.

For whole life principles to be integrated into the design, procurement, and construction processes and beyond, and for project teams to be engaged in a timely fashion, carbon assessments should be carried out at key project stages from concept design to practical completion.

4.2 WLCA Scope

Whole Life-Cycle Carbon (WLC) emissions are the carbon emissions resulting from the construction and the use of a building over its entire life, including its demolition and disposal. They capture a building's operational carbon emissions from both regulated and unregulated energy use, as well as its embodied carbon emissions, i.e., those associated with raw material extraction, manufacture and transport of building materials, construction and the emissions associated with maintenance, repair, and replacement as well as dismantling, demolition, and eventual material disposal.

A WLC assessment provides a true picture of a building's carbon impact on the environment and split into various life cycle stages as shown in the table below:

[1] Building to net zero: costing carbon in construction - Environmental Audit Committee

[2] Intergovernmental Panel on Climate Change https://www.ipcc.ch/

Product Stage			Construction Process Stage		Use Stage							End-of-Life Stage				Benefits and loads beyond the system boundary		
Raw material supply	Transport	Manufacturing	Transport to building site	Installation into building	Use/application	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction/demolition	Transport	Waste processing	Disposal	Reuse	Recovery	Recycling
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D	D	D
	x		x	x			x			x	x			x			x	

Table 2 Description of Life Cycle stages

A description of the life cycle stages, and analysis scope are provided in the tables below:

Impact category	Unit
A1-A3 Construction Materials	Raw material supply (A1) includes emissions generated when raw materials are taken from nature, transported to industrial units for processing and processed. Loss of raw material and energy are also considered. Transport impacts (A2) include exhaust emissions resulting from the transport of all raw materials from suppliers to the manufacturer's production plant as well as impacts of production of fuels. Production impacts (A3) cover the manufacturing of the production materials and fuels used by machines, as well as handling of waste formed in the production processes at the manufacturer's production plants until end-of-waste state.
A4 Transportation to site	A4 includes exhaust emissions resulting from the transport of building products from manufacturer's production plant to building site as well as the environmental impacts of production of the used fuel.
A5 Construction/installation process	A5 covers the exhaust emissions resulting from using energy during the site operations, the environmental impacts of production processes of fuel and energy and water as well as handling of waste until the end-of-waste state.
B1-B5 Maintenance and material replacement	The environmental impacts of maintenance and material replacements (B1-B5) include environmental impacts from replacing building products after they reach the end of their service life. The emissions cover impacts from raw material supply, transportation and production of the replacing new material as well as the impacts from manufacturing the replacing material as well as handling of waste until the end-of-waste state.
B6 Energy use	The considered use phase energy consumption (B6) impacts include exhaust emissions from any building level energy production plus the environmental impacts of production processes of fuel and externally produced energy. Energy transmission also considered.

Impact category	Unit
B7 Water use	The considered use phase water consumption (B7) impacts include the environmental impacts of production processes of fresh water and the impacts from wastewater treatment.
C1-C4 Deconstruction	The impacts of deconstruction include impacts for processing recyclable construction waste flows for recycling (C3) until the end-of-waste stage or the impacts of pre-processing and landfilling for waste streams that cannot be recycled (C4) based on type of material. Additionally, deconstruction impacts include emissions caused by waste energy recovery.
D External impacts/end-of-life benefits	The external benefits include emission benefits from recycling recyclable building waste. Benefits for re-used or recycled material types include positive impact of replacing virgin-based material with recycled material and benefits for materials that can be recovered for energy cover positive impact for replacing other energy streams based on average impacts of energy production.

Table 3 Description of Life Cycle stages included in EN15804:2012 and analysis scope included in WLCA

The table below lists the building elements included and excluded in the WLCA model.

Building Part/Element Group	Building element	Included
Demolition	0.1 Toxic/Hazardous/Contaminated Material treatment	N/A
	0.2 Major Demolition Works	Y (reported separately on GLA spreadsheet)
0 - Facilitating works	0.3 & 0.5 Temporary enabling works	Y
	0.4 Specialist groundworks	Y
1- Substructure	1.1 Substructure	Y
	2.1 Frame	Y
	2.2 Upper floors incl. balconies	Y
	2.3 Roof	Y
	2.4 Stairs and ramps	Y
	2.5 External walls	Y
	2.6 Windows and external doors	Y
	2.7 Internal walls and partitions	Y
	2.8 Internal doors	Y

3 - Finishes	3.1 Wall finishes	Y
	3.2 Floor finishes	Y
	3.3 Ceiling finishes	N
4- Fittings, furnishings and equipment (FF&E)	4.1 FF&E	Y (where applicable*)
5 - Building services/MEP	5.1 – 5.4 Building services	Y
6 - Prefabricated Buildings and Building Units	6.1 Prefabricated buildings and building units	Y
7 Work to Existing Building	7.1 Minor demolition and alteration works	N/A
8 - External works	8.1 Site preparation works	N
	8.2 Roads, paths, pavings and surfacings	Y
	8.3 Soft landscaping, planting and irrigation systems	Y
	8.4 Fencing, railings and walls	Y
	8.5 External fixtures	Y
	8.6 External drainage	Y
	8.7 External services	Y
	8.8 Minor building works and ancillary buildings	N/A

Table 4 Building elements included in the WLCA model

* The data centre is being built to a Shell & Core (Category A) fit out. Therefore, items related to Category B fit out, including servers and IT equipment are excluded from the assessment scope in line with GLA guidelines.

4.3 Environmental Data Sources and OneClick

One Click LCA was used in the undertaking of this LCA. The tool supports the CML[3] impact assessment database and methodology (2002-2012 or newer) and all assessed impact categories. All the datasets in the tool follow the EN 15804 standard. The software is fully compliant with the EN 15978 standard. One Click LCA has been third party verified by the Instytut Techniki Bodowlanej (ITB) for compliance with the following LCA standards: EN 15978, ISO 21931–1 and ISO 21929, and data requirements of ISO 14040 and EN 15804.

[3] CML, is the University of Leiden's Institute of Environmental Sciences

5 Inputs

5.1 Energy Consumption

The Energy Statement accompanying the planning application details how operational energy use has been minimised.

The operational energy figure used for this WLCA has been calculated in accordance with TM54. The CIBSE TM54 analysis was undertaken based on a tailored planning stage Part L 2021 Vol. 2 model and industry benchmarks to estimate regulated and unregulated energy. The model under the TM54 methodology utilises available design information including in-operation profile of the building. The model results include calculations for the annual energy associated with not only the regulated elements but also the unregulated elements such as IT equipment, lifts, refrigeration systems, external lighting, CCTV etc where applicable.

Further details are provided within HDR's Energy Statement (Issue 00, February 2025), also provided as part of the Planning Application.

The following quantities have been provided from the HDR energy model and have been assessed in terms of the whole life carbon using OneClick's dataset for UK specific electricity mixes.

Annual Energy Consumption (MWh /yr)			
		Unit (MWh/yr)	Profile
Grid Electricity	Regulated	35,596.83	SAP10_IEA2015 (SAP 10.1 and 10.2)
Grid Electricity	Unregulated	266,186.93	SAP10_IEA2015 (SAP 10.1 and 10.2)

5.2 Water Usage

5.2.1 Process water use

Water usage for process use within the building has been calculated by HDR as the following:

1,701,000 litres (1,701 m^3/year)

This includes an offset of approximately 210,000 litres provided by rainwater harvesting.

5.2.2 Water use for sanitary applications

Water consumption (non-process related) has been calculated using the BREEAM Wat01 methodology, based on a NIFA of 1,603m^2 for the admin building only. This provided a default occupancy of 178. Flow rates and flush volumes have been entered as the worst case allowable under the BREEAM Datacentre Wat01 methodology:

WCs – effective flush volume of 4.5 litres

Wash hand basin taps – 6 litres/min

Showers – 9 litres/min

Kitchen taps – 10 litres/min

Total water consumption has been calculated as 7.11m3/person/year

Overall water consumption 1,265m^3/year.

5.3 Construction Site Operations

In line with EN15978, the site impacts from construction works are reported in the A5 module (as indicated in Table 1 in section 4 of this report). As stage project specific information is not available, a climate zone average scenario has been included based on the total floor area.

The quantity of excavation material has been calculated using the Sweet Projects SWMP (10th February 2025), and the HDR Cut and Fill report (28th February 2025).

5.4 Emissions and Removals (B1)

Annual and 'End of Life' Refrigerant leakage rates have been included according to the proposed roof top plant. R-410a refrigerant will be used for all systems which has a Global Warming Potential (GWP) of 2088. The following systems are proposed at this stage:

Table 5: Refrigerant Information

System	Refrigerant type	Refrigerant per system (kg)	Service life	Annual leakage rate	Refrigerant GWP	End of life leakage rate
VRF System CU-101	R-410a	20.1	15	1	2088	0
VRF System CU-102	R-410a	20.1	15	1	2088	0
VRF System CU-103	R-410a	69.9	15	1	2088	0
VRF System CU-104	R-410a	69.9	15	1	2088	0
VRF System CU-105	R-410a	66.5	15	1	2088	0
VRF System CU-106	R-410a	66.5	15	1	2088	0
VRF System CU-107	R-410a	67.9	15	1	2088	0
VRF System CU-108	R-410a	67.9	15	1	2088	0
VRF System CU-109	R-410a	27	15	1	2088	0
VRF System CU-110	R-410a	26.6	15	1	2088	0
VRF System CU-111	R-410a	24.5	15	1	2088	0
VRF System CU-112	R-410a	25.4	15	1	2088	0

VRF System CU-113	R-410a	26.4	15	1	2088	0
VRF System CU-114	R-410a	26.4	15	1	2088	0
VRF System CU-115	R-410a	26.4	15	1	2088	0
VRF System CU-116	R-410a	26.4	15	1	2088	0
VRF System CU-117	R-410a	26.4	15	1	2088	0
CRAC System CRAC-001	R-410a	15	15	1	2088	0
CRAC System CRAC-002	R-410a	15	15	1	2088	0

Cementitious materials, such as concrete, cement and mortar, absorb carbon dioxide when exposed to air. This process is the chemical reversal of the cement production process calcination phase. The amount of carbon dioxide absorbed depends on exposure of the material, duration of the exposure as well as the initial amount of cement. Carbonisation of cementitious materials has not been included in this model.

However, vegetation carbon ('biogenic') withdrawals have been included based on the number of proposed trees, outlined in the Landscape design outlined in the Design and Access statement (Studio NWA, February 2025).

5.5 Modules B2 & B3

Paragraph 2.5.12 of the London Plan Guidance: Whole Life-Cycle Carbon Assessments (March 2022) confirms that during the design stage, modules B2 and B3 will be more challenging to estimate. Therefore, an estimate of electricity used, multiplied by the expected number of days of planned maintenance each year can be applied.

Module B2

Alternatively, for module B2 emissions, a total figure of 10 $kgCO_{2e}/m^2$ gross internal area (GIA) may be used to cover all building element categories, or 1 per cent of modules A1-A5, whichever is greater.

Building GIA = 33,727 m^2 (within and outside thermal line)

10 x 33727 = 337,270 $kgCO_{2e}$
Or
41,043,766.93 x 1% = 410,437.7 $kgCO_{2e}$

Therefore, the larger is 410,437.7 $kgCO_{2e}$ and this has been used within this LCA.

Module B3

For module B3 emissions, these may be estimated as 25 per cent of module B2, as per paragraph the RICS Professional Statement, November 2017.

410,437.7 $kgCO_{2e}$ x 25% = 102,609.42 $kgCO_{2e}$

6 Results

6.1 Estimated WLC emissions

The development has been modelled using OneClick software. Full details of the results can be found on the GLA's London Planning Guidance WLCA assessment template (March 2022 version) submitted alongside this report. A snapshot of these results can be seen below.

	WLC Benchmark ($kgCO_2e/m^2$)	Aspirational WLC Benchmark ($kgCO_2e/m^2$)	**Proposed Development ($kgCO_2e/m^2$)**
Modules A1-A5 (excluding sequestered carbon)	< 950	< 600	**1,217**
Modules B-C (excluding B6 & B7)	< 450	< 370	**685**
Modules A-C (excluding B6 & B7; including sequestered carbon)	< 1,400	< 970	**1,900**

Table 6 WLC benchmarks for office buildings compared to results of the Proposed Development

Datacentres are not covered by GLA benchmarks, therefore for the purposes of this assessment the offices benchmark was selected. These benchmarks are not considered representative of datacentres due to design differences between offices and datacentres in terms of the extent of MEP and structural build-up. Therefore, any comparison of carbon intensity of the proposed development to the benchmarks should be taken as indicative and used for reference purposes only.

7 Opportunities to reduce embodied carbon

7.1 Actions included in the WLCA

The following actions are decisions made by the design team to reduce the embodied carbon emissions in the RIBA Stage 2 design of the development. The floor area used in these calculations is 33,727m^2 (within and outside thermal line). The table below summarises the change in kgCO_2/m^2 per each design option:

Table 7: Summary of Carbon Emissions Reductions by Design Change

Design Option	Reduction in kgCO_2/m^2
Selecting a prefabricated structure over a non-prefabricated structure	12.6
Selecting a composite deck over reinforced concrete	11.83
Use of rainwater harvesting	0.81

7.1.1 Prefabricated vs Non-Prefabricated Structure

Compared to a traditional, non-prefabricated approach which involves on-site construction, a prefabricated building involves off-site construction processes in which components are manufactured in a factory and then transported to the site for assembly. Prefabricated buildings typically minimise material waste and reduce greenhouse gas emissions due to less on-site construction activity. On-site construction typically will generate more waste due to less precise material use and more transport requirements. Furthermore, prefabricated buildings are often designed for longevity and for disassembly.

The development at Union Park, Block 4 shows a value of 13,305,947 kg CO_2e if a traditional construction approach is undertaken, and a total of 12,880,878 kg CO_2e if a prefabricated structure is selected.

The preferred option of using prefabricated structures has led to a reduction of **12.6 kg CO_2/m^2**.

7.1.2 Reinforced Concrete Upper Floors v. Metal-Concrete Composite Floors

The upper floors of the data hall will have metal-concrete composite floors, which is preferred to floors made of reinforced concrete. The use of steel and concrete can have overall lower greenhouse gas emissions compared to reinforced concrete due to the optimised use of materials and more energy-efficiency production processes. Steel is also highly recyclable, compared to concrete which is a less efficient process and more energy intensive. Additionally, the precision manufacturing of steel components results in less construction waste.

The development at Union Park, Block 4 shows a value of 1,037,196 kg CO_2e if reinforced concrete floors were selected, and a total of 638,222 kg CO_2e if a composite deck is selected.

The preferred option of using metal-concrete composite floors has led to a reduction of **11.83 kg CO_2/m^2**.

7.1.3 Use of Rainwater Harvesting

The use of rainwater harvesting reduces water and energy demand of the site. Conserving rainwater and using this resource on site reduces the energy required to treat and pump municipal water, which lowers associated emissions. If rainwater harvesting was excluded from the design, there would be an increased reliance on surrounding systems and higher energy consumption for treatment. Rainwater harvesting also assists with stormwater management by reducing runoff and preventing pollution from entering surrounding ecosystems.

The development at Union Park, Block 4 shows a value of 356,394,869 kg CO_2e if rainwater harvesting is not used, and a total of 317,242,278 kg CO_2e if rainwater harvesting is included.

The preferred option of incorporating rainwater harvesting has led to a reduction of **0.81 kg CO_2/m^2**.

7.2 Further potential actions

7.2.1 Increase in recycled content in structural steel

The carbon factor of steel varied depending on its recycled content and production method. Basic Oxygen Furnace (BOF) is a fossil fuel-fired production process which produces steel from high proportions of virgin iron ore compared to scrap metal. The current default scenario 1 is 20% recycled content as stated in the RICS guidance (v1), based on BOF manufacturing route.

Electric Arc furnace (EAF) is a process powered by the electricity grid and can produce steel made with a very high recycled content (typically 97% in the UK).

Due to changes in global supply chains and manufacturing processes, the updated default scenario, as outlined in the RICS Whole Life Carbon for the built environment professional standard (2nd edition, Sept 2023) is a blended market rate of 60% BOF / 40% EAF production.

The current default scenario 1 is 20% recycled content as stated in the RICS guidance (v1). Increasing this to Scenario 2 with a blended market rate of 60% BOF / 40% EAF production (structural steel to energy centre and admin only) will reduce whole life carbon emissions.

The potential action of reviewing steel manufacturing methods and recycled content could lead to a reduction of **67.9 kg CO_2/m^2.**

8 Conclusion

A Whole Life Cycle Assessment in accordance with the GLA requirements (Whole life carbon guidance, March 2022) has been undertaken for the proposed development at Union Park – Block 4. This has been completed with the aim of recognising and encouraging measures to optimise construction product consumption efficiency, and the selection of products with a low environmental impact (including embodied carbon) over the life cycle of the building.

The WLCA has been run for the entire building envelope, in line with the GLA requirements. This has been based on materials data provided by the project design team for applicable building elements required by the GLA methodology at RIBA Stage 2.

This WLCA has assessed the following modules for the development.

Module A1 – A5	(Product sourcing and construction stage)
Module B1 – B7	(Use stage)
Module C1 – C4	(End of life stage); and
Module D	(Benefits and loads beyond the system boundary).

The following actions have been taken by the project team to reduce the whole life-cycle carbon emissions and will be reviewed as the project and the design develops.

- Selecting a prefabricated structure over a non-prefabricated structure
- Selecting a composite deck over reinforced concrete
- Use of rainwater harvesting

The following action has been identified as a further potential measure that will be considered in detailed design:

- Increase in recycled content in structural steel

Appendix A. Bill of Quantities

Section	Result category	Material quantity kg	Material intensity kg/m² Gross Internal Area	Estimated reusable materials kg/m²	Estimated recyclable materials kg/m²	Data source
1	1 Substructure	57006491	1690.23		1690.23	Information provided by the project team, extract from Revit models.
21	2.1 Superstructure: Frame	1408702	41.77	19.75	22.02	Information provided by the project team, extract from Revit models.
2.2	2.2 Superstructure: Upper Floors	5254611	155.8		155.44	Information provided by the project team, extract from Revit models.
2.3	2.3 Superstructure: Roof	1944107	57.64		42.58	Information provided by the project team, extract from Revit models.
2.4	2.4 Superstructure: Stairs and Ramps	49520.75	1.47		1.47	Information provided by the project team, quantities calculated through OneClick Carbon Designer software.
2.5	2.5 Superstructure: External Walls	835525.9	24.77	3.74	21.03	Information provided by the project team, extract from Revit models.
2.6	2.6 Superstructure: Windows and External doors	14809.76	0.44		0.44	Information provided by the project team, extract from Revit models.
2.7	2.7 Superstructure: Internal Walls and Partitions	1027962	30.48		30.42	Information provided by the project team, extract from Revit models.
2.8	2.8 Superstructure: Internal doors	72359.31	2.15		2.1	Information provided by the project team, extract from Revit models.
3	3 Finishes	1370958	40.65		38.18	Information provided by the project team, extract from Revit models.
4	4 Fittings, furnishings & equipment	762.79	0.023		0.00017	Information provided by the project team.
5	5 Services (MEP)	1800350	53.38		44.83	Plant Schedule
6	6 Prefabricated buildings and building units	5221815	154.83	154.83		Information provided by the project team, extract from Revit models.
7	7 Work to existing building					
8	8 External works	2448861	72.61	16.52	54	Information provided by the project team, Bill of Quantities,
0	0 Unclassified / Other					
total	Total					

Appendix B. Glossary

Term or acronym	Summary Description
Greenhouse Gases (GHG)	(Often referred to as 'carbon emissions' in general usage) 'Greenhouse Gases' are constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of infrared radiation emitted by the Earth's surface, the atmosphere, and clouds. For these 'Carbon Definitions', we are only addressing the GHGs with Global Warming Potentials assigned by the IPCC, e.g. carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), hydrofluorocarbons (HFC's), perfluorocarbons (PFC's), and sulphur hexafluoride (SF6).
Whole Life Carbon:	'Whole Life Carbon' emissions are the sum total of all asset related GHG emissions and removals, both operational and embodied over the life cycle of an asset including its disposal (Modules: A1-A5; B1-B7 (plus B8 and B9 for Infrastructure only); C1-C4). Overall Whole Life Carbon asset performance includes separately reporting the potential benefit from future energy recovery, reuse, and recycling (Module D).
Embodied Carbon:	The 'Embodied Carbon' emissions of an asset are the total GHG emissions and removals associated with materials and construction processes throughout the whole life cycle of an asset (Modules A1-A5, B1-B5, C1-C4).
Embodied Carbon:	'Upfront Carbon' emissions are the GHG emissions associated with materials and construction processes up to practical completion (Modules A1-A5). Upfront carbon excludes the biogenic carbon sequestered in the installed products at practical completion.
Operational Carbon - Energy	'Operational Carbon – Energy' (Module B6) are the GHG emissions arising from all energy consumed by an asset in-use, over its life cycle.
Operational Carbon - Water	'Operational Carbon – Water' (Module B7) are those GHG emissions arising from water supply and wastewater treatment for an asset in-use, over its life cycle.
Carbon Sequestration	'Carbon Sequestration' is the process by which carbon dioxide is removed from the atmosphere and incorporated as 'Biogenic Carbon' in 'Biomass', through photosynthesis and other processes associated with the carbon cycle.
Net Zero (Whole Life) Carbon	A 'Net Zero (Whole Life) Carbon' Asset is one where the sum total of all asset related GHG emissions, both operational and embodied, over an asset's life cycle (Modules A1-A5, B1-B7 (plus B8 and B9 for Infrastructure only), C1-C4) are minimized, meet local carbon, energy and water targets, and with residual 'offsets', equals zero.
Net Zero Embodied Carbon	A 'Net Zero Embodied Carbon' asset is one where the sum total of GHG emissions and removals over an asset's life cycle (Modules A1-A5, B1-B5 and C1-C4) are minimized, meets local carbon targets (e.g.kgCO2e/m2), and with additional 'offsets', equals zero.
Net Zero Upfront Carbon	A 'Net Zero Upfront Carbon' asset is one where the sum total of GHG emissions, excluding 'carbon sequestration', from Modules A1-A5 is minimized, meets local carbon targets (e.g.kgCO2e/m2), and with additional 'offsets', equals zero.

(Whole Life Carbon Network Definitions LETI) https://b80d7a04-1c28-45e2-b904-e0715cface93.filesusr.com/ugd/252d09_879cb72cebea4587aa860b05e187a32a.pdf