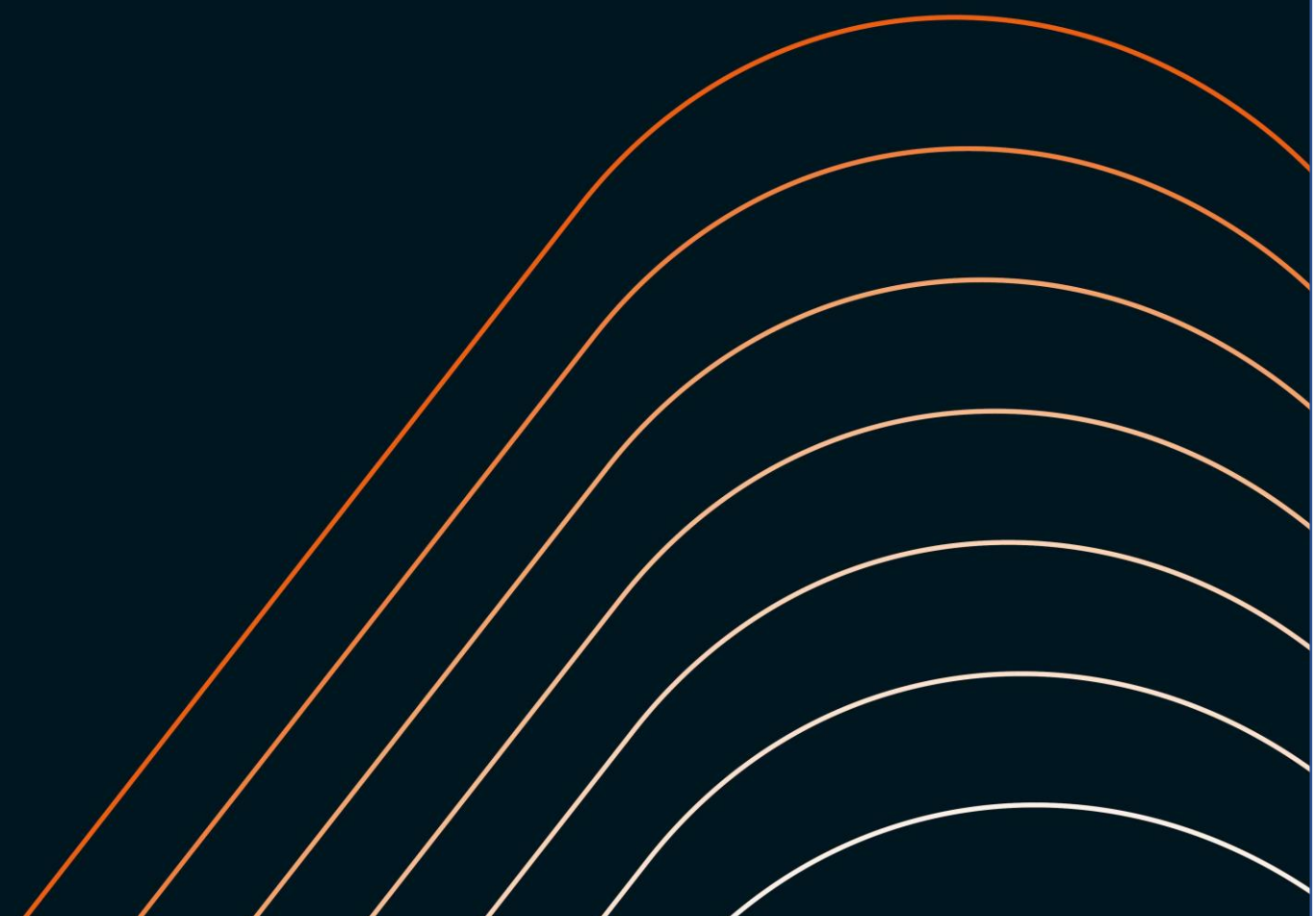




Winners Chapel

WLC

November 2024



Document Revision Control

Revisions	Date	Reason for Issue	By	Approved
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Executive Summary

Harley Haddow Consultant Engineers have undertaken a whole life-cycle carbon (WLC) assessment, to evaluate the embodied carbon associated with the proposed public worship building located off Chain Road, Blackley, Manchester – Winners’ Chapel.

The proposal involves the demolition of existing building and erection of Place of Worship, with associated landscaping, parking, and alterations to existing access, with a gross internal area (GIA) of 4,800 m². A Dynamic Simulation Model (DSM) has been conducted to demonstrate compliance with the Building Regulations Part L 2021 (conservation of fuel and power in buildings other than dwellings).

This report details the approach to minimising the associated embodied carbon, ensuring minimal overall impact in line with the RICS Whole life carbon assessment (WLCA) standard, 2nd edition.



Figure 1: Render of the Proposed Development, Winners Chapel

OneClick LCA software has been utilised to assess the carbon emissions over each life cycle stage, identifying opportunity areas for carbon reduction.

Please the results summarised in Table 1.

Total Carbon Emissions

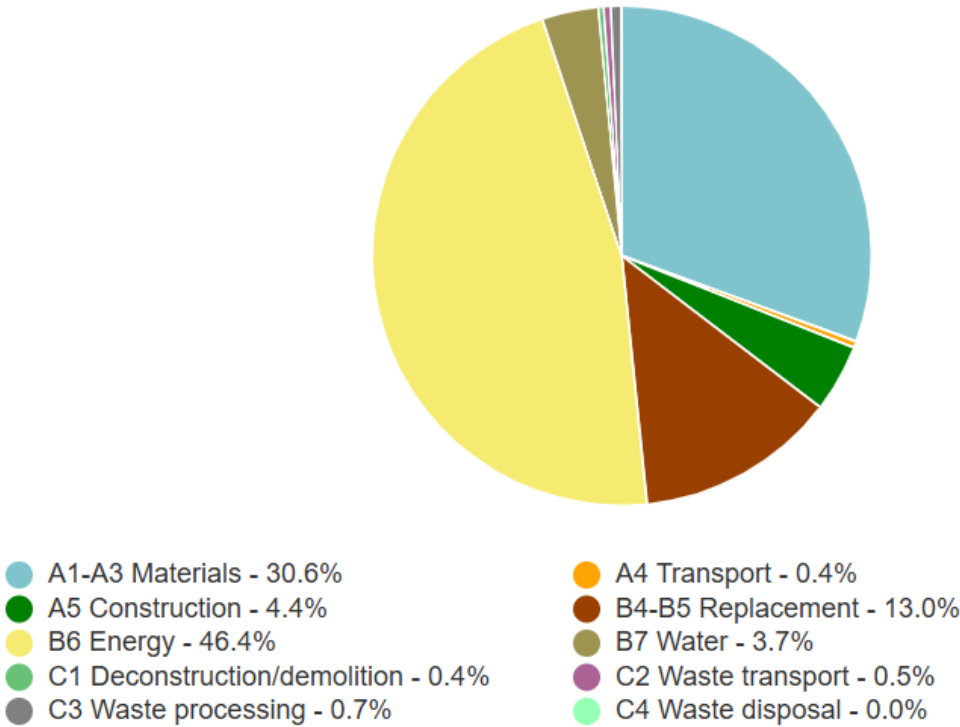
5,201 Tonnes CO₂e

Equivalent to 1,650 return flights to Perth (Australia) from London



Please see Table 5 and Figure 7 below displaying the carbon emissions over each life cycle stage.

Table 1: Global warming by life-cycle stage		
Item	Value (kg CO ₂ e)	Percentage %
A1-A3: Materials	1,600,000	30.58%
A4: Transport	22,000	0.42%
A5: Construction	230,000	4.38%
B4-B5: Replacement	680,000	13.03%
B6: Energy	2,400,000	46.44%
B7: Water	190,000	3.65%
C1: Deconstruction/demolition	19,000	0.36%
C2: Waste transport	24,000	0.46%



1. Introduction

1.1. Purpose and methodology

This assessment has been conducted to identify any opportunities for carbon emission reduction in the whole life cycle of the proposed development, i.e., the sourcing of materials, construction, operation, and end of life.

The assessment has followed the guidelines outlined in BS EN 15978:2011 for environmental performance assessment and the RICS Professional Statement 2024 'Whole Life Carbon Assessment for the Built Environment'.

1.2. Software and limitations

Life-Cycle Assessment

The life-cycle assessment (LCA) was conducted utilising OneClick LCA software. Embodied carbon was calculated over the whole life cycle of the proposed building utilising information from the architect, structural engineers, and MEP engineers.

As the development is in the relatively early stages, exact material and equipment selections are not yet defined. Therefore, several materials have been specified using OneClick LCA generic data.

Operational Energy

The operational energy figures stated in this report are based on dynamic thermal modelling software IESVE Version 2023.5.2.0. Energy consumption throughout the spaces is assessed for the whole building. Nevertheless, occupants may operate their systems differently and/or the weather may be different from the assumptions made by approved calculation methods, leading to different energy requirements.

1.3. Location and background

The site is located within the administrative boundary of Manchester City Council, within the suburban area of Blackley in a predominantly residential setting. The site is located south of the M60 outer ring road with an adjacent school to the west of the site.

The proposal involves the development of a circa 4,900 m² church building and staff office spaces.

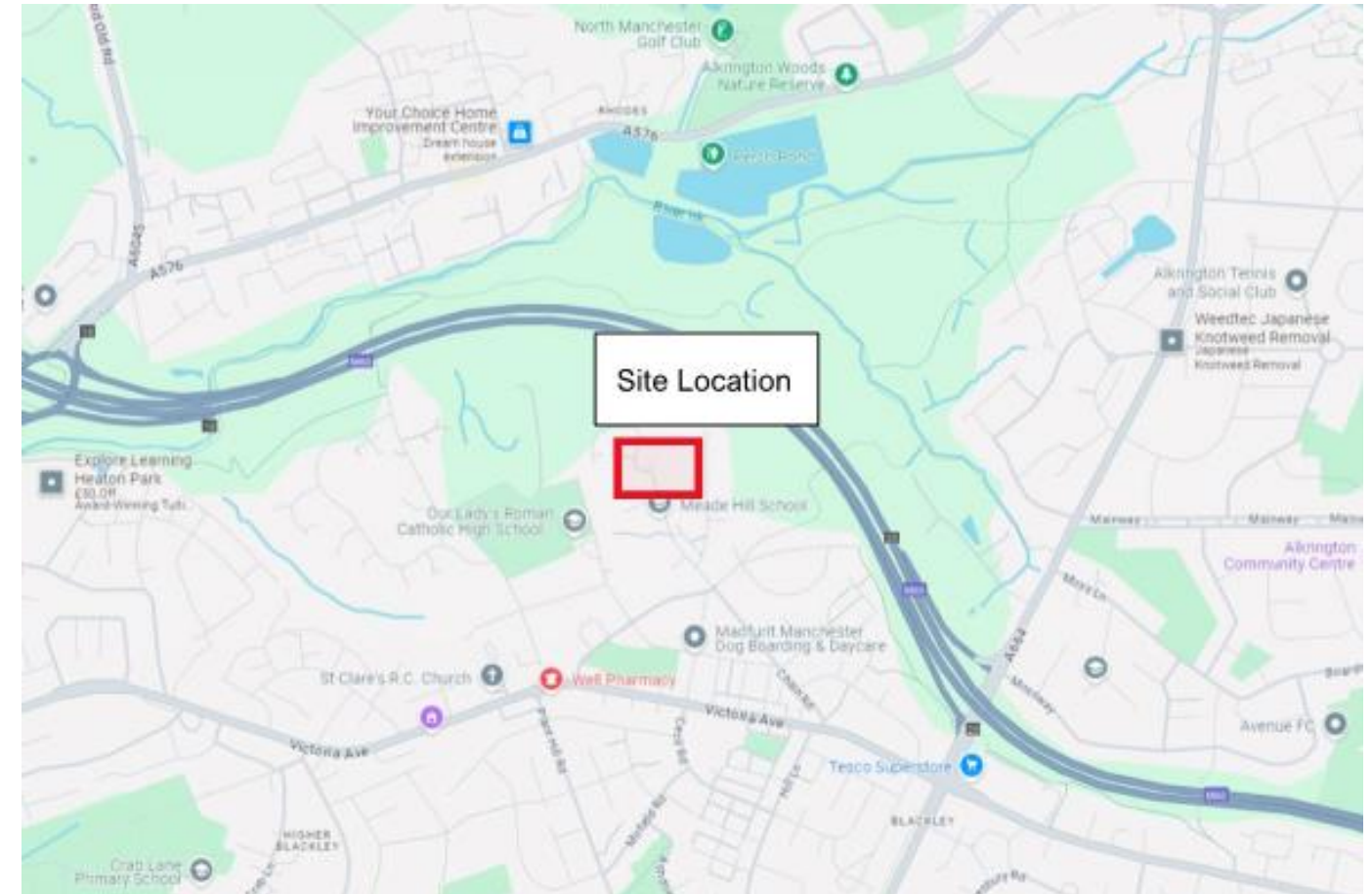


Figure 1: Site boundary highlighted in red.



Figure 2: Proposed Development

2. Life Cycle Assessment

Four key stages are outlined within the RICS Professional Statement and BS EN15978:2011 to define a building's life cycle. These stages, identified by modules, are crucial for understanding the environmental impact of a building throughout its existence.

2.1. Product Sourcing and Construction Stage (Modules A1 - A5):

This stage encompasses everything from the extraction and processing of raw materials to the transportation and on-site construction activities. It includes:

- A1: Raw material extraction and processing (e.g., mining, manufacturing)
- A2: Transportation of products to the site
- A3: Energy used in manufacturing
- A4: Transportation of products to the manufacturer
- A5: Construction process emissions (e.g., waste, site machinery)

This stage typically represents a significant portion of a building's embodied carbon footprint, highlighting the importance of sustainable material choices and construction practices.

2.2. Use Stage (Modules B1 - B7):

This stage covers the operational phase of a building, including energy consumption for heating, cooling, lighting, and appliances. It also considers water usage, maintenance activities, and occupant behaviour.

Key modules include:

- B1: Use of fuel and energy
- B2: Maintenance, repair, and replacement
- B3: Waste generated in the building.
- B4: Water consumption
- B5: Disposal of wastewater
- B6: Operational energy use
- B7: Capital repair and refurbishment

Optimising energy efficiency, implementing renewable energy sources, and encouraging responsible water usage are crucial for minimising the environmental impact of a building.

2.3. End of Life Stage (Modules C1 - C4):

This stage addresses the deconstruction, demolition, and disposal of the building and its materials. It considers:

- C1: Deconstruction and demolition processes
- C2: Transport of waste materials
- C3: Processing of waste materials (e.g., recycling, disposal)
- C4: Benefits and loads beyond the system boundary (e.g., recycled material credits)

By designing for deconstruction and using recyclable materials, the environmental impact at the end of life can be significantly reduced.

2.4. Benefits and Loads Beyond the System Boundary (Module D):

This module acknowledges the wider societal and environmental impacts of a building, such as the displacement of ecosystems, the creation of jobs, and the provision of community amenities. Although not directly quantified, considering these factors provides a more holistic understanding of the building's overall impact.

Understanding these life cycle stages, and their associated environmental burdens is crucial for informed decision-making throughout the building's lifespan. By considering the environmental impact at each stage, we can design, construct, operate, and ultimately dispose of buildings in a more sustainable manner.

Please refer to Figure 3 below, illustrating the life cycle of a building and the stated modules.

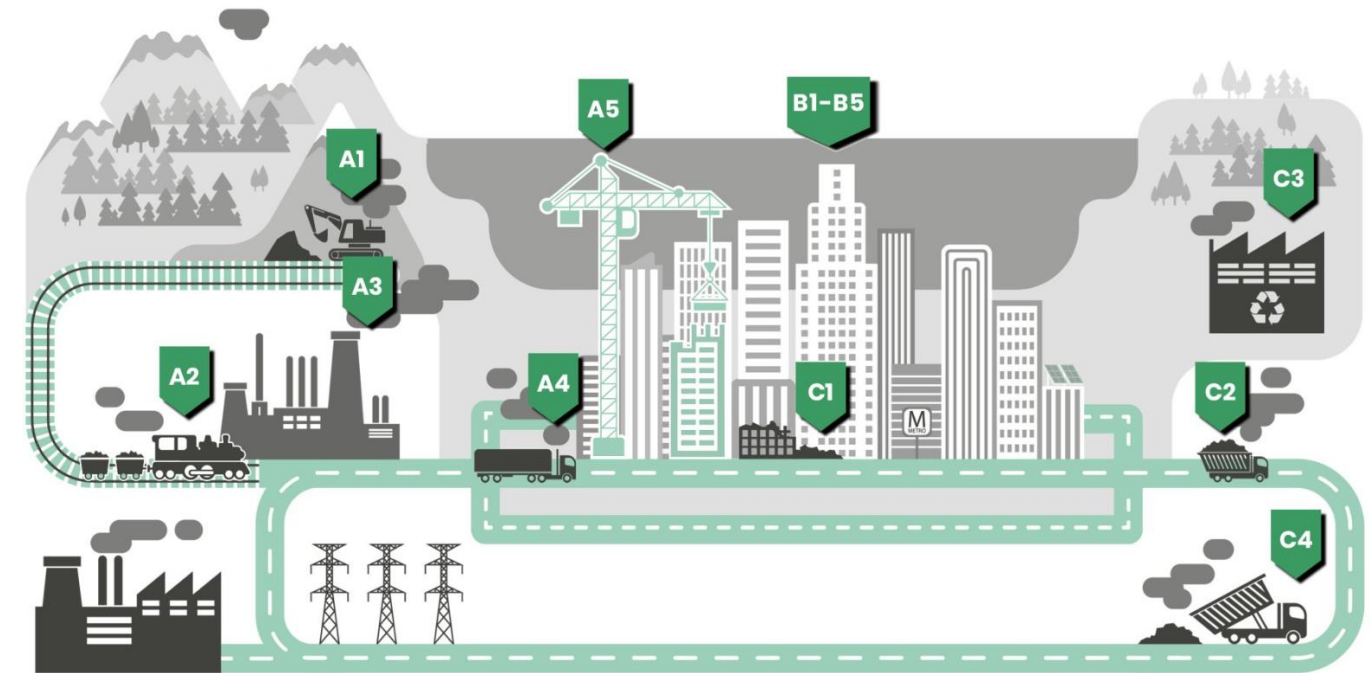


Figure 3: Illustration of life cycle modules (Source: OneClick LCA)

2.5. Items Excluded from Present Assessment

Insufficient information is available at this stage to determine emissions associated with the following:

- Fitting, Furnishings and Equipment (FFE)
- External elements (landscaping/planting etc.)

Therefore, these items have been excluded from the present assessment.

3. Assessment Results

3.1. Materials

Material areas, lengths and volumes have been calculated using the following information:

- Architectural (GA's, elevations, fabric build ups)
- Structural (GA's, elevations, general beam and column specifications)
- MEP (HVAC systems, lighting, public health)

Generic materials were assumed and specified within OneClick LCA, where specification was not available. Materials have been assigned to RICS WLC classifications. Please see Table 2 below, displaying the carbon emissions in kg CO₂e, across the primary classifications.

Table 2: Global warming by classification

Category	Value (kg CO ₂ e)	Percentage %
1. Substructure	241,849	10.21%
2.1.1. Steel frames	403,571	17.04%
2.3. Roofs	167,772	7.08%
2.5. External walls	161,800	6.83%
5. Services	666,019	28.12%
5.8.5. Local electricity generation systems	388,115	16.39%
Other classifications	339,044	14.32%

Additionally, please see Figure 4 below, displaying this graphically.

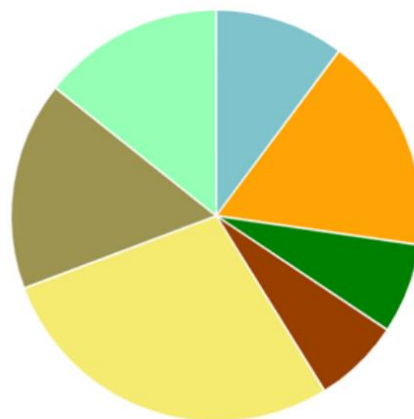
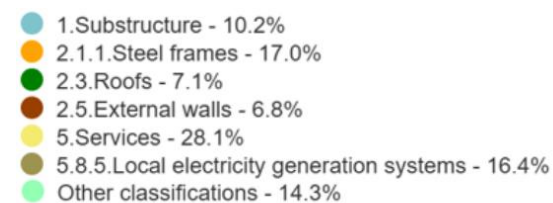


Figure 4: Global warming by classification

Most Contributing Materials

When observing the embodied carbon of the proposed materials in more detail, opportunities for reduction become clearer.

Please see Table 3 below for the top 15 highest contributing materials, and their cradle to gate (stages A1 – A3) impact.

Table 3: Most contributing materials

No.	Resource	Cradle to gate impacts (A1-A3)	Of cradle to gate (A1-A3)
1	Structural steel profiles, generic, 60% recycled content, I, H, U, L, and T sections, S235, S275 and S355 co2	421 tonnes CO2e	26.50%
2	Ready-mix concrete, C 30/37, 2380 kg/m3 co2	189 tonnes CO2e	11.90%
3	Photovoltaic monocrystalline panel	129 tonnes CO2e	8.10%
4	Reversible air/water heat pump	107 tonnes CO2e	6.80%
5	Circular galvanized steel pipe	107 tonnes CO2e	6.70%
6	PIR (polyisocyanurate foam) insulation panels,	98 tonnes CO2e	6.10%
7	Red brick, average production, UK, co2	75 tonnes CO2e	4.70%
8	Ventilation centralized with heat recovery (Air handling unit (AHU))	49 tonnes CO2e	3.10%
9	Insulating Glass Unit (IGU), fire-resistant, double glazed	46 tonnes CO2e	2.90%
10	Roof slate, 30.0 kg/m2, EN15804+A1, ref. year 2018	45 tonnes CO2e	2.80%
11	Hot-dip galvanized steel sheets	43 tonnes CO2e	2.70%
12	Ready-mix concrete, normal-strength, generic	36 tonnes CO2e	2.30%
13	Steel pipes for heating and cooling system, DN=65mm, 6.63 kg/m	34 tonnes CO2e	2.20%
14	Gypsum plaster board, regular, generic	28 tonnes CO2e	1.80%
15	Emergency power supply source, ground standing,	27 tonnes CO2e	1.70%

From Table 3, high contributors are identified, allowing the design team to target reductions in these areas. This can be achieved through the procurement of higher recycled content materials, materials with Environmental Product Declarations (EPDs), redesign of certain elements to minimise material, etc.

For example, structural steel profiles (highlighted in red) have the highest embodied carbon content. This includes the proposed structural beams, bracings and columns. As displayed, a 60% recycled content steel has been selected for the assessment which is on the lower end of the UK average. If the contractor was to procure steel from a manufacture with a higher recycled content, carbon would reduce.

3.2. Operational Emissions (B6)

Operational emissions were calculated using IESVE Version 2023.5.2.0. This dynamic simulation software conducts performance calculations upon incremental time steps as low as 2 minutes. This high-resolution modelling accurately captures variations in thermal mass, weather, occupancy, and internal/solar gains, thereby simulating real-world building and plant operations.

Building loads determine the heating and cooling requirements of a building. Generic zone types, i.e., classrooms, WCs etc. have been assigned an operational template corresponding to the expected use of that space. Therefore, a reasonable estimation of the expected energy usage of the building can be obtained.

Please see Figure 5 for the model within IESVE.

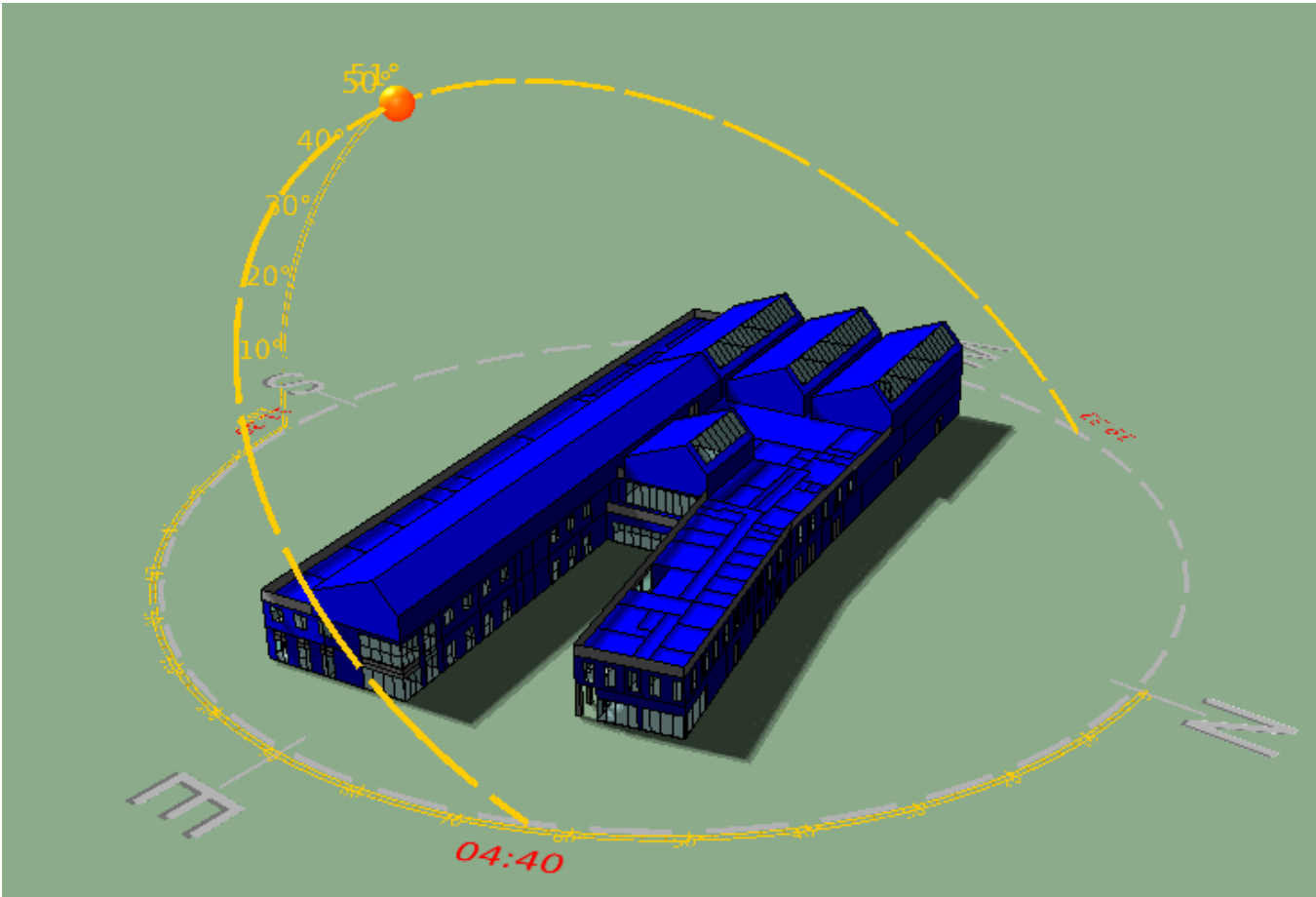


Figure 5: Model within IESVE

Performance Parameters

The passive and active design measures assumed for the approved refurbishment scheme are displayed in Table 3. Please note the additional assumptions made below:

- Thermal performances are indicative, and in line with the current build up calculations.
- MEP systems are assumed to be in line with the Energy Strategy submitted for planning.
- Occupancies have been developed from information provided by the project Architects.

Please note, the Manchester_try.epw weather file was utilised for the dynamic thermal model simulation.

Table 3: Passive and Active Design Measures defined in IESVE model	
Passive Design Measures	
External Wall U-Value	0.21 W/m².K
Window U-Value	1.40 W/m².K
Window G-Value	0.40
Exposed Floor U-Value	0.10 W/m².K
Roof U-Value	0.15 W/m².K
Infiltration	0.20 ach
Ventilation and Cooling	Natural ventilation for classrooms, perimeter offices, gym, and bookshop.
Active Design Measures	
Space Heating System	ASHP (SCoP = 3.0)
Space Cooling System	ASHP (SSEER = 4.0)
DHW System	Point of use
Ventilation System	MVHR with 76% efficiency for remaining spaces.
Lighting	High efficiency LED lighting has been assumed for 100% of spaces.
LZC Technology	Photovoltaic Solar Panel circa 500m²

Operational Results

Utilising the performance parameters outlined in Table 3, the proposed development is predicted to use 296 MWh of energy annually. Please refer to Figure 7 below, displaying this consumption over a year.

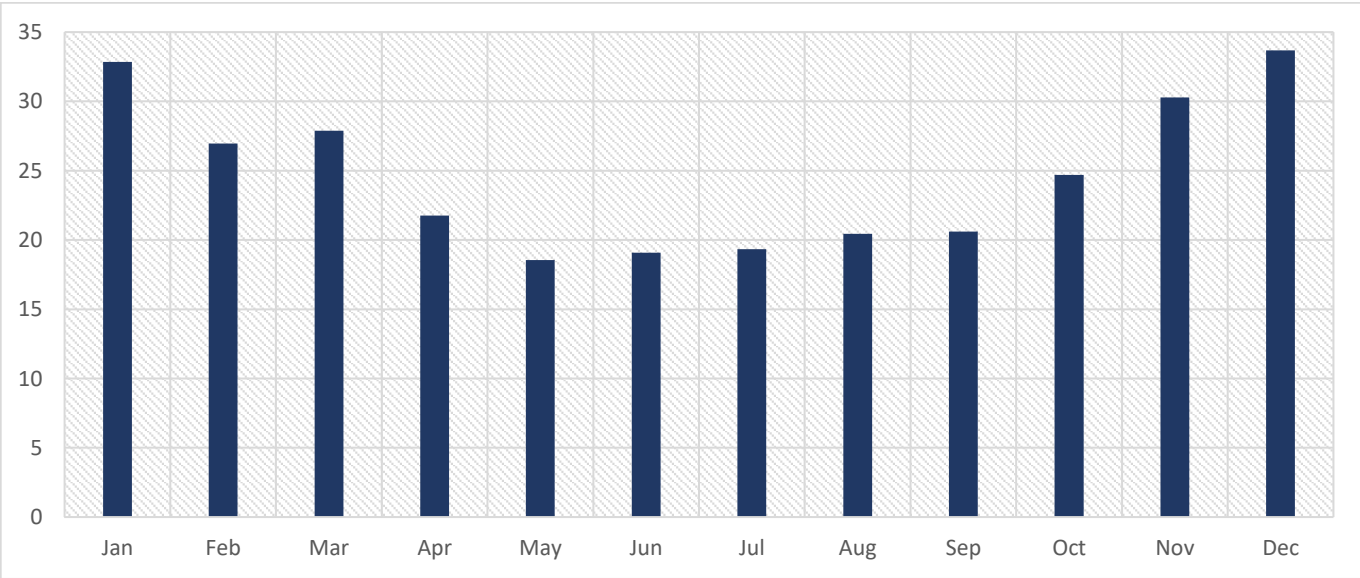


Figure 6: Estimated monthly energy usage (MWh)

3.3. Resultant Carbon Emissions (Option A)

Total Carbon Emissions	5,201 Tonnes CO ₂ e
Equivalent to 1,650 return flights to Perth (Australia) from London	
	

Please see Table 5 and Figure 7 below displaying the carbon emissions over each life cycle stage.

Table 5: Global warming by life-cycle stage		
Item	Value (kg CO ₂ e)	Percentage %
A1-A3: Materials	1,600,000	30.58%
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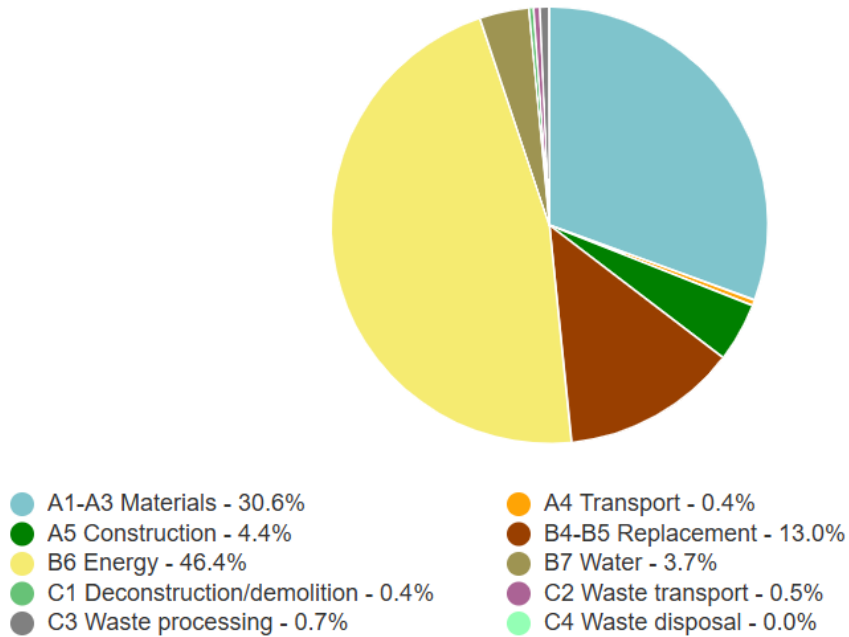


Figure 7: Global warming by life-cycle stage

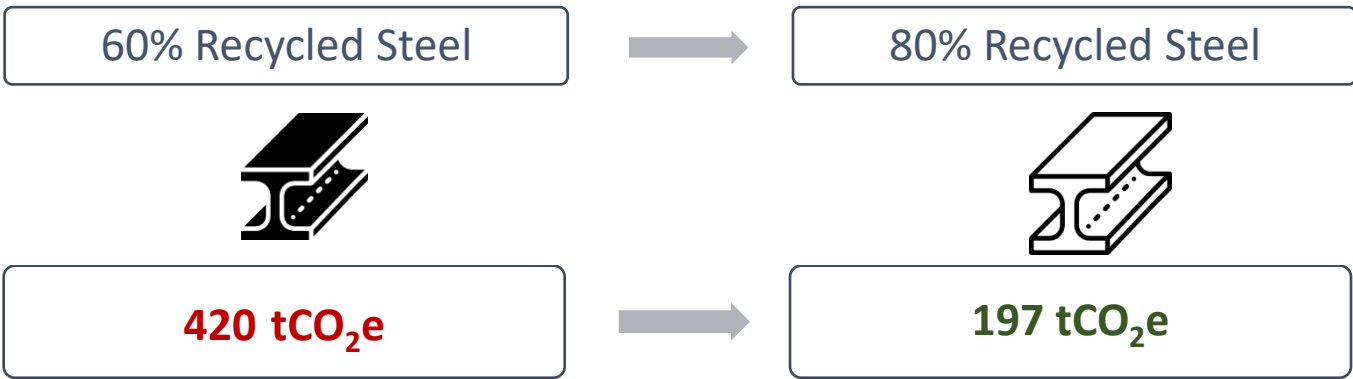
4. Whole Life Carbon Reduction Options

As the project matures, more accurate information will aid the identification of carbon-intensive areas in the design, allowing for a range of carbon reduction options to become apparent. The design team should progress with this in mind, considering material selection and manufacturer specification throughout the project’s development.

Nevertheless, several reduction options have been presented in this section to be considered moving forward.

4.1. Material Selection

Specification of materials with EPDs and low embodied carbon content can significantly reduce cradle-to-grate emissions. As presented in in section 3.1, structural steel profiles (specified at 60% recycled content) output **420 tonnes CO₂e**. If these are substituted for 80% recycled steel content, carbon emissions reduce to **197 tonnes CO₂e**, as displayed below:



This ethos can be adopted for all materials. Please see some further suggestions below based on the WLC assessment conducted:

- Concrete with recycled aggregate
- Low carbon MEP systems, i.e., specifying manufacturers with EPDs
- Reclaimed brick



Figure 8: EPDs

4.2. Design and Construction Practices

Modular Construction

Modular construction is a method where building components are preconstructed in a controlled factory setting and then transported to the construction site for assembly. This process offers several advantages over traditional construction, including faster construction times, reduced labour costs, and greater quality control, therefore, reducing embodied carbon.

Please see Figure 9 below for a representation of this method.



Figure 9: Modular construction

Prefabricated Construction

Prefabricated construction involves building components manufactured in a controlled factory setting. These components, such as walls, floors, and roofs, are then transported to the construction site and assembled into a complete building. Again, this method offers faster construction, reduced labour costs, and better-quality control compared to traditional construction.

This method may be better suited to the proposed development and its use, with the more complex nature of some of the architectural elements, providing greater flexibility in design.



Figure 10: Prefabricated construction

4.3. Operational Emissions

As displayed in Table 5 and Figure 7, operational emissions (Stage B6) account for the greatest portion of carbon over the building's lifecycle. An Energy Statement has been prepared and submitted by Harley Haddow Ltd. detailing how these emissions have been reduced, in line with the following energy hierarchy:

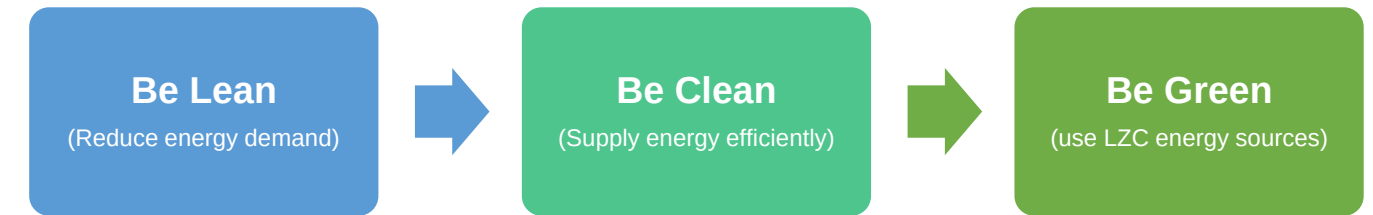


Figure 11: Energy Hierarchy

Further improvements can be made where technically and financially feasible on the system specifications and thermal performances on the final build up. This is subject to the development of the detailed design.

4.4. Circular Economy

The UK Green Building Council (UKGBC) defines a circular economy as the following:

“At its simplest, the circular economy prioritises the reuse of materials, preventing the over extraction of natural resources and the number of usable materials that end up in landfill.”

Please see Figure 12 below for a representation of this.

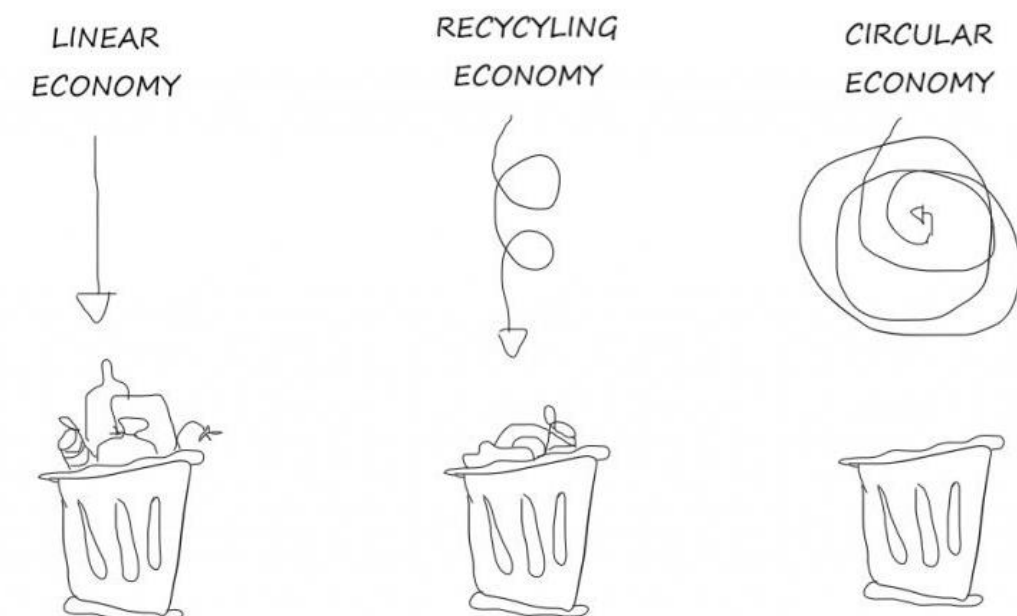


Figure 12: Circular Economy

For the proposed development, this can be achieved through the following:

- Reusing demolition material from the existing site (for example, red brick)
- Reusing demolition material from neighbouring sites
- Designing for adaptability – this has been pursued with the open nature of the general arrangements allowing for adaptability to any future uses
- Designing for deconstruction – resources can be economically recovered and reused at the end of the building's life cycle.

5. Conclusion

Harley Haddow Consultant Engineers have undertaken a whole life-cycle carbon (WLC) assessment, to evaluate the embodied carbon associated with the proposed public worship building located off Chain Road, Blackley, Manchester – Winners’ Chapel.

The development has been estimated to emit approximately **5,200 tonnes CO₂e**.

Total Carbon Emissions	5,201 Tonnes CO ₂ e
Equivalent to 1,650 return flights to Perth (Australia) from London	
	

By quantifying the site's full lifecycle carbon emissions, opportunity areas are identified for reduction. Several carbon reduction strategies have been presented. By adopting these/considering them, the environmental footprint of the project can be reduced.

Furthermore, the identified material alternatives offer practical examples of potential low-carbon choices. Most of these options should be cost-effective or even cost-saving. This report should be utilised to inform design decisions moving forward.