MEADOW HIGH SCHOOL HAREFIELD
School Expansion

Whole Life Carbon Assessment, Aug 2022
Rev 02

CDC Studio

Issue Status

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Content

Executive Summary

This Whole Life Carbon Assessment has been prepared by CDC Studio and the wider project team with regard to a project proposed for an expansion of Meadow High School at a site in Harefield, Hillingdon. The purpose of the statement is to consider how the whole life carbon policy requirements of the London Plan 2021 can be met.

The project comprises the refurbishment and extension of an existing residential boarding block - with associated landscape and external spaces - to provide a new special school for 90 pupils. In total, the accommodation will comprise approximately 2235m2 GIA.

This document should be read in conjunction with related information submitted with the planning application.

Key Considerations

The project team has chosen to retain and refurbish the existing building on the site, retaining services and finishes where possible to reduce carbon intensity and support the change of use of the building to the required standards.

- **Re-use/ adaption of existing building sub-structure, super-structure and skin layers**
- **Adaption/ recycling of building services/ stuff layers**
- **Replacement of gas with ASHP and PV renewable energy to decarbonise operational energy**
- **Use of timber CLT timber frame to sequester carbon and form lightweight building to reduce concrete sub-structure.**

Scope

The report considers strategic approaches to minimising the carbon use of the proposed building over the course of its life.

The project is supported by the adjacent team members.

Project Team Members

Executive Summary

Betterment of Benchmarks

The WLC Assessment for the proposed expansion of Meadow High School, Harefield indicates approximately *44% reduced carbon emissions* in comparison to the GLC benchmark for school projects included in the March 2022 guidance*. This reduction is also below the GLA's 'aspirational' target. The adjacent diagram indicates the comparison.

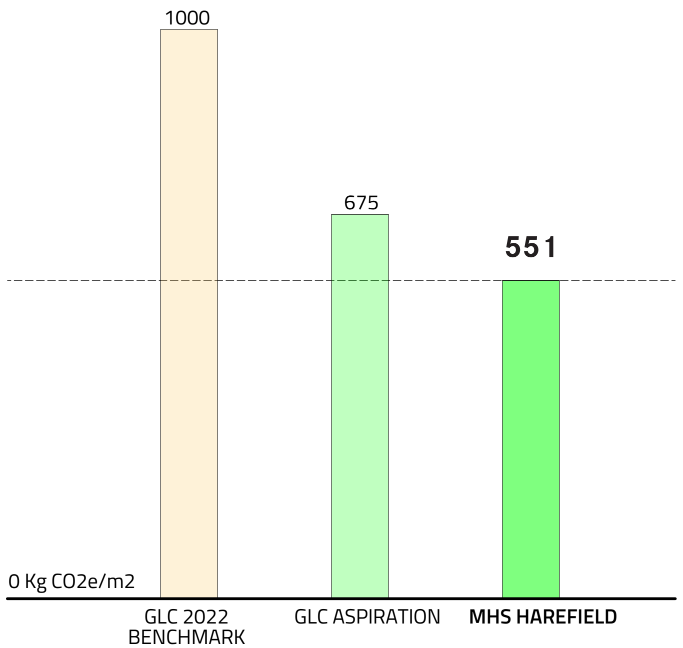
The reason for this reduction is primarily due to the retention and refurbishment of the existing residential block building on the site.

Considering the building element by mass chart (below right), this indicates that the largest part of the embodied carbon in the project is associated with the external areas eg access road, pavings, surfaces, groundworks etc

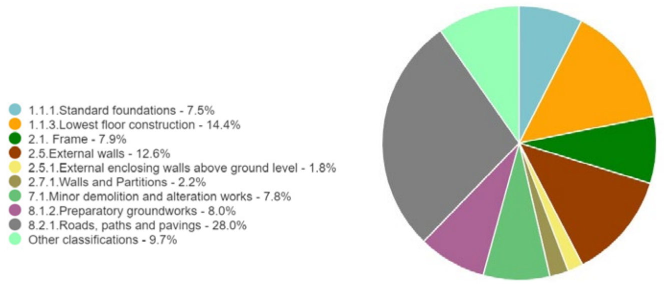
This perhaps to be expected of a change of use to a special school, which depends heavily upon the external areas of the school grounds to extend the curriculum and provide bespoke spaces for social and physical activity. However, this assessment provides the project team with a focus to reduce the carbon intensity of the proposed external works by reducing below-ground works and by seeking carbon-efficient materials.

Operational carbon has been reduced by removing the building from gas as a heating source and providing ASHP and a roof-mounted photovoltaic panel array.

The new extension to the refurbished building has been designed to 'fabric first' principles with high levels of thermal performance and air tightness to reduce operational energy loads.



School Benchmark Comparison
Modules A-C (excl. B6 & B7 incl. sequestration)



Building Element Comparison by Mass
One-Click LCA output

* *Based upon Modules A-c excl B6 & B7 incl. sequestration*

1 Introduction

1.1 Background

The Site

The site is located adjacent to Northwood Road in Harefield, Hillingdon. The site is currently part of Harefield Academy school and contains an existing residential block building which was constructed in 2011 but is currently redundant. The existing building comprises some 1613me GIA.

The related site is currently comprised by car parking and an access road, as well as a MUGA games area and areas of soft landscape.

The project proposes to retain the existing building and repurpose it as a special school for 90 pupils (and related staff) as an extension to Meadow High School, Uxbridge. The existing external areas will be resurfaced and reconfigured to provide dedicated external areas for the school.

The space requirements of BB104 for special schools indicate that the existing building is too small to accept all of the accommodation, and so the building is also proposed to be extended with a new extension providing new classroom spaces over a further 622m2 of GIA.

Purpose of WLC Assessment

The report considers means of reducing both operational and embodied energy throughout the expected 60 year lifespan of the building and the related site.

The purpose of the assessment is to enable the project team to understand areas of carbon intensity and make decisions about how these could be reduced over the whole life of the building, from construction to deconstruction.

This document is structured around the GLA London Plan Guidance - 'Whole Life Cycle Carbon Assessments' March 2022.

Spatial Boundary of WLC Assessment

Key:

1 Harefield Academy
2 Residential Boarding Block

1.2 Key Principles

Standards and Guidance

Policy SI2 of The London Plan 2021 sets out to minimise carbon emissions both in-use and through reduction of embodied carbon in the fabric of the building throughout its life. This policy requires the preparation of a Whole Life Carbon Assessment for major planning applications - with a net zero carbon target - the requirements for which are outlined in recent guidance published in March 2022.

The GLA guidance is structured around the principles of BS EN 15978:2011 and the RICS Professional Statement 'Whole Life Carbon Assessments' 2017, which provide a structure based on lifecycle modules A-D as a means for quantifying the total carbon emissions of a building from cradle to grave.

This structure has been further adopted by LETI in their paper 'Embodied Carbon Primer' 2020 and by the RIBA in their '2030 Climate Challenge' advice 2021.

Circular Economy

A key component of reducing carbon emissions is to reduce waste to landfill, ensuring that the value of carbon embodied in the production and processing of materials in buildings is not lost by disposal. This project has considered circular economy principles to maintain the value of materials where possible.

A Circular Economy Statement has been prepareed for the MHS Harefield project in accordance with GLA Policy SI7, which shares data with this WLC Assessment and which should be read in conjunction with this document.

	CARBON REDUCTION PRINCIPLE	BENEFIT	PROJECT-SPECIFIC EXAMPLE
1	**Reuse and Retrofit of Existing Building**	Reduces carbon, costs, and accelerates programme.	Existing building fabric and below-ground/ incoming services retained as Pre-Demolition Audit. Re-use of external area sub-bases and fencing. Primary project intent is to retain as much material as possible in the existing building.
2	**Use Repurposed or Recycled Materials**	Reduces waste and carbon emissions	Pre-Demolition Audit identifies potential re-use of materials on and off-site. Circular Economy Statement Bill of Materials identifies reasonable material recycled content for specification benchmarks.
3	**Material Selection**	Reduces replacement and associated carbon/ costs	All timber products to be FSC or PEFC sourced. BRE 'Green Guide to Materials' to be used as specification reference.
4	**Minimise Operational Energy Use**	Fabric First approach to reduce energy demand and carbon emissions	Existing gas boilers to be removed. Heat source to be new ASHP with new 51 panel PV array providing renewable energy source. Extension designed to high fabric performance in excess of Part L 2021.
5	**Minimise Carbon Emissions Associated with Water Use**	Optimise choice of materials and durability of systems	School use greatly lowers building water heating loads from residential use. Low water fittings to be specified with suitable controls for school use.
6	**Disassembly and Reuse**	Ensures products do not become future waste and and maintain value	Circular Economy Statement outlines end-of-life measures and principles for disassembly/ reuse.
7	**Building Shape and Form**	Compact efficient shape minimises operational and embodied carbon	New extension size minimised to meet spatial requirements of the brief; 100% utilisation of existing building spaces.
8	**Regenerative Design**	Removing carbon through materials and systems	CLT timber structure sequesters carbon. Green roof to new extension has limited carbon absorption benefits.

1.3 Key Principles

Carbon Reduction Principles

The project team has collaborated to consider how carbon emissions could be reduced during construction, in-use and at end-of-life, taking into account lifecycle modules A-D.

The adjacent table indicates how the 16 principles of carbon reduction outlined in the GLA guidance are considered to apply to the MHS Harefield project. These principles have led the design of the project to the point of the planning application and will structure project team actions within RIBA Stages 4-7.

	CARBON REDUCTION PRINCIPLE	BENEFIT	EXAMPLE OF CARBON REDUCTION PRINCIPLE
9	**Designing for Durability & Flexibility**	Durability reduces whole-life building emissions. Flexibility avoids obsolescence.	School use drives internal robustness of finishes to ensure durable and resilient interiors. Space planning and accessibility improvements ensure flexibility of use. Circular Economy Statement outlines material/ product choice principles.
10	**Optimising Operational and Embodied Carbon**	Contributes to resource efficiency and overall cost reduction	Existing building themal performance improved with high fabric performance extension. Removal of gas source for ASHP and PVs for decarbonisation of heat source possible due to high fabric u-values and air-tightness.
11	**Building Life Expectancy**	Defining life expectancy enables efficent choices of materials and products.	Building is designed for 60 year lifespane. Pre-Demolition Audir identifies potential extended lifespan of existing building for new sustainable community use.
12	**Local Sourcing**	Reduces transport distances and has social and economic benefits	Standardisation of components and materials will ensure that materials are able to be sourced from multiple suppliers. Contractor to consider supply chain labour and materials from local sources.
13	**Minimising Waste**	Buildings should be designed to avoid construction waste and ease repair and replacement with minimum waste	Circular Economy Statement outlines principles of component and material selection. Retaining sub-structure, superstructure, shell and below-ground services layers of building makes ongoing use of existing resources.
14	**Efficient Construction**	Efficient construction (eg MMC) can reduce construction phase waste and increase quality	Pre-frabricated CLT frame proposed to new extension will reduce on-site waste and minimise operations on-site. FFE, external windows and internal joinery (doorsets) also pre-fabricated.
15	**Lighweight Construction**	Lightweight construction uses less material and reduces carbon emissions	CLT frame provides a lightweight superstucture which enables a lean sub-structure design.
16	**Circular Economy**	CE principles can have carbon and cost benefits	Circular Economy Statement outlines principles of approach and metrics relating to materials and end of life.

2 Strategy

2.1 Building Refurbishment

Change of Use

The project seeks to retain as mch of the existing building fabric on site as part of the re-purposing of the residential building to a new special school use.

As a residential building, the small cellular bedrooms do not provide the larger classrooms and support spaces required by BB104 standards.

To ensure that the standards can be achieved, internal structural and non-structural walls need to be removed and internal finishes, fittings and services reconfigured to suit the spatial planning.

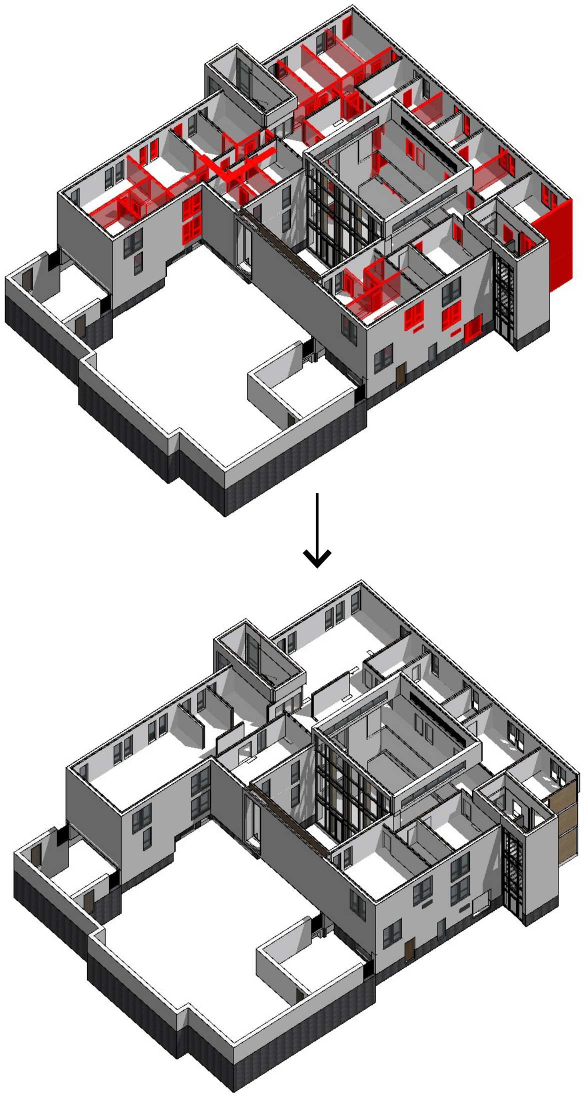
The Pre-Demolition Audit (please see Circular Economy Statement) lists materials to be removed to facilitate the re-purposing of the building.

The existing fabric of the existing building is largely retained. The building is refurbished with new finishes, services and fittings to allow occupation of the building for a sustainable community use as a special school.

Retention of Fabric

As the existing building on the site is reasonably modern - constructed in 2011 - it benefits from good levels of thermal performance. The proposal is to retain the existing elements broadly untouched, but with upgraded performance to new elements such as new windows or doors in line with the consequential improvement requirements of Part L 2021.

Key Materials and Elements Identified in Pre-Demolition Audit



100% Building Re-Purposed for School Use

Project Intent

The construction industry is challenged by organisations such as LETI, the RIBA, RICS, ISructE and the Architect's Journal to prioritise the re-use of buildings. This project is very much aligned with this intent.

2.2 Approach to Extension

New-Build Extension

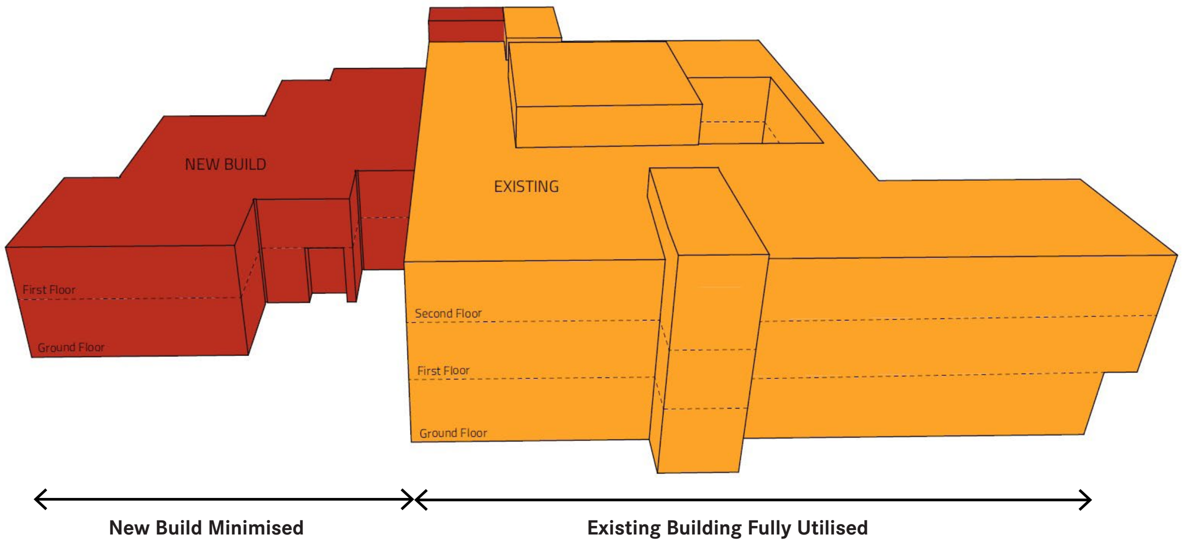
The existing building comprises approximately 1613m2 GIA. However, BB104 standards suggest a building size larger than this for a special school of 90 pupils with MLD/ SLD needs.

A new extension is proposed to the existing building which increases the overall school size to oapprox 2235m2 GIA.

Forming space within the new-build element is more resource-hungry than the existing building and therefore the extension has been designed to be spatially efficient to minimise its size whilst maximizing the re-use of the existing building. In this way, the project reduces new materials to reduce the overall embodied carbon of the proposal.

The extension has been designed on a 'fabric first' strategy with thermal performance in excess of Part L 2021 requirements as outlined below:

Element	Value
External Walls	0.14 u-value
Ground Floor Slab	0.10 u-value
Roof	0.11 u-value
Windows/ Doors	1.2 u-value
Glazing	0.4 g-value
Air tightness	3 m3/hr.m2 @50pa



2.3 Reducing Operational Carbon

Life-Cycle Stages B6-B7

Operational Energy has been calculated to CIBSE TM54 guidance to consider regulated, unregulated and water loads over a 60 year lifespan for the proposed building.

Heating to the existing building is currently provided by two gas boilers, with a further biomass boiler as a back-up (but never used).

As part of the refurbishment works, the project proposes to remove gas as a heating source in line with UK government energy policy to remove reliance on fossil fuels. This helps to future-proof the building's energy source and services.

Heating will be provided by five new roof-mounted ASHP units, which are aided in operation by a 51 panel photovoltaic panel array providing renewable energy as electricity. It is expected that approximately 7% of the generated electricity will be exported to the grid.

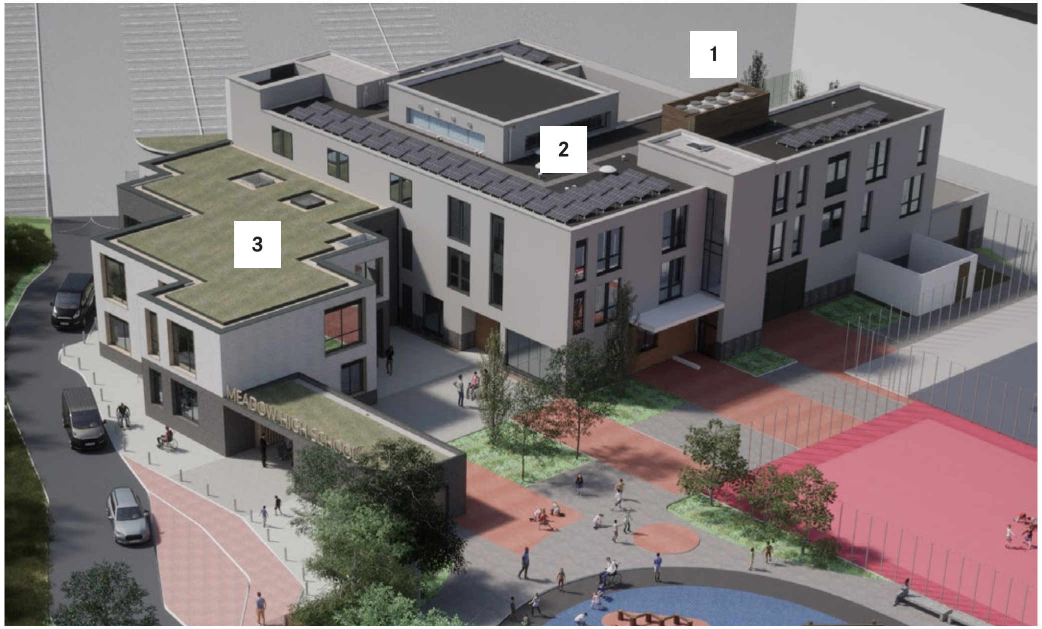
The building will depend upon grid-supplied electricity for its operational energy over and above electricity generated on-site. As the electricity grid decarbonises, it is expected that overall carbon emissions will reduce over the lifetime of the building.

Repurposed as a school building, the water usage and heat loads are expected to greatly reduce compared to the existing residential use, and so the water heating strategy is proposed to provide local heating points around the building rather than depend upon a centralised system. This is expected to reduce carbon emissions related to water use.

Given the reuse of the existing building fabric (and a relatively low emissions related to embodied carbon), operational energy is expected to account for approximately 49% of the total carbon emissions of the project. This will be the focus of the team during later design stages.

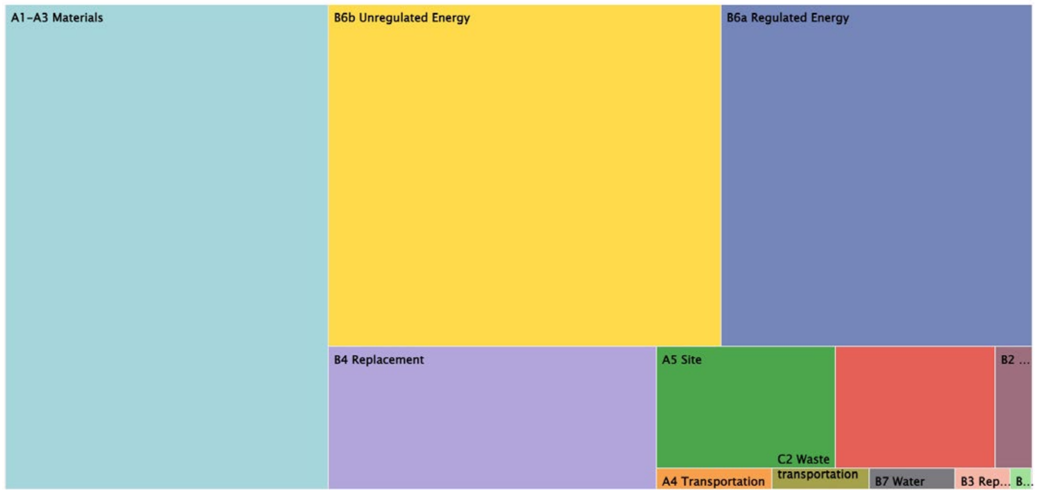
Key:

1 New ASHP allows removal of gas-fired boilers
2 New roof-mounted PV panels reduce electricity drawn from grid
3 High fabric performance of new elements reduces energy loads



Aerial View

TOTAL kg CO2e kg CO2e - Life-cycle stages



Graphic demonstrating carbon related to regulated and unregulated energy

2.4 Assessment

WLC Assessment Methodology

This WLC assessment has been formed by the collaboration of project team members to assess project materials and quantities, life-cycle factors such as replacement and maintenance, and end-of-life scenarios. All inputs have been brought into OneClick LCA WLC software to prepare this report and the associated GLA WLC spreadsheet.

The assessment is structured around the principles of BS EN 15978:2011 and the RICS Professional Statement 'Whole Life Carbon Assessments' 2017.

Material quantities derived from the project BIM model created in Archicad and Revit sotware. Assessments of services and operational energy have been based upon CIBSE TM54 and TM 65 guidance.

Operational energy and associated carbon emissions have been broken down into regulated and unregulated loads as required by the GLA spreadsheet.

In line with GLA requirements, SAP 10 has been used as the basis of emission factors.

Within the OneClick LCA tools, materials and components have been selected from EPD certificates where available. Where this is not possible, similar materials have been selected from the database.

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

Biogenic carbon within timber elements such as the CLT frame have been factored into the calculation.

Transport distances have been based upon RICS PS guidance with transport carbon factors as included within the OneClick software.

WLC Assessment Summary

The adjacent table indicates carbon emissions for the MHS Harefield project, broken down by lifecycle module.

The related pie chart indicates that the majority of carbon emissions are expected from the operational use of the building, which reflects that the re-use of the existing building has greatly reduced the embodied carbon of the building fabric over its lifetime.

The assessment indicates areas of carbon intensity which will be addressed by the project team at the next design stage to further reduce emissions where possible.

GLA Benchmark Comparisons

The table below indicates the project achieves an improvement of approximately 44% against the 2022 benchmark, and a 17% improvement against the GLA's aspirational benchmark.

ASSESSMENT	CARBON EMISSIONS KgCO2e	CARBON EMISSIONS KgCO2e/ m2 GIA
Operational Energy & Water Modules B6-B7	1,196,100	535
Embodied Carbon Modules A1-A5	831,354	372
Embodied Carbon Modules A-C (exc. B6-B7 and inc. sequestered carbon)	1,233,551	551
Whole Life Carbon	2,429,651	1087

Project Carbon Emissions by Lifecycle Module

ASSESSMENT Modules A-C exc. B6-B7 and inc. sequestered carbon	CARBON EMISSIONS KgCO2e/m2
GLA 2022 BENCHMARK	1000
GLA ASPIRATION BENCHMARK	675
MHS HAREFIELD	**551**

Project Benchmark Comparison

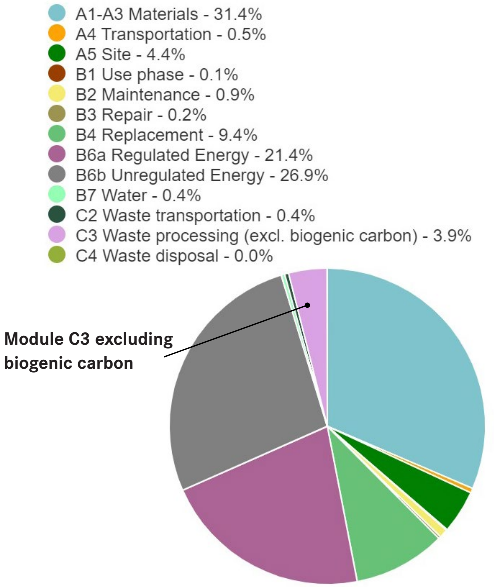
2.5 Analysis

GLA Benchmark Comparisons - Modules B&C

For modules B-C (excluding B6&B7), the project exceeds the project benchmark of 250KgCO2e/m2 by approximately 35%. However, this is principally due to module C3 containing biogenic carbon release from the CLT frame at end-of-life.

The pie chart below indicates that module C3 is much smaller when sequestered carbon is excluded from the metrics (as determined by Oneclick LCA), bringing the benchmark to nominally 170KgCO2e/m2, around 32% *below* the benchmark.

This indicate the importance of sourcing sustainable timber throughout the project in order that the release of biogenic carbon at the end of life is mitigated towards zero, thereby meeting and improving against the benchmark.



Graphic Demonstrating Emmisions relating to Lifecycle Module kgCO2e

Regulated and Unregulated Emissions

Operational energy has been modelled by JAW Sustainability and submitted as a separate document as part of the planning application for this proect. Operational energy use for the building equates to approximately 535kgCO2e/m2. It is projected that approximately 860,000KWhrs of renewable electricity will be generated on-site over the life of the building by new roof-mounted photovoltaic panels, reducing the load required from the electricity grid.

|For the purposes of the assessment, approximately 54% of the operational energy is projected as unregulated loads relating to the specific use of the building (eg internal equipment, computers, operation of services etc).

Reducing Carbon Emissions of Primary Elements

The adjacent graphic demonstratesthe primary elements of the building by mass using RICS categories.

Roads, paths and pavings account for approximately 28% of the works by mass, followed by external wall s and ground floor slab at 14% each.

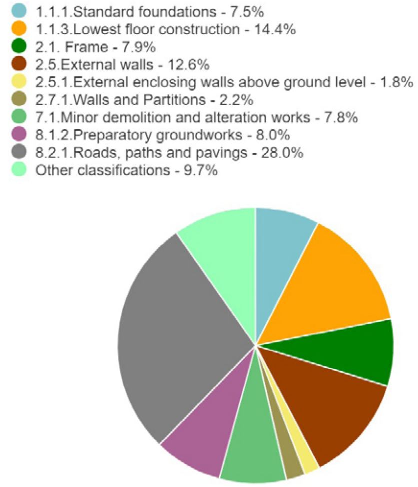
All of these elements have been mitigated in their resource use:

- External surfaces have been designed to retain existing sub-bases where possible to reduce excavation and material removal

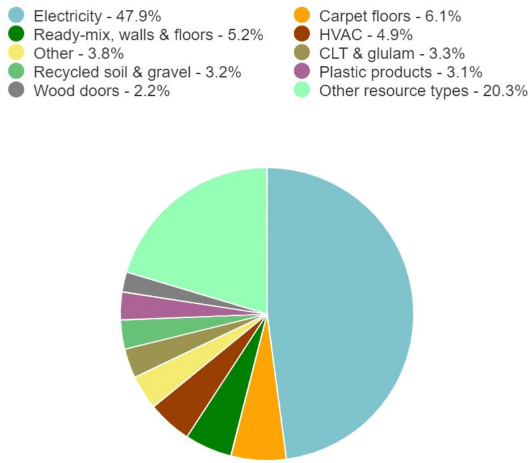
- New external walls have been designed assuming a CLT lightweight frame that reduces the need for an extensive sub-structure and which sequesters carbon.

- The ground floor slab is 100% retained to the existing building, with only a new slab required to the new extension.

Graphic Demonstrating Mass of Materials Kg



Graphic Demonstrating Project Resource Types kgCO2e



2.6 Conclusions

Monitoring

This Whole Life Carbon Assessment has been prepared to support the planning application for the project, and follows the GLA guidance for the level of detail at this design stage.

As the design progresses through RIBA Stages 4-5, there are a number of actions that should be implemented to develop the WLC assessment. These will enable the assessment to reflect - at a detailed level - the specifics of the building design, construction, and expectations for maintenance through to the end-of-life.

Key actions include:

- Embedment of WLC assessment into the building contract to ensure that the Design & Build contractor is aware of the preliminary WLC strategies and to enable resourcing.

- Following the detailed design of the building fabric, external areas and building services, the preparation of a detailed Bill of Quantities to accurately reflect the developed design.

- The development of an Access & Maintenance Strategy to establish expected lifecycles of specified materials.

- The use of EPD certificates to reflect specified materials and verify material/ component performance.

- The publication of a post-construction WLC which is shared with the GLA and the BECD to refine benchmarking and methodology.

Conclusions

This WLC suggests that the proposed project supports Policy SI2 of the London Plan 2021 by adopting strategies that effectively reduce carbon emissions related to the establishment of a new special school on the site.

Notable items include:

- A 44% improvement in carbon emissions versus the GLA 2022 benchmark for schools and a 17% improvement against the aspirational benchmark*
- Carbon emissions associated with operational energy indicate a 59% improvement against Part L 2013 for the refurbishment element of the works, and a 80% improvement for the extension.
- Carbon Emissions over the whole life of the buiding of 1087kgCO2e/m2
- Pre-Demolition Audit and appraisal of existing building has led to its proposed re-use and refurbishment, consequently forming a low embodied-carbon project nominally 47% below the GLA benchmark for embodied carbon**
- The proposed extension to the building has been designed to minimise its volume relative to the existing building and therefore reduce its material requirements whilst being designed to a high performance using' Fabric First' principles.
- The WLC assessment has identified areas for development and investigation in the next stages, including reducing the impact of external areas and ways of reducing regulated operational energy loads

** Benchmark based upon Modules A-C exc B6&B7 inc. carbon sequestration*
*** Benchmark based upon Modules A1-A5 exc. sequestration*

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