

NORTHUMBERLAND DEVELOPMENT PROJECT **HOTEL**

S73 APPLICATION

WHOLE LIFE CARBON ASSESSMENT

NDP Hotel

Whole Life Carbon Statement

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1 Introduction

This Whole Life Carbon Statement has been prepared on behalf of Tottenham Hotspur Property Company Limited ("THFC") known from now on known as "the Applicant", in support of an application for minor material amendments to the London Borough of Hackney (LBH) made under Section 73 (S73) of the Town and Country Planning Act 1990 (as amended), following the grant of planning permission for the Northumberland Park Development.

The NDP permission is a 'hybrid consent' ("the Hybrid Consent") which comprises of: full planning permission for Plot 1 (The Stadium), Plot 2 (The Tottenham Experience) and Plot 3 (Hotel); and outline planning permission for Plot 4 (The Extreme Sports Building), Plot 5 (The Residential Buildings and Flexible B1/D1 Space) and Plot 6 (The Community Health Building). This S73 Application proposes amendments focussed on Plot 3 (the "Plot 3 Site").

This report is an Addendum to the original Energy Strategy that was produced for the NDP permission in 2015. It applies to Plot 3 only (the hotel building) and addresses any updates to policy and design since the original application. This document has been prepared in alignment with GLA guidance "Greater London Authority guidance on preparing energy assessments (2022)" and other accompanying documentation from both the GLA and the London Borough of Haringey.



Figure 1—1 The Proposed development

This S73 application seeks to enhance the deliverability of the proposals and respond to the evolving regeneration of the surrounding area.

The changes to the Plot 3 hotel building relate to:

- Changes to the building form and layout
- Increase to the height of the building from 23 to 29 storeys
- An increase in the site wide hotel floorspace to 16,132m2

The description of development is as follows:

"Application under Section 73 of the Town and Country Planning Act for variations to Condition A4 (Consented Drawings and Documents) and Condition A7 (Maximum Quantity/Density) of the hybrid planning permission HGY/2015/3000 (as amended) for the proposed demolition and comprehensive redevelopment of the Northumberland Park Development Project (the amendments consist of revisions to the design, height and maximum floorspace at Plot 3 Hotel and other changes)."

The following images show the typical floor plans of the hotel levels and the residential levels and are used to give the energy officer context of the scheme.



Figure 1—2 Typical hotel floor plan (Levels 2 to 10)

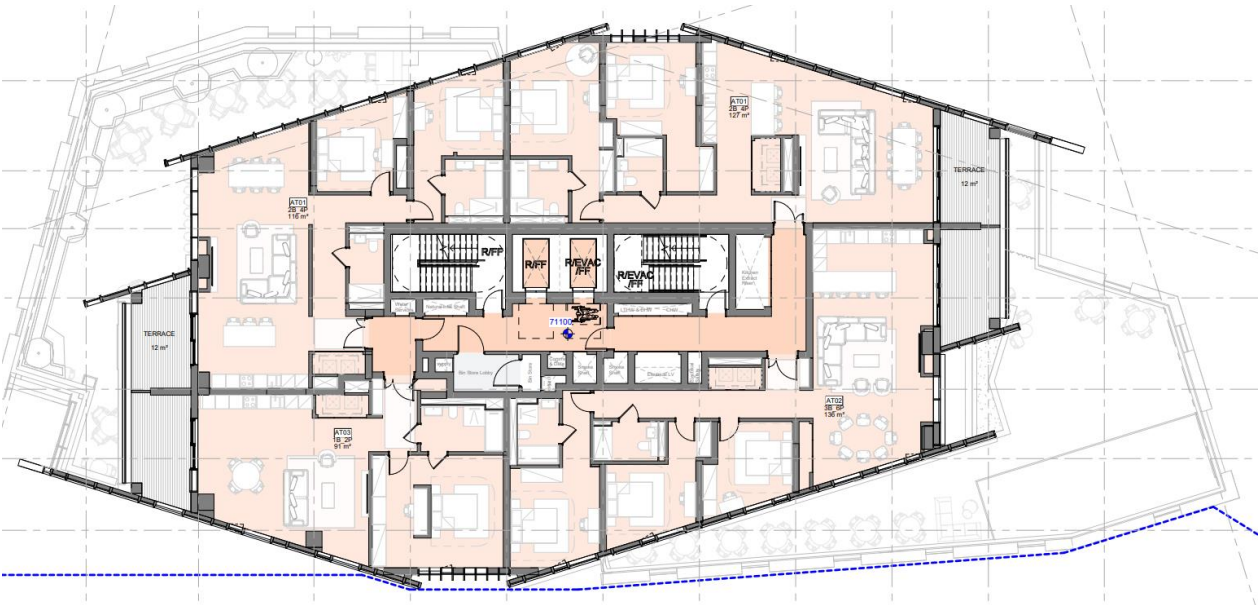


Figure 1—3 Typical residential floor plan (Levels 14 to 18)

1.1 Background

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

Operational carbon emissions will make up a declining proportion of a development’s whole life carbon emissions as operational carbon targets become more stringent. To fully capture a development’s carbon impact, a whole life-cycle approach is needed to capture its unregulated emissions (i.e. those associated with cooking and small appliances), its embodied emissions (i.e. those associated with raw material extraction, manufacture and transport of building materials, and construction) and emissions associated with maintenance and eventual material disposal).

Development proposals referable to the Mayor of London should calculate whole life-cycle carbon emissions through a nationally recognised Whole Life-Cycle Carbon Assessment and demonstrate actions taken to reduce life-cycle carbon emissions. (London Plan 2021 Policy SI2)

To provide a holistic view of the Global Warming Potential (GWP), the whole life carbon assessment accounts for all components relating to the project during all life stages.

Embodied Carbon emissions are attributed to four main categories taken from BS EN 15978. The categories are:

- Product Stages (module A1 to A3): The carbon emissions generated at this stage arise from extracting the raw materials from the ground, their transport to a point of manufacture and then the primary energy used (and the associated carbon impacts that arise) from transforming the raw materials into construction products.
- Construction (module A4 to A5): These carbon impacts arise from transporting the construction products to site, and their subsequent processing and assembly into the building.
- In-Use Stages (module B1 to B5): This covers a wide range of sources from the embodied carbon emissions associated with the operation of the building, including the materials used during maintenance, replacement and refurbishment.
- End of Life Stages (module C1 to C4): The eventual deconstruction and disposal of the existing building at the end of its life takes account of the on-site activities of the demolition contractors. No ‘credit’ is taken for any future carbon benefit associated with the reuse or recycling of a material into new products.
- Benefits and loads beyond the system boundary (Module D).

2 Executive Summary

A whole life-cycle carbon assessment was carried out on the proposed hotel building development. The relevant quantities from the cost plan (Draft Version 13. July 2023) were used to complete the assessment as accurately as possible.

It was estimated that the total **emissions (modules A1-A5) per area based on the GIA were ~916 kgCO₂e/m²**, which were found to be higher than the GLA's standard benchmarks. The analysis has identified that the largest opportunities contributing to potential reduction in life-cycle carbon are the continued investigation of lower carbon façade design and leaner design of concrete elements. This might include the specification of post tensioned slabs to replace the flat slabs within the current design and/or the selection of lower cement content concrete mixes. The height of the building presents challenges to carbon reduction, for that reason, at this stage, assumptions have been taken in a conservative manner. As the project evolves further reduction strategies will be analysed in close interaction with the design team.

The results show an overall embodied carbon value of **1203 kgCO₂e/m² GIA for modules A-C (excluding B6 and B7)**. This achieves the GLA standard benchmark of 1250kg CO₂e/m² but falls short of the GLA aspirational target of 800 kgCO₂e/m² GIA. In order to reach the aspirational benchmark target, the project will need to reduce its overall embodied carbon by 29%.

Additionally, it was estimated that the total emissions **(modules B-C excluding B6 & B7) per area based on the GIA were ~434 kgCO₂e/m²**, which were found to miss both the GLA's aspirational and standard benchmarks. The analysis has identified that the largest factors contributing to life-cycle carbon are the replacement of façade elements and the services. The specification of specific design lives and a robust repair and maintenance strategy for the both the façade and the mechanical equipment would help to reduce this impact.

Main recommendations going forwards to support the reduction of embodied carbon include:

- **Focus on leaner structural design and optioneering to reduce structural sizing**
- **Continue to investigate cement replacements and novel concrete technology outside of GGBS**
- **Investigation of steel reuse over recycling within roof and canopy**
- **Minimise carbon intensive internal finishes such as suspended ceilings and raised access flooring, instead focus on longer lifespan, higher quality materials**
- **Specification of long life and deconstructable façade materials**
- **Specification of lower embodied carbon refrigerant within MEP kit and planning of MEP maintenance regime to increase longevity**

3 Methodology

3.1 Sourcing of material quantities

The assessment collated the most up-to-date and representative data that was available for material quantities for each building and the associated infrastructure on the site. This involved the use of figures from a high-level cost model, OneClick LCA as well as reports and diagrams produced by other disciplines in the design team. The detail and EPDs available for the Furniture, Fixtures & equipment (FF&E) across the proposed development were not available to produce an accurate or representative figure. Therefore, a weighted average was taken from the benchmarks provided for “Residential” building uses in the GLA Whole-Life Carbon Assessments Guidance Appendix 2.

Similarly, at this stage of the project, maintenance and repair scenarios for the site had not been developed and a weighted average for these modules was taken for the proposed development.

It should be noted that the information contained within this report is taken from the draft cost plan (Draft Version 13. July 2023) provided by Arcadis on 13/7/23.

The following are key calculation inputs and assumptions made during the life cycle assessment conducted for the Site.

Table 3-1 LCA Inputs

Building element	Input Parameters
Foundations & Lowest floors	Preliminary structural calculations supplemented with figures received from structural engineer
	50% GGBS for foundations, C35/45 concrete
	97% recycled steel assumed for all reinforcement
Floor slabs	Structural volumes received from the Structural Engineers
	30% GGBS slabs and beams, C35/45 concrete
	97% recycled steel assumed for all reinforcement and PT tendons
Concrete Frame	Data from draft cost plan and other structural volumes received from the Structural Engineers
	50% GGBS all columns and walls, C50/60 concrete
	97% recycled steel assumed for all reinforcement
Internal Doors	Data measured from typical GA plans given by the architects within the design freeze issue for stage 2.
Windows	Cost plan provides façade area. Architects façade elevation provide glazing ratio.
External doors	Data from cost plan
Roof Finishes	Data from cost plan
Stairs	Data from cost plan

Facade	Façade typology from architect façade elevation. Buro Happold façade studies used to provide early stage build up.
Internal Finishes	Data measured from the typical GA plans given by the architect within the GA's for planning. Data from cost plan used where possible.
External Works	Landscaping design from Stage 1 design issue and from cost plan.
Energy Consumption	Calculated by Buro Happold Building Physics team
Construction Site Emissions	In lieu of complete construction information: Average site impacts - temperate climate (North) used based on GFA from One Click LCA
Building Services	Building services strategy and data inputs provided by BH MEP team. Where information was limited, for example included at a quare meter rate, inputs were approximated based on information from previous projects of the same building typology.
GIA (m²)	Floor area of 27,378m2 taken from accommodation schedule

3.2 Key Material Inputs

The below table details the key material inputs which have been deemed the most impactful with respect to upfront embodied carbon either due to the variance of embodied carbon factor (ECF) or their embodied carbon intensity. This table should be reviewed in parallel with the results of the LCA and should inform material procurement in order to achieve results in practice that mirror the WLC study.

Table 3-2 - Key Material Inputs

Material	Element	Recycled Content	Embodied Carbon Factor (ECF) (A1-A3)	Assumed Transportation Distance (Leg 1 + Leg 2)
Concrete	Piles & pile caps (C35/45)	50% GGBS	228.5 kg CO2e / m3	50km
	Floor slabs (C35/45)	30% GGBS	240 kg CO2e / m3	50km
	Columns (C50/60)	50% GGBS	231.3 kg CO2e / m3	50km
Reinforcement Steel	Concrete reinforcement	97%	0.79 kg CO2e / kg	1500km + 200km
	PT tendons	97%	0.79 kg CO2e / kg	1500km + 200km
Steel open sections	Steel open sections	Refer to ECF	1.74 kg CO2e / kg	1500km
Aluminium	Façade panels and bracketry	Refer to ECF	10.46 kg CO2e / kg	10,000km
	Linear profiles in façade	Refer to ECF	8.46 kg CO2e / kg	10,000km
	Aluminium sheet	Refer to ECF	6.95 kg CO2e / kg	1500km
	Profiles for BMU track	0%	8.6 kg CO2e / kg	1500km

All EPDs used in the assessment are given in the ‘Reference EPDs for WLC Assessment’ Appendix.

3.3 LCA scope and service life

The following life cycle stages were included in this assessment according to EN 15804:

- A1-A3 Manufacturing of construction materials
- A4 Transportation to site
- A5 Site Works
- B1-B5 Maintenance and material replacements
- B6-B7 Operational energy and water use
- C1-C4 Deconstruction
- D Reuse, recovery and recycling potential (not included in totals)

This study includes the following building elements:

1. Foundations and substructure
2. External walls and façade
3. Columns
4. Upper floor constructions
5. Roof constructions
6. Internal walls and partitions
7. Internal doors
8. Internal finishes
9. Windows and external doors
10. Stairs
11. Building services

The building’s design life was set to 60 years, the standard reference study period for GLA assessments. Component lifespans have been assumed as per Table 9 of the RICS guidance, ‘Whole life carbon assessment for the built environment (2017)’, unless noted otherwise.

3.4 LCA software

The software used in this study was One Click LCA. The software has been third party verified for compliancy with the following LCA standards: EN 15978, ISO 21931–1 and ISO 21929, and data requirements of ISO 14040 and EN 15804.

4 Whole Life Carbon Targets

Within whole life carbon modelling, the GLA have provided a number of targets covering upfront embodied carbon (Modules A1-5), in-use and end of life carbon (Modules B-C) and life-cycle carbon (Modules A-C). These targets are reported below in Table 4-1.

Table 4-1 Proposed hotel building Project Targets

	A1-A5 (kg CO2e/m2 GIA)	B-C (excl B6 & B7) (kg CO2e/m2 GIA)	A-C (excl B6 & B7) (kg CO2e/m2 GIA)
WLC benchmark – Residential	<850	<350	<1200
Aspirational WLC benchmark - Residential	<500	<300	<800

5 Results

The following table details the outcomes from the Whole Life-Cycle Carbon Assessment for the proposed hotel building.

Table 5-1 - Estimated WLC emissions of the proposed hotel building

NDP Hotel – GIA 27,378m²						
	Module A1-A5	Module B1-B5	Module B6-B7	Module C1-C4	Module D	A-D, excluding Modules B6 & B7
TOTAL kg CO2e	25,403,554	11,009,493	18	636053.2585	-12,634,492	24,033,211
TOTAL kg CO2e/m2 GIA	916	397	0	23	-455	866

5.1 Overall Results

The results for the proposed hotel building embodied carbon (modules A1-A5) are given in Table 5-2.

The results show an overall embodied carbon value of 1203 kgCO2e/m² GIA for modules A-C (excluding B6 and B7), This achieves the GLA standard benchmark of 1250kg CO2e/m² but falls short of the GLA aspirational target of 800 kgCO2e/m² GIA. In order to reach the aspirational benchmark target, the project will need to reduce its overall embodied carbon by 29%.

The 916 kg CO2e/m2 (A1-A5) of the proposed development is not performing better than the standard WLC benchmarks given by the GLA as it falls short of the benchmark target of 850 kg CO2e/m2 (A1-A5) as shown in Table 5-1. At present, the proposed hotel building falls short of the GLA upfront embodied carbon target of 850 CO2e/m² by approximately 8%, however it must be noted that any LCA undertaken at Stage 2 should be taken as a snapshot of the current design. This can be used at this early design stage to inform reductions and lean design optioneering across the following design stages. In addition to this, as per the recent RICS guidance for undertaking an LCA, a 10% uplift factor has been applied to all modules to account for design changes that may occur following stage 2 alongside market uncertainties and procurement. This means that the reported results are 10% higher than the results of the LCA model.

5.2 Modules A1-A5

As per GLA guidance, the substructure, superstructure, and façade are expected to occupy roughly 25%, 33% and 17% of the A1-5 emissions respectively. The preliminary results for the proposed hotel building report the substructure, superstructure, and façade as 9%, 39% and 34% respectively, indicating that these results fall outside of the expected boundaries. The percentage of embodied carbon contribution for the substructure is much lower due to the retention of piling within some of the foundation zones. The high embodied carbon percentages of the superstructure could be due to the high-rise nature of the development alongside the redistribution of the substructure percentage allocation.

For a concrete framed building sitting atop piles, it is to be expected that concrete and rebar will occupy the top slots with respect to embodied carbon. In the case of the proposed hotel building, around 49% of the overall upfront carbon emissions of the structure come from the concrete elements. The concrete used at present has a recycled content ranging from 30% within the substructure to 50% within the superstructure. **It is recommended that the team exercise caution within this concrete specification given the current market uncertainties surrounding the GGBS supply chain. If**

possible, the team should look to further investigate lean façade and structural designs and alternative cement replacement options.

An additional avenue for exploration is the sourcing of reused steel. BH estimate that if all of the steel specified within the roof and terrace areas could be sourced from previously used steel, 134 tonnes of embodied carbon could be saved.

Table 5-2- WLC results with the breakdown of building elements for modules A1-A5 for the proposed hotel building

Building elements	WLC emissions (kg CO2e)	WLC emissions (kg CO2e/ m2 GIA)	Modules A1-A5 Modules A1-A5 <table><tr><th>Building element</th><th>Percentage</th></tr><tr><td>Substructure</td><td>9%</td></tr><tr><td>Superstructure</td><td>39%</td></tr><tr><td>Façade</td><td>34%</td></tr><tr><td>Internal Finishes</td><td>8%</td></tr><tr><td>FFE</td><td>0%</td></tr><tr><td>MEP</td><td>9%</td></tr><tr><td>External Works</td><td>1%</td></tr></table>	Building element	Percentage	Substructure	9%	Superstructure	39%	Façade	34%	Internal Finishes	8%	FFE	0%	MEP	9%	External Works	1%
Building element	Percentage																		
Substructure	9%																		
Superstructure	39%																		
Façade	34%																		
Internal Finishes	8%																		
FFE	0%																		
MEP	9%																		
External Works	1%																		
Substructure	2,200,010	79																	
Superstructure	9,507,473	343																	
Façade	8,334,389	300																	
Finishes	2,036,803	73																	
FF&E	-	-																	
Services	2,284,201	82																	
External Works	126,860	5																	
Total	25,403,554	916																	

The façade results are considerably higher than what is set to enable the attainment of the GLA embodied carbon targets. This is in part due to the high aluminium content within the façade, and the inefficient aspect ratio of the tower style building. The façade has been modelled using the Buro Happold façade input library. As it is rare for a façade build-up to be fully established at stage 2, the façade library enables a comprehensive façade build-up to be accounted for including supporting structure, insulation, waterproofing etc within the LCA model based on a variety of façade types. In the case of the proposed hotel building, the cost plan provided general areas and façade types that have been used to inform the input into the LCA model. At present, the largest contributor to the upfront embodied carbon of the façade is the metal rainscreen (aluminium). This is followed by the unitised glazed system, and the aluminium louvres. At this early design stage, conservative assumptions have been taken with respect to the embodied carbon of the aluminium aligning with the average emissions of aluminium across the European market. This aligns with the RICS methodology for this stage of design, but also provides a large opportunity for reductions at later design stages if lower embodied carbon aluminium can be sourced.

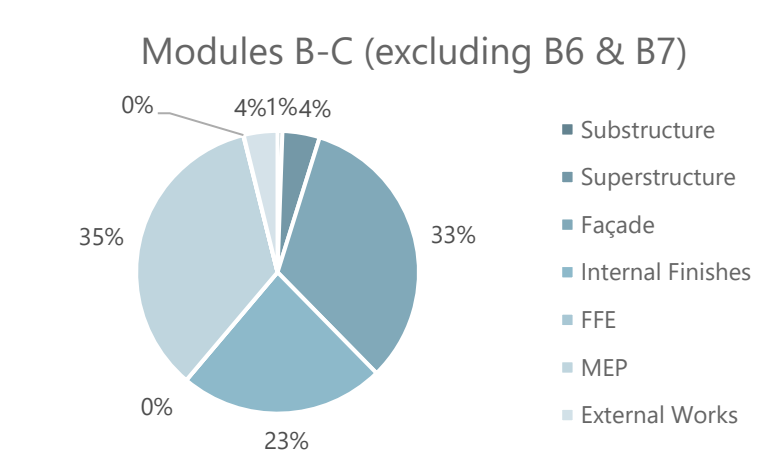
The building services represent around 9% of A1-A5 emissions compared to the 11% expected by the GLA. The building services strategy has been modelled alongside the Buro Happold MEP team and will be refined as the design progresses. Within the proposed hotel building, the residential and penthouse areas have been modelled to represent the MEP full fit out as reflected in the design. High impact areas for the MEP focused around the vertical transportation, cabling, and the residential MVHR units. Due to the nature of the early design stage, a number of assumptions have been. While the systems are correct, as the design progresses, it is anticipated that these inputs will be refined to more accurately represent the exact scale and materiality of these systems.

At present, internal finishes do represent a slightly high proportion of the upfront embodied carbon ~11% in comparison with the GLA breakdown of 9%. Due to the nature of the early design stage and the limited finishing and fit out specification available, a number of assumptions were made. These can be seen primarily in the inclusion of carpet tiles and suspended ceilings within the hotel and amenity areas. At present, the suspended ceilings occupy the 6th highest contribution to the upfront embodied carbon, totalling 6% of the upfront embodied carbon of the whole building. While this may change as the finishing strategy is finalised, **it is highly recommended that exposed finishes are used where possible.**

5.3 Modules B-C (Excluding B6 & B7)

The results for the proposed hotel building embodied carbon (modules B-C excluding B6 & B7) are given in the following table.

Table 5-3- WLC results with the breakdown of building elements for modules B-C (excluding B6 & B7) for the proposed hotel building

Building elements	WLC emissions (kg CO2e)	WLC emissions (kg CO2e/ m2 GIA)	Modules B-C (excluding B6 & B7)
Substructure	76,244	3	
Superstructure	515,056	19	
Façade	3,950,745	142	
Finishes	2,836,802	102	
FF&E	-	-	
Services	4,212,657	152	
External Works	5,990	0	
Refrigerant leakage	465,503	16	
Total	12,062,997	434	

The 434 kgCO₂e/m² B-C modules (excluding B6 & B7) of the proposed development falls short when compared to both the standard and aspirational WLC benchmarks provided by the GLA of 350 kgCO₂e/m² GIA and 300 kgCO₂e/m² GIA. In order to reach the 350 kgCO₂e/m² GIA standard benchmark, the B-C modules must be reduced by a measure of 19%.

It must be noted that assumptions have been made for the B2/B3 modules following the GLA’s Whole Life Carbon Assessment guidance (March 2022), as repair and maintenance strategies have yet to be developed, alongside the other material assumptions provided in Table 3-1. This is therefore an area that should be monitored closely, and updated when information is produced, over future design stages. Furthermore, generic RICS guidance assumptions on lifespans have been taken for all elements due to lack of specific product specification at the current design stage in addition to the mandated 10% uplift due to the early design stage of the project. It is expected that B4 emissions will reduce substantially with the introduction of the correct lifespans, particularly with relation to facades. It is hoped that at minimum, the 8% reduction will occur during the coming refinements of the analysis model alongside the reduction of the 10% uplift to the 5% contingent with detailed design and that this will enable the project to achieve the GLA standard benchmark.

The results identify the major contributors to be the façade (~33%), the services (35%) and the finishes (~23%). The contribution of the in-use modules are generally through the repair and replacement of componentry, or when a component reaches the end of its design life. As such, façade components and finishes such as suspended ceilings, which are assumed to have shorter design lives when compared to the rest of the building but disproportionately high embodied carbon content often heavily influence the in-use modules. Within the NDP Hotel, high-carbon intensity glazing façade typologies used can help to explain why these modules do not fall within the GLA benchmarks at this stage. This does not suggest that the benchmarks will not be met once further, more detailed modelling has been undertaken. The reduction of this contribution could be supported by more advanced description of the project’s design for deconstruction intentions and the specification of component design lives. This would enabling more accurate modelling of replacement and end of life scenarios. To minimise the impact of the finishes, suspended ceilings and shorter life finishes such as carpets could be removed from the proposals.

Similarly, building services contribute an equally high quantity of B-C emissions due to the short lifespans assumed for these elements, drastically increasing the B4 emissions. Again, the specification of design lives and the implantation of maintenance strategies could help to reduce this.

Key recommendations for the next stage are to identify equipment with good longevity as well as the minimisation of cooling system requirements. The use of more efficient MEP kit such as the use of hermetically sealed cooling systems to minimise the leakage of high embodied carbon refrigerant could be an option to explore. As discussed above, the prioritisation of exposed finishes or higher quality, longer lasting materials should be prioritised.

5.4 Module Breakdown

The following graph shows the total emissions breakdown per module. The operational energy emissions were obtained using the SAP methodology and follow Part L, BRUKL reports. B2 and B3 stages were benchmarked following the Whole Life-Cycle Carbon Assessments Guidance (March 2022).

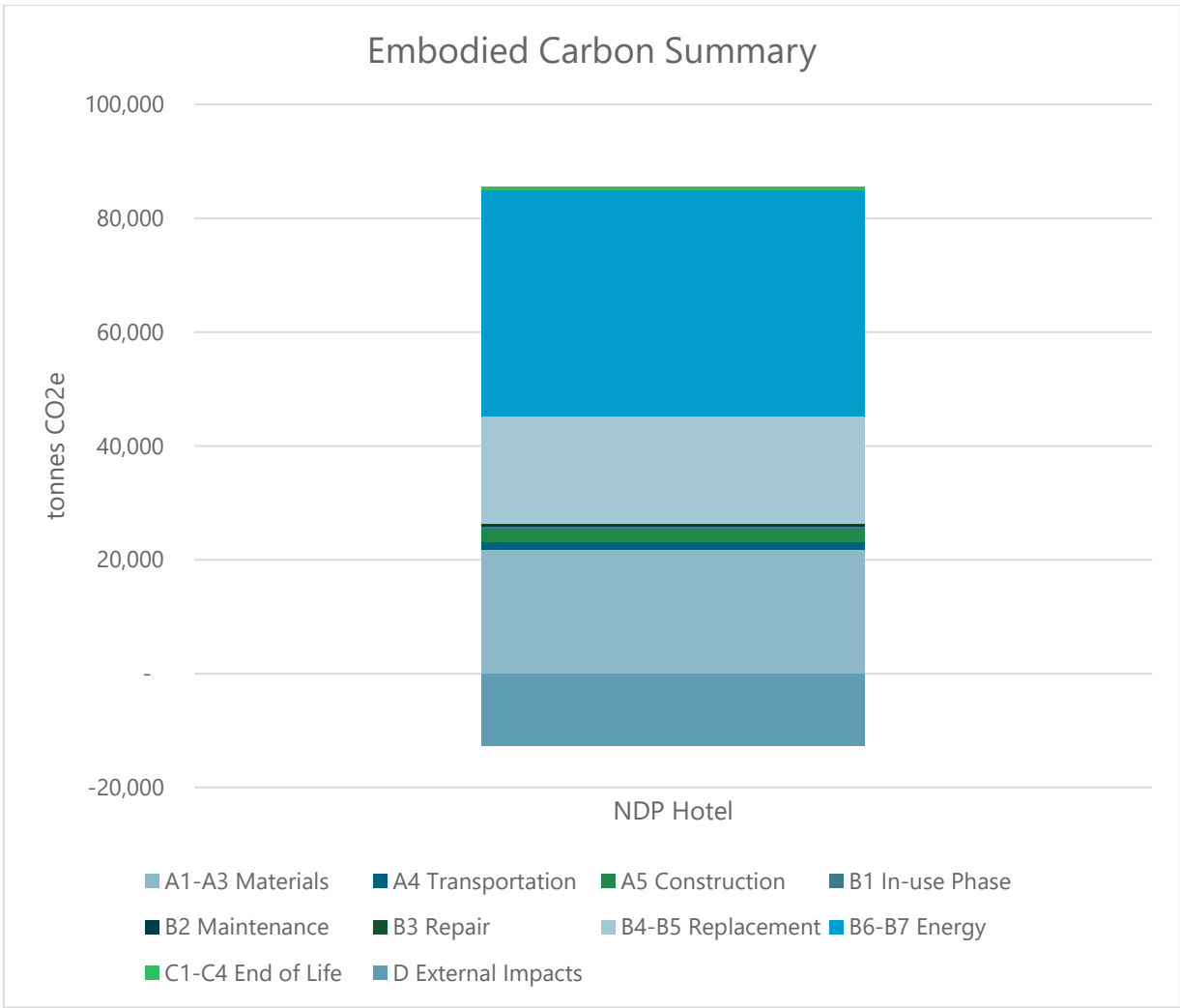


Figure 5—1- Module Breakdown

5.5 Strategies for Reducing Environmental Impact

The façade has been identified as the building element that will require the highest percentage reduction in order to achieve the GLA target. Optioneering studies, and preliminary design discussions could create a pathway to reduce embodied carbon in the early stages of the project as well as early engagement with the supply chain to support this.

As discussed previously, given that aluminium, concrete and rebar contributes to ~70% of the upfront embodied carbon of the overall project, particular attention should be paid to reducing the embodied carbon of this element. At present, the main way to achieve lower embodied carbon within concrete mixes is through the use of cement replacements such as GGBS. As mentioned previously, care should also be taken to consider the relatively volatile supply chains surrounding GGBS, and it should not be used alone to support the sustainability aspirations of the development. **It is recommended that optioneering is undertaken to further investigate the prioritisation of leaner design and the reduction of concrete volume within the project.** Further, the implementation of reused steel presents itself as an major opportunity within the project. Reused steel is considerably lower in upfront embodied carbon that recycled steel and creates very

little risk to designers with respect to strength retention. Steel reuse could enable large embodied carbon savings within the roof and terrace build ups.

Further opportunities to reduce the carbon associated with the project will present themselves as the detailed design is developed such as including a minimum recycled content above 40% for all aluminium façade elements or setting an upfront embodied carbon target for aluminium materials. Additionally, maximising where possible the recycled content within the steel façade elements. Integrating brick with high recycled content (above 80%) or using brick produced using alternative fuel source could also be considered.

With regards to building services, the key design recommendations are to identify ways to reduce all pipework and ductwork length, to look to minimise refrigerant charge and/or use lower GWP refrigerant types and the identification of equipment with longer lifespans, in order to reduce whole-life embodied carbon emissions.

The internal finishes considered for the project should also take reduced use and longevity as priority actions. Exposed soffits as opposed to suspended ceilings would contribute the largest A1-A5 savings, with polished concrete floors opposed to carpet or vinyl finishes being second. Where finishes are required, the most resilient solutions and any solutions including recycled materials (e.g. recycled carpet tiles) should be identified.

6 Conclusion

A whole life-cycle carbon assessment was carried out on the proposed hotel building development. The relevant quantities from the cost plan (Draft Version 13. July 2023) were used to complete the assessment as accurately as possible.

It was estimated that the total emissions (modules A1-A5) per area based on the GIA were ~916 kgCO₂e/m², which were found to be higher than the GLA's standard benchmarks. The analysis has identified that the largest opportunities contributing to potential reduction in life-cycle carbon are the continued investigation of lower carbon façade design and leaner design of concrete elements. This might include the specification of post tensioned slabs to replace the flat slabs within the current design and/or the selection of lower cement content concrete mixes. The height of the building presents challenges to carbon reduction, for that reason, at this stage, assumptions have been taken in a conservative manner. As the project evolves further reduction strategies will be analysed in close interaction with the design team.

The results show an overall embodied carbon value of 1203 kgCO₂e/m² GIA for modules A-C (excluding B6 and B7), This achieves the GLA standard benchmark of 1250kg CO₂e/m² but falls short of the GLA aspirational target of 800 kgCO₂e/m² GIA. In order to reach the aspirational benchmark target, the project will need to reduce its overall embodied carbon by 29%.

Additionally, it was estimated that the total emissions (modules B-C excluding B6 & B7) per area based on the GIA were ~434 kgCO₂e/m², which were found to miss both the GLA's aspirational and standard benchmarks. The analysis has identified that the largest factors contributing to life-cycle carbon are the replacement of façade elements and the services. The specification of specific design lives and a robust repair and maintenance strategy for the both the façade and the mechanical equipment would help to reduce this impact.

The study included analysis of the D stage as well, including the modules reuse, recovery and recycle. D modules are usually incorporated with circular economy analysis but are still relevant to the overall whole life carbon of the building as the building sits within a wider network of buildings within the borough. Maximising the positive impacts of the D modules, while not directly contributing to the result will support the transition to a net zero building industry.

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