EUSTON TOWER

Whole Life Carbon Assessment

December 2023

British Land

WLCA – Method Statement

10th November 2023
RIBA 2

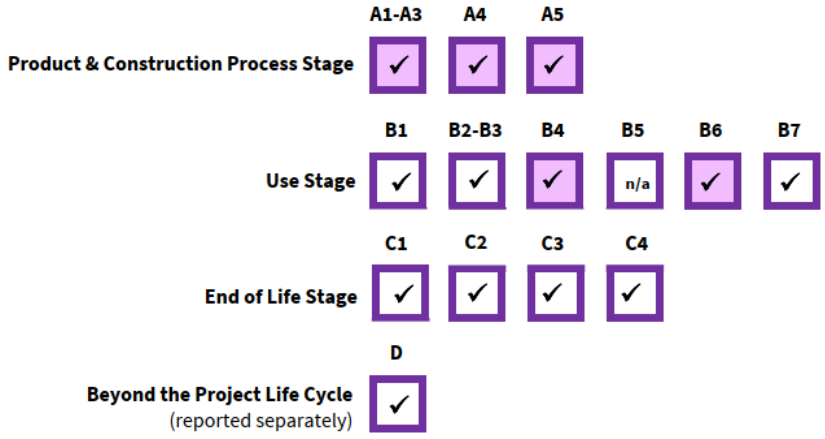
Euston Tower

RIBA Stage 2 Whole Life Carbon assessment note.

This is a RIBA 2 Whole Life Carbon Assessment (WLCA) method statement for the Euston Tower development. This statement is constructed to accord with the methodological requirements of the RICS Professional Statement Whole life carbon analysis for the built environment (2017) publication.

EN 15978 Module Coverage

As per the requirements of the RICS PS 1st Edition Table 2, a WLCA must cover core modules of EN 15978:2011, typically representing where the majority of WLC impacts fall. As an absolute minimum, a Sweco WLCA assessment will cover these modules in full. Sweco look to include all possible EN 15978:2011 modules, subject to the limitations of the One Click LCA tool, the RIBA stage/timing of the assessment and the availability of data/scenario information from the industry at the time of writing. The below demonstrates which modules have been included in this study.



Reference Study Period

The RICS Professional Statement has set requirements for the reference study period (RSP) which must be used for the WLC assessment process. For domestic and non-domestic projects, the RSP is **60 years**. The RSPs are fixed to provide a level of comparability between WLC results for different projects, and to enable better future interrogation and interpretation of results.

Building Elements Coverage

The table presented below shows the percentage of costs covered by the G&T cost plan for each elemental category. In cases where the coverage is less than 100%, an adjustment factor was applied to provide an allowance for the carbon impacts of the missing elements or components as per the RICS WLCA PS 1st Edition recommendation. For instance, if the coverage is 95%, then the adjustment factor for carbon of those elements quantified in that category would be 1.05.

For certain building element categories, based on the current stage in design and availability of information, benchmarked carbon values were used on a per m^2 basis. These categories are indicated below.

It is worth noting that in the latest version of the Cost Plan issued to Sweco, costs were redacted, therefore the same cost plan coverage factors were used as per the interim Stage 2 WCLA, which was itself based on an earlier version of the cost plan with costs presented. However, Sweco have determined that the same overall coverage of elements in this iteration is equivalent to the interim Stage 2 assessment so maintaining these coverage factors is deemed appropriate.

Table 1.0: Building elements coverage for ET at RIBA 2.

	Building parts/ Element groups	Building Elements	Coverage (%)
0	Facilitating works	0.1 Temporary/Enabling works/ Preliminaries	Benchmarked Value
		0.2 Specialist groundworks	N/A
1	Substructure	1.1 Substructure	95%
2	Superstructure	2.1 Frame 2.2 Upper floors incl. balconies 2.3 Roof 2.4 Stairs and ramps	99%
	Superstructure	2.5 External Walls 2.6 Windows and External Doors	100% (Contingency factors added separately as part of CWCT process)
	Superstructure	2.7 Internal Walls and Partitions 2.8 Internal Doors	100%
3	Finishes	3.1 Wall finishes 3.2 Floor finishes 3.3 Ceiling finishes	97%
4	Fittings, furnishings, and equipment (FF&E)	Building-related Non-building-related	59%
5	Building services / MEP	5.1 - 5.14 Building-related services	44%
		Non-building-related	N/A
6	Prefabricated Buildings and Building Units	6.1 Prefabricated Buildings and Building Units	N/A
7	Work to Existing Building	7.1 Minor Demolition and Alteration Works	Benchmarked Value

	Building parts/ Element groups	Building Elements	Coverage (%)
8	External works	8.1 Site preparation works 8.2 Roads, Paths, Paving and Surfacing 8.3 Soft landscaping, Planting, and Irrigation Systems 8.4 Fencing, Railings and Walls 8.5 External fixtures 8.6 External drainage 8.7 External Services 8.8 Minor Building Works and Ancillary Buildings	Benchmarked Value

Measurement Source References

Table 2.0: Key material quantities data sources (non-exhaustive).

Data Source	Data Source Type	Comments
Euston Tower - Cost Plan (17.10.23)	Cost Plan	Source for majority of quantities.
ET - WLCA Structural Quantities Review – Rev F (GT AMENDS REVA) – Received 09.11.23	Material Quantity Schedule	Further refinement of structural material quantities provided by G&T and Arup.
1312_Sustainability_Mtg_230531_RevA	PDF Presentation	Provided the baseline carbon factors (A1-A3) for concrete.
Euston Tower Interim Stage 2 Area Schedule (20.10.23)	Area Schedule	Latest area schedule provided by G&T.
ARUP Structures correspondence	Emails	A number of further clarifications and quantity provision on a more granular level than in cost plan – see below.
CWCT Façade Calculations	Excel data sheet	CWCT compliance calculations for façades provided by 3XN.
Initial MEP Equipment Schedule	Excel data sheet.	Arup MEP provided a provisional/high level equipment schedule that formed the basis of their initial Stage 2 Design. (Sanitaryware, lifts, trench heaters and floor diffusers updated as per latest cost plan).
ARUP Energy Statement - EST-ARP-XX-XX-RP-M-00002	Energy Report	TM54 calculation used for B6 module.
Refrigerant Schedule	Excel data sheet.	Arup MEP filled in refrigerant schedule based on initial Stage 2 Design.

Product and Construction Process Stage

At Stage 2, there was insufficient design information in certain categories to derive reliable quantities from the cost plan of material specifications from other reference material. In these cases, an overall carbon rate per m² GIA, that was established earlier in the design, was applied as a placeholder allowance. This is relevant to the following elemental categories:

- Demolition impacts of existing building: **20 $kgCO_2e/m^2$ GIA.**
- Temporary works (which included Works to Existing Building): **15 $kgCO_2e/m^2$GIA.**
- External works: **20 $kgCO_2e/m^2$ GIA.**
- Site activities: **26 $kgCO_2e/m^2$ GIA.**

Carbon factors used (A1-A3)

Structural Components

The baseline carbon factors for structural materials were confirmed to Sweco as follows:

- **Structural steel:** Bracing, façade, columns and floors – **0.33 $kgCO_2e/kg$ –** as per Acellor Mittal's XCarb Steel.
- **Structural steel:** Connections only – **2.45 $kgCO_2e/kg$ –** Basic Oxygen Furnace UK typical.
- **Structural steel:** Basement truss and bolt on podium structure – **1.74 $kgCO_2e/kg$ –** blended rate of EAF to BOF.
- **Structural steel:** 10% of 7,818 tonnes assumed reused steel (782 tonnes) with CF of **0.0466 $kgCO_2e/kg$,** based on EMR EPD.
- **Steel reinforcement**: 0.3 $kgCO_2e/kg$ – Acellor Mittal's XCarb Rebar product.
- **Piles, continuous piled wall concrete carbon factor:** RC 32/40 50% GGBS - 0.0888 $kgCO_2e/kg$.
- **Raft slab, Liner wall, satellite retaining wall, basement slabs concrete carbon factor:** RC 32/40 25% GGBS – 0.12 $kgCO_2e/kg$.
- **Precast slabs concrete carbon factor:** RC 32/40 25% GGBS – 0.12 $kgCO_2e/kg$.
- Arup structures provided structural steel intumescent paint rate of **80,000 m² at 1mm** thick in mid stage 2, updated proportionally with new steel tonnage (**84,310 m² at 1mm thick**).
- Arup structures confirmed **grouting** between slabs at **8 kg/m².**
- **Basement slab waterproofing**: Sweco material library default input polyethene membrane.
- **Basement slab:** Sweco material library default input **300mm EPS.**
- **Precast stair reinforcement** rate assumed at **130 kg/m³.**

Facades

- **BMU** – only 'number of' highlighted in Cost Plan – generic Sweco input used for this with material weights.
- **Internal lining of external wall** assumed as 2 x 15mm plasterboard with steel studwork at 1.3kg/m².

CWCT calculations provided by 3XN. Some key notes and assumptions from these calculations:

- The carbon performance of the **Podium Façade** was based on the averaged performance of the other façade types.
- A **5% material scale up** factor was applied to all material components, then a separate **façade scale up factor of 5%** was also applied.
- The facades were assumed to be assembled **offsite in European factory.**
- **The aluminium extrusions** were based on the **Hydro Reduxa EPD** value for billet only at **4 $kgCO_2e/kg$** plus a placeholder allowance for extruding (**0.5 $kgCO_2e/kg$**), pre anodization (**2.24 $kgCO_2e/kg$**) and PPC coating (**0.13 $kgCO_2e/kg$**).
- An allowance of **263 $kgCO_2e/m^2$ FSA (A1-A5)** was assumed for the **soffits** with the area for this element being taken from the Cost Plan.

The performance of the other façade types, including all contingencies (i.e., material and overall façade scale up) for modules A1-A5:

- **Typical Bay:** 461 $kgCO_2e/m^2$ FSA
- **Amenity Façade:** 527 $kgCO_2e/m^2$ FSA
- **Wedges:** 530 $kgCO_2e/m^2$ FSA
- **Podium Façade:** 506 $kgCO_2e/m^2$ FSA (averaged value from other types)

Internal Walls, Finishes & Fittings

- Sweco material library defaults for **drylining build-ups** in model i.e., **plasterboard, acoustic insulation and metal studwork.**
- Sweco material library defaults for **bike racks and lockers.** Number of units taken from Cost Plan.
- **Internal doors:** allowance in cost plan on a cost per m² GIA basis rather than the number of doors itemised. Therefore, Sweco looked at the number of internal doors per m² GIA on other office developments and used this as a means to estimate the number of doors in Euston Tower.
- **Reused RAF for S&C areas** (excluding the WC's) – input based on RMF e-coated (0.71 $kgCO_2e/m^2$) with pedestals assumed 4kg/m² of material.
- **RAF for WC's and office CAT A** - input based on Kingspan RMG 600 (40.56 $kgCO_2e/m^2$) in first instance (worst case) with pedestals assumed 4kg/m² of material.
- **Screed –** 50mm thick assumed to all basement area (provided by G&T in a call with Sweco on 02/11).

Where not directly provided in architectural responses following assumptions made to finishes:

- **Void formers** at 100mm.
- **Ceramic floor tiles** at 10mm thick and associated adhesive at 10mm thick.
- **0.4mm epoxy resin** finish to **plant and bike store areas.**
- **Natural stone** 10mm thick and associated adhesive at 10mm thick for enhanced finishes to **lifts.**

Building Services

Main plant items as per the basis of design in ARUP indicative MEP schedule.

- **Distribution MEP materials** in base build areas based on per m^2 inputs i.e. pipework, ductwork and containment.
- **280 m^2 of PV** assumed based on Arup MEP response (noted as still to be formally confirmed).

CAT A fit out assumptions:

- **Lab enabled:** Cost Plan confirmed that floors 3-11 are being designed as lab enabled, and two of these floors will be fitted out. Area from cost plan.
- CAT A office areas: **floor area** from latest cost plan **(4 floors).**
- CAT A for office and Lab **specific equipment** based on **per m^2 inputs** for areas above e.g., **ductwork, cabling, lighting, sprinklers, containment**.
- **No localised building services** materials assumed in Office or lab enabled tenant areas that are to be fitted to **shell and core** specification.

Assumptions for Transportation Distances (A4)

For the vast majority of modelling inputs, the transport distances have been based on the RICS WLCA PS defaults. A summary of these assumptions are provided in the table below.

Table 3.0: RICS WLCA PS (2017) Default transport distances.

Assumed Transport Distance (km)	Product group/material in project WLC analysis
50 (local)	Concrete, screed, aggregates
300 (UK)	Formwork, steel deck, timber terrace decking, pavers, balustrades & handrails, stone pavers, resin-bonded gravel, internal timber doors, blockwork, cement mortar, plasterboard, acrylic paint, carpet, vinyl flooring, RAF, suspended metal ceiling, baffle ceiling, ceramic tiles, concrete sealant, terrazzo.
1500 (EU)	Insulation, bitumen membranes, pedestals, sanitaryware, steel studwork, pipe/duct insulation, lighting, waterproofing membranes for structure, rebar, riser doors, revolving door sets, aluminium/glass internal doors, stair core doors, glazed internal screens, cycle racks & lockers, ductwork & pipework, all other building services items not assumed in UK (300km) list above.

An exception to this is the precast concrete elements, where two transport distances have been applied (300 km x2 concrete and 1500 km + 300 km for rebar). These additional distances provide an allowance for to account for upstream transportation movements prior to leaving the factory to site i.e., it avoids the underestimation of transport impacts where A2 impacts are lacking from the EPD used.

In a similar vein, any building services product or system that has been built up by Sweco from individual materials, and not taken directly from a product EPD, two transport distances have again been provided to make an allowance for movements of raw materials/products to the factory, and then from factory to site (1500 km x 2).

As noted in previous sections, some elemental categories at this stage have been based on benchmarked A1-A5 carbon intensity values. Therefore, the transport impacts are included within this benchmarked figure. However, as the majority of the data that underpins the intensity allocations came from internal portfolios (particularly from Sweco), based on design information from other projects, it is reasonable to state that all values for transport are in accordance with the design values set out within the RICS PS WLCA (2017) methodology.

Predicted Construction Site Energy Use and Waste (A5)

This section can be separated into two parts: construction site emissions (A5s) and construction site waste (A5w). The methodology for each is set out below.

The emission rate of 26 $kgCO_2e/m^2$ GIA for A5s it was suggested by Sweco based on a target rate for a 100% new build and the modification was made based on the difference in construction program length between the Hybrid C option being proposed for planning and a hypothetical new build. It's important to note that this emission rate only takes into account site emissions and doesn't include waste.

The A5w data uses default WRAP waste values as applied within software such as One Click and is included within reported A1-A5 values. Again, for those elements based on benchmarked values the same default rates are included in the A1-A5 value in the sense that the same methodology was used in the projects that provided these benchmarked values.

Use Stage

Assumption for Refrigerants (B1)

The refrigerant information was provided by ARUP, while the annual and end-of-life leakage rates have been taken from the CIBSE TM65 Table 4.13 values for the relevant systems, as set out below.

Table 4.0: Systems & refrigerants used in WLCA Stage 2 baseline.

System	Refrigerant Type	GWP ($kgCO_2e/kg$)	Service Life (yrs.)	Total Charge (kg)	Annual Leakage Rate (%)	EoL Leakage Rate (%)
ASHP	R513A	656.45	15	1955	2	1
Chillers	R513A	656.45	15	2250	2	1
DX Units	R-32	675	15	315	6	3

Assumptions for Maintenance and Repair (B2 & B3)

Modules B2 and B3 includes the embodied carbon associated with maintenance and repairs over the duration of the building's RSP. Greater London Authority (GLA) updated "London Plan Guidance – Whole Life-Carbon Assessments" publication, released in March 2022 provides some guidance on assumptions for Modules B2 and B3 when they are unknown at an early stage within section 2.5.15, and to encourage some assessment of the impact of these modules provides the following guidance:

"…for module B2 emissions, a total figure of 10 kgCO2e/m2 gross internal area (GIA) may be used to cover all building element categories, or 1 per cent of modules A1-A5, whichever is greater. For module B3 emissions, these may be estimated as 25 per cent of module B2, as per the RICS PS (item 3.5.3.3). "

These additions are not added between all buildings parts as some will require either minor maintenance and repairs only during its life span, or no maintenance/repairs at all. The following categories are used for the additions as stated in RICS PS section 3.5.3.2; roof, façade and external doors, finishes, and services.

Assumptions for Lifecycles of materials (B4)

The assumptions for life cycle replacement of materials have been made in accordance with RICS PS, except for building services, which adheres to CIBSE Guide M, and for the facade, which follows the CWCT methodology.

Assumption for Operational Energy and Water (B6 & B7)

The predicted energy consumption for Euston Tower was provided by ARUP, as part of their energy statement draft issued on the 20th of October 2023.

Table 5.0: Predicted Energy Consumption for ET.

Baseline Office/Lab	Predicted Energy Consumption (MWh/year)		
	Base Build	Tenant	Total
	7139.67	8313.96	15453.63

For the baseline water consumption calculation, Sweco have used the Better Building Partnership's 2020 Real Estate Energy Benchmarking (REEB) publication, released in August 2021. The 'Typical Practice' water use intensity (WUI) for offices of 636 (litres/m2 NLA/year) was used, in the absence of more specific data. The emissions factors associated with water use and treatment are derived from Thames Water, and the consequent emissions factors, published in 2022/2023, are 0.0402 $kgCO_2e/m^3$ for water supply, and 0.1822 $kgCO_2e/m^3$ for water treatment (assuming 90% of potable water ends up going to sewer).

End of Life Stage

Assumption for End of Life (C1-C4)

The end-of-life waste streams, and their associated C1-C4 impact, is based on the pre-set typical practice UK scenarios for each material type.

Results

The A1-A3 section summarises the key assumptions made within each building element category. However, prior to presenting the results it is worth reiterating the specific carbon reducing intervention measures that are included in these results. These were outlined as reduction measures in the interim Stage 2 WLCA, and subsequently they have been committed to by the client for inclusion in the Baseline position. These specific intervention measures are listed as follows:

- 10% of the rolled sections (782 tonnes) are targeted as being used by reused steel. Sweco have applied a placeholder input for the small carbon allowance for these reused steel as per the EMR EPD with a carbon factor of **0.0466 kgCO_2e/kg**.
- Then the remaining rolled steel sections (7,037 tonnes) comprising: bracing, façade support, columns, and floors – have been modelled as per Acellor Mittal's (AM) XCarb steel product (0.33 kgCO_2e/kg).
- AM XCarb rebar has also been included for steel reinforcement within the associate concrete elements within the substructure and superstructure.
- The base build raised access flooring (RAF) (24,526 m²), which excludes WC areas, is based on the RMF Eco range tiles.
- Concrete elements are based on the GGBS proportions, and associated carbon factors, as confirmed to Sweco and set out in the A1-A3 inputs section earlier in this note.

Table 6.0 below shows the performance, provided at three levels – whole life carbon (A-C including B6 & B7), life cycle embodied carbon (A-C excluding B6 & B7) and upfront embodied carbon (A1-A5).

Table 6.0: Summary of Baseline RIBA Stage 2 WLC performance of ET at the three levels of detail, with all values as intensity (kgCO_2e/m² GIA) according to GLA.

EN 15978:2011 Modules	Whole Building (inc. contingencies) kgCO_2e/m^2 GIA
Whole Life Carbon (A-C inc. B6 & B7) **Including sequestration**	**2,894**
Life Cycle Embodied (A-C ex. B6 & B7) **Including sequestration**	**1,262**
Upfront Carbon (A1-A5)	**711**

Contingencies

As this assessment is still at an early design stage, suitable contingencies have been allowed for in the results. However, is more than one type of contingency applied, and some are only applicable to specific elements. For transparency, Table 7.0 below sets out the results across the various building elements, in intensity terms, and segregates the various contingencies applied. All of these contingencies then culminate in the total A1-A5 figures.

The façade scale-up factors are in line with CWCT guidance. The cost coverage factors reflect the coverage of building elements, as stated at the start of this note. Additionally, a 15% contingency is applied to account for early-stage design, in line with RICS WLCA PS 2nd edition. This last contingency applies to all elements except for façades, external works, site activities, temporary works and demolition. However, a 10% contingency is applied to demolition as a thorough Pre-Refurbishment/Demolition Audit has been carried out during the initial stages of the feasibility study by Reusefully. However, a reduced contingency of 10% is deemed appropriate for demolition impacts as a thorough Pre-Refurbishment/Demolition Audit has been carried out during the initial design stages.

Table 7.0: A1-A5 results intensity ($kgCO_2e/m^2$ GIA) segregated out to highlight the various contingencies including in the reporting.

Building Element	Stage 2 - A1-A5 ($kgCO_2e/m^2$)					
	Results Intensity	Façade Scale up Factors (CWCT)		Cost Plan Coverage Factors	15% Contingency *	Total Intensity with Contingencies
Demolition	20			0	2	**22**
Substructure	46			2	7	**56**
Superstructure	178			2	27	**207**
External walls, windows and doors	159	8	7	0	0.7	**174**
Internal Walls & Doors	19			0	3	**21**
Finishes	24			1	4	**29**
Fittings	3			1	0	**5**
Building Services	88			49	21	**158**
External Works	20			0	0	**20**
Site Activities	26			0	0	**26**
Temporary Works	15			0	0	**15**
Total	**599**	**8**	**7**	**55**	**65**	**733**

*excludes: demolition, CWCT façade, external works, site activities and temporary works.

Reduction Opportunities

Options have been presented in the waterfall below. They cover modules A1-A5 only at this stage, given the current industry focus on upfront embodied carbon. All reductions are in intensity ($kgCO_2e/m^2$ GIA) and are measured against the base specification material.

The table below provides an estimated quantification of these further reductions in A1-A5 intensity terms. They are also illustrated in the subsequent waterfall chart. It should be noted that in a number of cases these reductions reported are cumulative i.e., the quantified reduction cannot be taken separately from the other associated reductions before it.

Material use efficiencies.

Material specification.

Site activities.

Table 8.0: Cumulative reduction opportunities for upfront carbon with estimated reduction quantities provided in A1-A5 intensity.

Item	Reduction Measure (Description)	Intensity Reduction $kgCO_2e$ A1-A5
1	Foundation Optimization - Pile Caps + Piles instead of Raft + Piles	-10.0
2	High recycle content for substructures elements - in-situ concrete - Piles 70% GGBS (137.3 $kgCO_2e/m^3$ A1-A5). Other elements - 50% GGBS (206 $kgCO_2e/m^3$).	-8.0
3	Steel Design Optimisation (omit 10%) from the new tonnage excluding connections, podium, truss and reused steel	-4.6
4	Optimize Column Grid - Reduce to a 9x6 Grid instead of 9x12	-6.4
5	Sacrifice demountable floor plate	-3.8
6	Residual Moment Connection - Residual Moment Connections would allow to reduce steel weights	-1.3
7	Review of the Floor to Ceiling Height - Cable Trays under the beam implies no rectangular openings into beams	-1.3
8	Columns - CFT columns instead of S460	-1.3
9	Xcarb Steel for Truss and bolt on podium structure	-6.2
10	Etex plasterboard (ceilings + walls)	-3.7
11	Reuse of existing building concrete (ribbed slabs)	-2.0
12	High recycle content - precast concrete -50% GGBS	-12.7
13	Extrusions made with high recycled content (Hydro Circal75 billet)	-10.2
14	Use SGG ORAE low carbon glass	-4.0
15	RAF - RMG600+ at WC'S and CAT A areas	-1.9

Item	Reduction Measure (Description)	Intensity Reduction $kgCO_2e$ A1-A5
16	Lendlease Data - electrified site apart from HVO concrete pumps	-17.9
17	Lendlease Data - electrified site apart from HVO concrete pumps - electricity on renewable tariff	-8.1

- **Items 1,3,4,5,6,7 and 8** – provided by ARUP.
- **Items 13 and 14** – provided by 3XN.
- **Items 16 and 17** – provided by Lendlease.
- Other items calculated by Sweco.

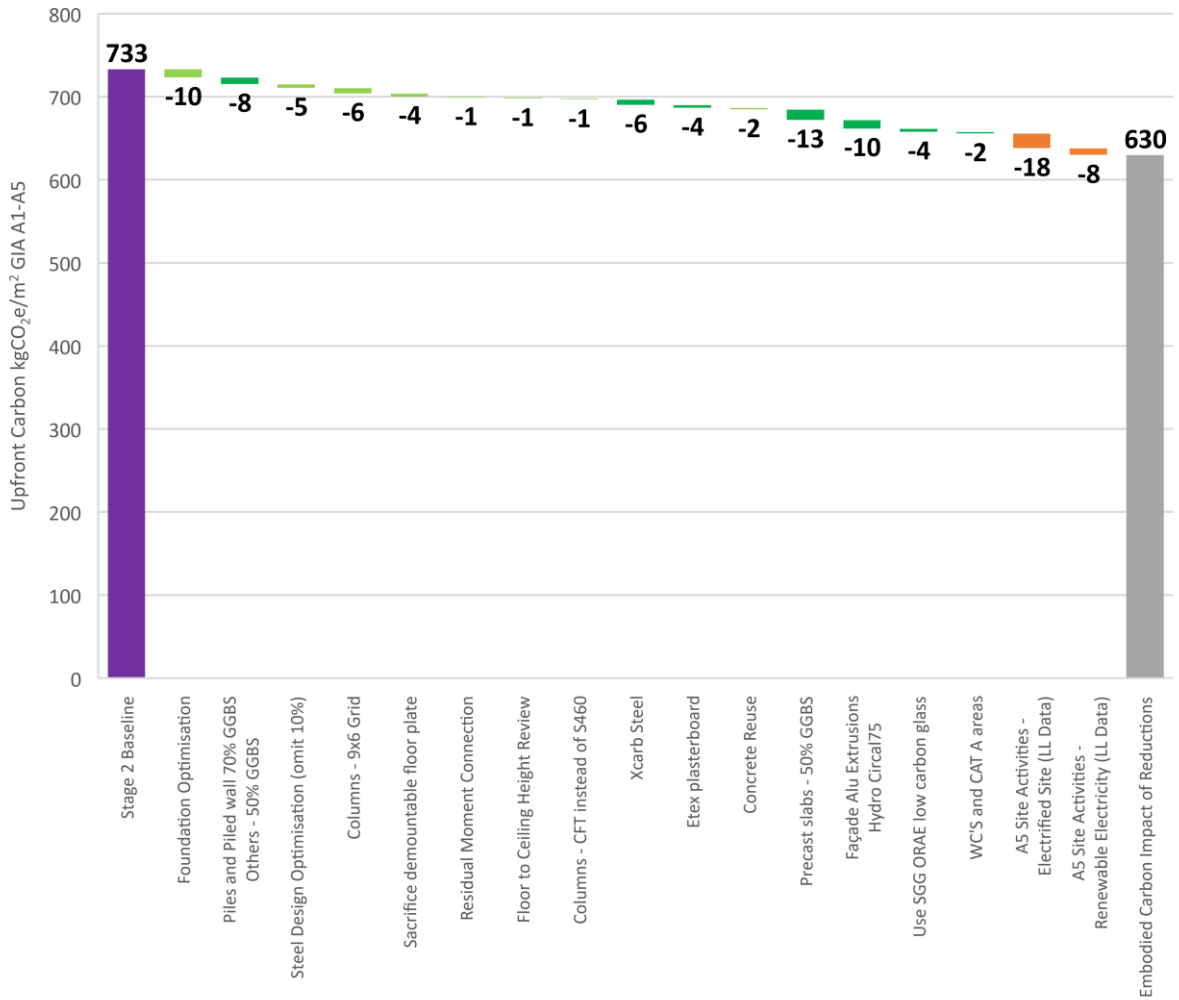


Figure 1.0: Cumulative waterfall chart with further reduction opportunities for upfront carbon with estimated reduction quantities provided in A1-A5 intensity.

All of the reduction opportunities above are based on information available at this stage in the design. However, is worth noting that they will need to be re validated with updated information as the design progresses and more detail is known for certain elements i.e., there is no guarantee that these quantified reductions will remain static throughout the design stages. They should instead be seen as

indicative opportunities to be reviewed and revisited as the project moves through the design stages and a greater granularity in detail is available.

ARUP identified a separate reduction opportunity associated with an alternative metal decking upper floor system. A high-level reduction of -17 $kgCO_2e$ A1-A5 was estimated for this intervention measure. As in reality this reduction measure would have several knock-on implications to other reductions listed in the figures above, it cannot be included in the same cumulative waterfall/table. However, to illustrate its potential as an alternative route to reducing the impact for ET the waterfall chart below includes the metal decking strategy with other measures not anticipated to be influenced by this measure.

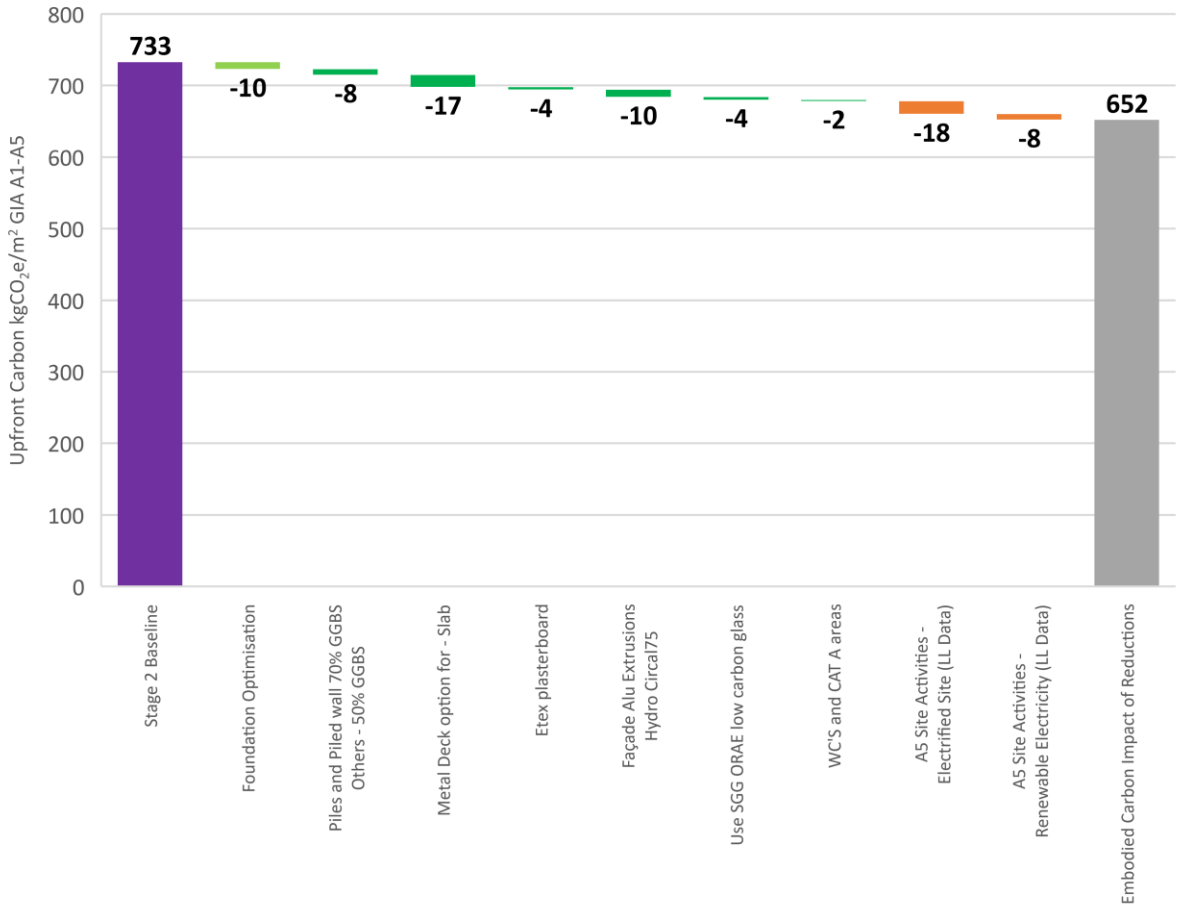


Figure 2.0: Alternative cumulative waterfall chart with metal decking solution to upper floors with other reduction opportunities for upfront carbon with estimated reduction quantities provided in A1-A5 intensity.

It is worth highlighting current industry shifts in relation to the use of GGBS as a means to reduce carbon emissions in concrete. Firstly, Sweco has been made aware of forthcoming increase to the carbon content of GGBS in 2024. Based on a reallocation of its status as a coproduct, rather than a biproduct, in the steel manufacturing process.

Secondly there is a general understanding that, as a constrained or limited resource, the over specification of GGBS in one project my limit its availability in others. Hence a question is raised over its effectiveness to reduce greenhouse gas (GHG) emissions at a global scale. This is all to say that the reductions above, which are based on GGBS percentages currently, may be better understood in terms of their respective carbon factors rather than stated GGBS percentages. That way emerging cement

replacement technologies i.e., alternatives to GGBS, can be considered in the context of delivering the same carbon factor.

Sweco would like to emphasise that caution should also be exercised when considering the reduction in A5 site activities. In the recently released RICS WLCA PS 2nd edition, specific reference is made to the fact that green or renewable tariffs must not be taken into account when reporting the carbon impact of grid electricity consumed. Following this guidance, the -8 $kgCO_2e/m^2$ GIA reduction above would not be accepted.

Key	
(green)	Data automatically calculated - no direct input required
(blue)	Cells that require information / data inputting
(crossed)	N/A

Project details

Project name	Euston Tower
Planning application reference number (if applicable)	
Use Class	E, including lab-enabled spaces
Brief description of the project	Existing building, maintaining the below ground foundations, substructure and existing elevator core and provide new slabs to have lab-enabled (level 03 to 13) and office space (level 14 to 29).
GIA (m^2)	77542

Assessment details

Authors (organisation or individuals)	Rafaella Klaus, Sweco UK
Date of assessment	14th November 2023
Operational modelling methodology for Module B6 results	TM54
Reference study period (if not 60 years)	[This cell should only be filled in if the reference study period, i.e. the assumed building life expectancy, exceeds or is less than 60 years. Applicants should state the reference study period in this cell. While the assessment should still be done to 60 years, applicants may, if they choose to, submit an additional assessment of the modules B, C and D for the actual reference study period by copying and pasting an additional 'GWP potential for all life-cycle modules' table, see below].
Software tool used	One Click LCA
Types of EPDs and carbon database used	Gabi, EcoInvent
Please confirm if 95% of the cost allocated to each building element category has been accounted for in the assessment?	Yes
Explanation of mechanisms which have been adopted to quality assure the submission	Internal QA from Sweco Head of Buildings Whole Life Carbon Matthew Mapp, review of all quantities with QS Gardiner & Theobald, wider review of material quantities and base inputs from the whole design team, third party review of feasibility studies, findings of which informed some of the approaches in the WLCA.
Please confirm whether you have submitted this assessment to the Built Environment Carbon Database (https://www.becd.co.uk/) or if you give permission for the GLA to do this on your behalf by checking one of the following boxes	I have submitted this assessment to the BECD ☐
	I give permission for the GLA to submit this assessment to the BECD on my behalf ☑

Estimated WLC emissions
N.B. This forms the WLC baseline for the development. The green cells will automatically populate from the tables below

	Module A1-A5 (excluding sequestered carbon)	Modules B-C (excl B6 & B7)	Modules A-C (excl B6 & B7; including sequestered carbon)	Module B1-B5	Module B6-B7	Module C1-C4	Module D
TOTAL kg CO_2e	55,146,062 kg CO2e	43,524,388 kg CO2e	97,837,978 kg CO2e	39,054,461 kg CO2e	126,527,289 kg CO2e	4,469,927 kg CO2e	-18,030,870 kg CO2e
TOTAL kg CO_2e/m^2 GIA	711	561	1262	504	1632	58	-233
Please select most appropriate benchmark from drop-down menu	Offices						
WLC Benchmark	*<950*	*<450*	*<1400*				
Aspirational WLC Benchmark	*<600*	*<370*	*<970*				
Comparison with WLC benchmarks (see Appendix 2 of the guidance)	The WLCA results presented here at application stage all fall below the GLA WLCA Guidance targets in terms of upfront and total WLC; the upfront embodied carbon in particular is significantly below the GLA WLC benchmark. Opportunities have been presented within the planning documentation to further reduce this towards the GLA's 'aspirational' performance benchmark position. The targets are not directly comparable because of the lab-enabled requirement for some of the floors; this increases the emissions associated with MEP equipment in particular, which skews the B1-C4 values in a fairly significant way due to the inclusion of this use type. This is why there is a disparity between the reported value and the benchmark in this area only.						

Retention of existing buildings and structures

Confirmation that options for retaining existing buildings and structures have been fully explored before considering substantial demolition	The carbon figures presented on this document represent the 'partial retention and extension (retain the core)' option represented within the feasibility studies that have been prepared for the planning application submission. Please refer to this document and the Sustainability and Cricular Economy Statements for further details on this key point.
Carbon emissions associated with pre-construction demolition ($kgCO_2e$)	22kgCO_2e/m^2
Estimate of the percentage of the new build development which will be made up of existing elements	20%

Summary of key actions to reduce whole life-cycle carbon emissions that have informed this assessment, including the WLC reductions

Actions included in WLC assessment results reported	WLC reduction (kg CO_2e/m^2 GIA)
Steel Reuse	-20
Xcarb structural steel	-95
Xcarb rebar	-20
Reused RAF for landlord areas (excluding WC's)	-13

Specify further opportunities to reduce the development's whole life-cycle carbon emissions. including the WLC reduction potential

Further potential opportunities	WLC reduction potential (kg CO_2e/m^2 GIA)
Foundation Optimisation - Pile Caps + Piles instead of Raft + Piles	-10
High recycled content in substructures elements	-8
Steel Design Optimisation (omit 10%)	-5
Optimize Column Grid - Reduce to a 9x6 Grid instead of 9x12	-6
Sacrifice demountable floor plate	-4
Residual Moment Connection - Residual Moment Connections would allow to reduce steel weights	-1
Review of the Floor to Ceiling Height - Cable Trays under the beam implies no rectangular openings into beams	-1
Columns - CFT instead of S460	-1
Xcarb Steel for Steel Truss and bolt on podium structure	-6
Etex plasterboard - ceilings and internal walls	-4
Reuse of existing building concrete (ribbed slabs)	-2
High recycled content in Precast slabs	-13
Extrusions made with high recycled content (Hydro Circal75 billet)	-10
Use SGG ORAE low carbon glass	-4
RAF - RMG600+ for WC'S and CAT A areas	-2

MATERIAL QUANTITY AND END OF LIFE SCENARIOS

Building element category		Product and Construction Stage (Module A): Material type	Product and Construction Stage (Module A): Material quantity (kg)	Assumptions made with respect to maintenance, repair and replacement cycles (Module B)	Material 'end of life' scenarios (Module C)	Benefits and loads beyond the system boundary (Module D): Estimated reusable materials (kg)	Benefits and loads beyond the system boundary (Module D): Estimated recyclable materials (kg)
Note/example		Breakdown of material type in each category [Insert more lines if needed] e.g. Concrete	65000 kg	For all primary building systems (structure, substructure, envelope, MEP services, internal finishes) including assumed material/product lifespans and annual maintenance/repair %	Declare 'end of life' scenario as per project's Circular Economy Statement, and used in the WLC assessment to produce Module C results	0 kg	25 kg
		e.g. Reinforcement	5000 kg			2 kg	8 kg
		e.g. Formwork	250 kg			0 kg	0 kg
0.1	Demolition: Toxic/Hazardous/Contaminated Material Treatment	None - Category not required	0 kg		n/a	0 kg	0 kg
0.2	Major Demolition Works	TBC - no quantfiied material detail - based on benchmarks	0 kg		n/a	0 kg	0 kg
0.3	Temporary Support to Adjacent Structures	TBC - no quantfiied material detail - based on benchmarks	0 kg		n/a	0 kg	0 kg
0.4	Specialist Ground Works	None - Category not required	0 kg		n/a	0 kg	0 kg
1	Substructure	Excavation	18,824,960 kg	n/a	Benefitical use of excavated materials	0 kg	0 kg
		Steel	214,864 kg	60 years	Steel recycling	15,040 kg	199,824 kg
		EPS	17,013 kg	60 years	Plastic based material incineration	0 kg	0 kg
		Concrete - C32/40	18,452,928 kg	60 years	Concrete crushed to aggregate	0 kg	17,991,605 kg
		Rebar	1,655,582 kg	60 years	Steel recycling	0 kg	1,622,470 kg
		Waterproof Membrane	752 kg	60 years	Plastic based material incineration	0 kg	0 kg
2.1	Superstructure: Frame	Structural Steel	8,961,275 kg	60 years	Steel recycling	627,289 kg	8,333,986 kg
		Intumescent Paint	129,837 kg	60 years	Intert material - landfilling	0 kg	0 kg
2.2	Superstructure: Upper Floors	Concrete - C32/40	27,560,880 kg	60 years	Concrete crushed to aggregate	0 kg	26,871,858 kg
		Rebar	1,435,210 kg	60 years	Steel recycling	0 kg	1,406,506 kg
		Mortar	701,730 kg	60 years	Cement/mortar use in a backfill	0 kg	666,644 kg
2.3	Superstructure: Roof	Concrete - C32/40	1,156,248 kg	60 years	Concrete crushed to aggregate	0 kg	1,127,342 kg
		Rebar	72,720 kg	60 years	Steel recycling	0 kg	71,266 kg
		Waterproof Membrane	7,362 kg	30 years	Plastic based material incineration	0 kg	0 kg
		Gravel	264,000 kg	30 years	Do nothing	0 kg	0 kg
		Precast concrete paving	272,600 kg	30 years	Rebar separated (2 %), concrete to aggregate	0 kg	258,970 kg
		Steel Pedestals	19,932 kg	30 years	Steel recycling	997 kg	18,536 kg
		XPS Insulation	25,263 kg	30 years	Plastic based material incineration	0 kg	0 kg
2.4	Superstructure: Stairs and Ramps	Concrete - C32/40	74,231 kg	60 years	Concrete crushed to aggregate	0 kg	72,375 kg
		Rebar	4,567 kg	60 years	Steel recycling	0 kg	4,476 kg
		Steel Stair	221,781 kg	60 years	Steel recycling	15,525 kg	206,256 kg
		Steel handrail	15,315 kg	30 years	Steel recycling	1,072 kg	14,243 kg
		Wood handrail	5,294 kg	30 years	Wood incineration	0 kg	0 kg
2.5	Superstructure: External Walls	Steel Studwork	21,178 kg	30 years	Steel recycling	1,059 kg	19,695 kg
		Plasterboard	431,036 kg	30 years	Gypsum recycling	0 kg	73,276 kg
		BMU (cable, eletric motor	17,842 kg	60 years	Metal-containing product recycling (90 % metal)	0 kg	16,058 kg
2.6	Superstructure: Windows and External Doors	Aluminium & Glass Door	3,789 kg	30 years	Glass Recycling / Aluminium Recycling	0 kg	3,600 kg
		Aluminium Frame	638,311 kg	60 years	Aluminium recycling	0 kg	612,779 kg
		Revolving Door	10,920 kg	30 years	Glass Recycling / Aluminium Recycling	0 kg	10,374 kg
		GRC	1,779,508 kg	60 years	Concrete crushed to aggregate	0 kg	1,717,225 kg
		Laminated Glass	821,595 kg	30 years	Glass recycling	0 kg	501,173 kg
		Aluminium sheet	97,186 kg	60 years	Aluminium recycling	0 kg	93,299 kg
		Rockwool	329,848 kg	60 years	Landfilling (for inert materials)	0 kg	0 kg
		Galvanised Steel	81,058 kg	60 years	Steel recycling	4,053 kg	75,384 kg
2.7	Superstructure: Internal Walls and Partitions	Cement Mortar	126,876 kg	60 years	Cement/mortar use in a backfill	0 kg	120,533 kg
		Steel Studwork	216,075 kg	30 years	Steel recycling	10,804 kg	200,950 kg
		Precast Blockwork	1,242,167 kg	60 years	Concrete crushed to aggregate	0 kg	1,211,113 kg
		Plasterboard	1,801,237 kg	30 years	Gypsum recycling	0 kg	306,210 kg
		Steel handrail	2,895 kg	30 years	Steel recycling	145 kg	2,693 kg
		Insulation	109,792 kg	30 years	Landfilling (for inert materials)	0 kg	0 kg
		Aluminium and Glass partitioning	47,038 kg	30 years	Glass Recycling / Aluminium Recycling	0 kg	44,686 kg
2.8	Superstructure: Internal Doors	Aluminium Doors	919 kg	30 years	Glass Recycling / Aluminium Recycling	0 kg	873 kg
		Timber Doors	102,991 kg	30 years	Wood incineration	0 kg	0 kg
3	Finishes	Epoxy Paint	6,739 kg	10 years	Intert material - landfilling	0 kg	0 kg
		Adhesive	182,275 kg	10 years	Intert material - landfilling	0 kg	0 kg
		Carpet	30,766 kg	10 years	Plastic-based material incineration	0 kg	0 kg
		Ceramic Tile	178,468 kg	10 years	Brick/stone crushed to aggregate	0 kg	169,545 kg
		Dust Sealant	36 kg	10 years	Intert material - landfilling	0 kg	0 kg
		Paint (general)	12,265 kg	10 years	Intert material - landfilling	0 kg	0 kg
		EPS	12,055 kg	60 years	Plastic based material incineration	0 kg	0 kg
		RAF	711,800 kg	30 years	Steel recycling, plastic-based material incineration & chipboard incineration	0 kg	676,210 kg
		HDPE	1,336 kg	10 years	Plastic based material incineration	0 kg	0 kg
		Screed	441,734 kg	30 years	Cement/mortar use in a backfill	0 kg	419,647 kg
		Plasterboard	265,992 kg	20 years	Gypsum recycling	0 kg	45,219 kg
		Steel Studwork	33,110 kg	20 years	Steel recycling	1,656 kg	30,792 kg
		Natural Stone	155,876 kg	20 years	Brick/stone crushed to aggregate	0 kg	148,082 kg
4	Fittings, furnishings & equipment (FFE)	Lockers	8,852 kg	30 years	Various - constituent material dependant.	0 kg	0 kg
		Galvanised Steel - Bike racks	30,960 kg	20 years	Steel recycling	1,548 kg	28,793 kg
		Turnstile	7,749 kg	30 years	Metal-containing product recycling (90 % metal)	0 kg	6,974 kg
5	Services (MEP)	AHU	186,851 kg	20 years (CIBSE Guide M)	Metal-containing product recycling	0 kg	74,740 kg
		ASHP	42,755 kg	15 years (CIBSE Guide M)	Metal-containing product recycling	0 kg	29,929 kg
		Cast Iron Pipes	25,787 kg	35 years (CIBSE Guide M)	Steel recycling	0 kg	23,208 kg
		Chillers	39,239 kg	15 years (CIBSE Guide M)	Metal-containing product recycling (90 % metal)	0 kg	35,315 kg
		Circulating Pump	291 kg	20 years (CIBSE Guide M)	Metal-containing product recycling (90 % metal)	0 kg	262 kg
		Copper Pipe	5,755 kg	45 years (CIBSE Guide M)	Copper recycling	0 kg	5,180 kg
		Diffusers	10,618 kg	25 years (CIBSE Guide M)	Aluminium recycling	0 kg	4,247 kg
		Drainage	9,266 kg	60 years	Various - constituent material dependant.	0 kg	0 kg
		Electricity Cabling	151,721 kg	35 years (CIBSE Guide M)	Metal-containing product recycling	0 kg	75,860 kg
		Transformer	19,709 kg	30 years (CIBSE Guide M)	Various - constituent material dependant.	0 kg	0 kg
		Water tanks (Cat 1, Cat 5 etc.)	5,572 kg	35 years (CIBSE Guide M)	Plastic based material incineration	0 kg	0 kg
		Glass Wool Insulation	36,491 kg	30 years (CIBSE Guide M)	Landfilling - inert	0 kg	0 kg
		HDPE Pipe	5,330 kg	25 years (CIBSE Guide M)	Plastic based material incineration	0 kg	0 kg
		LED Lighting	45,155 kg	20 years (CIBSE Guide M)	Landfilling (for inert materials)	0 kg	20,320 kg
		Lifts	247,142 kg	20 years (CIBSE Guide M)	Metal-containing product recycling (90 % metal)	0 kg	222,427 kg
		Rock wool Insulation	15,716 kg	30 years (CIBSE Guide M)	Landfilling - inert	0 kg	0 kg
		Trench Heaters	55,791 kg	15 years (CIBSE Guide M)	Various - constituent material dependant.	0 kg	0 kg
		PV Panels	8,844 kg	25 years (CIBSE Guide M)	Metal-containing product recycling (90 % metal)	0 kg	7,959 kg
		PVC Pipe	9,192 kg	35 years (CIBSE Guide M)	Plastic based material incineration	0 kg	0 kg
		Shower Screen	5,660 kg	25 years (CIBSE Guide M)	Glass-containing product recycling (80 % glass)	0 kg	4,528 kg
		Shower Trays	2,670 kg	25 years (CIBSE Guide M)	Landfilling (for inert materials)	0 kg	0 kg
		Showers	364 kg	25 years (CIBSE Guide M)	Metal-containing product recycling (90 % metal)	0 kg	327 kg
		Stainless steel bars	977 kg	25 years (CIBSE Guide M)	Stainless steel recycling	0 kg	929 kg
		Sprinkler System	11,519 kg	25 years (CIBSE Guide M)	Various - constituent material dependant.	0 kg	0 kg
		Steel Duct	104,542 kg	40 years (CIBSE Guide M)	Steel recycling	0 kg	41,817 kg
		Steel Pipe	96,174 kg	30 years (CIBSE Guide M)	Steel recycling	0 kg	86,557 kg
		Steel sinks	173 kg	25 years (CIBSE Guide M)	Steel recycling	0 kg	164 kg
		Taps	1,725 kg	25 years (CIBSE Guide M)	Metal-containing product recycling (90 % metal)	0 kg	1,552 kg
		Cable tray	44,040 kg	40 years (CIBSE Guide M)	Steel recycling	0 kg	41,838 kg
		Washbasins	5,000 kg	25 years (CIBSE Guide M)	Landfilling (for inert materials)	0 kg	0 kg
		Electronic soap	2,333 kg	25 years (CIBSE Guide M)	Metal-containing product recycling (90 % metal)	0 kg	2,100 kg
		WCs	13,464 kg	25 years (CIBSE Guide M)	Landfilling (for inert materials)	0 kg	0 kg
		Generator	10,188 kg	30 years (CIBSE Guide M)	Metal-containing product recycling (90 % metal)	0 kg	9,169 kg
6	Prefabricated Buildings and Building Units	None - Category not required	0 kg	n/a	n/a	0 kg	0 kg
7	Work to Existing Building	TBC - no quantfiied material detail - based on benchmarks	0 kg	n/a	n/a	0 kg	0 kg
8	External works	TBC - no quantfiied material detail - based on benchmarks	0 kg	n/a	n/a	0 kg	0 kg

Please add rows where more than 1 material type exists per building element category

Refrigerants		Refrigerant name	Initial Charge(kg)	Annual leakage rate %	Refrigerant GWP ($kgCO_2e/kg$)	End of Life recovery rate %
a	Refrigerants Type 1 (if applicable) - please see CIBSE TM65 for methodology	R513A	1,955 kg	2%	656.45	99%
b	Refrigerants Type 2 (if applicable) - please see CIBSE TM65 for methodology	R513A	2,250 kg	2%	656.45	99%
c	Refrigerants Type 3 (if applicable) - please see CIBSE TM65 for methodology	R-32	315 kg	6%	675	97%

Please add rows if required

	Material quantity	Estimated reusable materials	Estimated recyclable materials
TOTAL	91,281,193 kg	679,187 kg	66,089,966 kg
Material intensity (kg/m2 GIA)	1,177 kg/m2 GIA	9 kg/m2 GIA	852 kg/m2 GIA

GWP POTENTIAL FOR ALL LIFE-CYCLE MODULES
($kgCO_2e$) (See Note 1 below if you entered a reference study period in cell C12)

Building element category		Sequestered (or biogenic) carbon (negative value) ($kgCO_2e$)	Product stage ($kgCO_2e$), Module A: [A1] to [A3]	Construction process stage ($kgCO_2e$), Module A: [A4]	Construction process stage ($kgCO_2e$), Module A: [A5]	Use stage ($kgCO_2e$), Module B: [B1]	[B2]	[B3]	[B4]	[B5]
0.1	Demolition: Toxic/Hazardous/Contaminated Material Treatment									
0.2	Major Demolition Works									
0.3	Temporary Support to Adjacent Structures	0 kg CO2e	0 kg CO2e	0 kg CO2e	1,163,115 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e
0.4	Specialist Ground Works	0 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e
0.5	Temporary Diversion Works	0 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e
1	**Substructure**	0 kg CO2e	3,558,534 kg CO2e	608,302 kg CO2e	171,196 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e
2.1	Superstructure: Frame	0 kg CO2e	5,566,266 kg CO2e	1,631,544 kg CO2e	285,135 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e
2.2	Superstructure: Upper Floors	0 kg CO2e	4,518,791 kg CO2e	2,572,441 kg CO2e	93,074 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e
2.3	Superstructure: Roof	0 kg CO2e	369,100 kg CO2e	119,441 kg CO2e	15,393 kg CO2e	0 kg CO2e	12,839 kg CO2e	3,210 kg CO2e	224,352 kg CO2e	0 kg CO2e
2.4	Superstructure: Stairs and Ramps	-7,427 kg CO2e	751,472 kg CO2e	43,312 kg CO2e	74,897 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e	76,233 kg CO2e	0 kg CO2e
2.5	Superstructure: External Walls	0 kg CO2e	12,634,728 kg CO2e	682,018 kg CO2e	25,532 kg CO2e	0 kg CO2e	389,843 kg CO2e	97,461 kg CO2e	3,992,746 kg CO2e	0 kg CO2e
2.6	Superstructure: Windows and External Doors	0 kg CO2e	136,776 kg CO2e	2,702 kg CO2e	0 kg CO2e	0 kg CO2e	3,554 kg CO2e	888 kg CO2e	257,059 kg CO2e	0 kg CO2e
2.7	Superstructure: Internal Walls and Partitions	0 kg CO2e	1,288,124 kg CO2e	125,687 kg CO2e	130,128 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e	1,275,865 kg CO2e	0 kg CO2e
2.8	Superstructure: Internal Doors	-177,424 kg CO2e	113,030 kg CO2e	3,953 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e	118,758 kg CO2e	0 kg CO2e
3	**Finishes**	-631,866 kg CO2e	1,955,565 kg CO2e	108,723 kg CO2e	180,616 kg CO2e	0 kg CO2e	57,196 kg CO2e	14,299 kg CO2e	4,248,305 kg CO2e	0 kg CO2e
4	**Fittings, furnishings & equipment**	-11,986 kg CO2e	371,636 kg CO2e	11,504 kg CO2e	18,113 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e	524,750 kg CO2e	0 kg CO2e
5	**Services (MEP)**	-3 kg CO2e	11,784,959 kg CO2e	340,776 kg CO2e	119,289 kg CO2e	4,213,825 kg CO2e	311,979 kg CO2e	77,995 kg CO2e	22,421,361 kg CO2e	0 kg CO2e
6	**Prefabricated Buildings and Building Units**	0 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e
7	**Work to Existing Building**	0 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e
8	**External works**	-3,768 kg CO2e	1,136,790 kg CO2e	379,493 kg CO2e	37,844 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e	731,944 kg CO2e	0 kg CO2e
Other site construction impacts or overall construction stage [A5] carbon emissions not specific to an individual building element category					2,016,066 kg CO2e					
TOTAL kg CO_2e		**-832,473 kg CO2e**	**44,185,768 kg CO2e**	**6,629,896 kg CO2e**	**4,330,398 kg CO2e**	**4,213,825 kg CO2e**	**775,410 kg CO2e**	**193,853 kg CO2e**	**33,871,374 kg CO2e**	**0 kg CO2e**
TOTAL - kg CO_2e/m^2 GIA		**-11 kg CO2e/m2 GIA**	**570 kg CO2e/m2 GIA**	**86 kg CO2e/m2 GIA**	**56 kg CO2e/m2 GIA**	**54 kg CO2e/m2 GIA**	**10 kg CO2e/m2 GIA**	**2 kg CO2e/m2 GIA**	**437 kg CO2e/m2 GIA**	**0 kg CO2e/m2 GIA**

Building element category		Use stage, Module B: [B6]	[B7]	End of Life (EoL) stage ($kgCO_2e$), Module C: [C1]	[C2]	[C3]	[C4]	TOTAL Modules A-C $kgCO_2e$	Benefits and loads beyond the system boundary ($kgCO_2e$): Module D
0.1	Demolition: Toxic/Hazardous/Contaminated Material Treatment			0 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e
0.2	Major Demolition Works			1,705,902 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e	1,705,902 kg CO2e	0 kg CO2e
0.3	Temporary Support to Adjacent Structures			0 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e	1,163,115 kg CO2e	0 kg CO2e
0.4	Specialist Ground Works			0 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e
0.5	Temporary Diversion Works			0 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e
1	**Substructure**			21,232 kg CO2e	82,707 kg CO2e	47,199 kg CO2e	0 kg CO2e	4,489,169 kg CO2e	-422,615 kg CO2e
2.1	Superstructure: Frame			33,212 kg CO2e	386,238 kg CO2e	21,921 kg CO2e	356 kg CO2e	7,924,672 kg CO2e	-2,130,046 kg CO2e
2.2	Superstructure: Upper Floors			26,962 kg CO2e	66,137 kg CO2e	3,887 kg CO2e	0 kg CO2e	7,281,292 kg CO2e	-63,828 kg CO2e
2.3	Superstructure: Roof			2,202 kg CO2e	4,267 kg CO2e	74,621 kg CO2e	0 kg CO2e	825,424 kg CO2e	-117,632 kg CO2e
2.4	Superstructure: Stairs and Ramps			4,484 kg CO2e	9,885 kg CO2e	9,171 kg CO2e	0 kg CO2e	962,026 kg CO2e	-652,978 kg CO2e
2.5	Superstructure: External Walls			75,387 kg CO2e	128,212 kg CO2e	3,326 kg CO2e	9 kg CO2e	18,029,261 kg CO2e	-207,706 kg CO2e
2.6	Superstructure: Windows and External Doors			816 kg CO2e	648 kg CO2e	4 kg CO2e	9 kg CO2e	402,455 kg CO2e	-485 kg CO2e
2.7	Superstructure: Internal Walls and Partitions			7,686 kg CO2e	54,150 kg CO2e	2,318 kg CO2e	445 kg CO2e	2,884,402 kg CO2e	-1,106,151 kg CO2e
2.8	Superstructure: Internal Doors			674 kg CO2e	494 kg CO2e	205,256 kg CO2e	62 kg CO2e	264,803 kg CO2e	-20 kg CO2e
3	**Finishes**			11,668 kg CO2e	29,730 kg CO2e	828,078 kg CO2e	34 kg CO2e	6,802,347 kg CO2e	-2,669,690 kg CO2e
4	**Fittings, furnishings & equipment**			2,217 kg CO2e	2,478 kg CO2e	14,036 kg CO2e	5 kg CO2e	932,752 kg CO2e	-358,049 kg CO2e
5	**Services (MEP)**	58,259,707 kg CO2e / 67,841,914 kg CO2e	425,669 kg CO2e	70,316 kg CO2e	70,556 kg CO2e	120,740 kg CO2e	1,013 kg CO2e	166,060,096 kg CO2e	-9,983,310 kg CO2e
6	**Prefabricated Buildings and Building Units**			0 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e
7	**Work to Existing Building**			0 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e	0 kg CO2e
8	**External works**			6,783 kg CO2e	238,491 kg CO2e	93,614 kg CO2e	292 kg CO2e	2,621,483 kg CO2e	-318,361 kg CO2e
Other site construction impacts or overall construction stage [A5] carbon emissions not specific to an individual building element category								2,016,066 kg CO2e	
TOTAL kg CO_2e		**126,101,621 kg CO2e**	**425,669 kg CO2e**	**1,969,541 kg CO2e**	**1,073,991 kg CO2e**	**1,424,171 kg CO2e**	**2,224 kg CO2e**	**224,365,267 kg CO2e**	**-18,030,870 kg CO2e**
TOTAL - kg CO_2e/m^2 GIA		**1,626 kg CO2e/m2 GIA**	**5 kg CO2e/m2 GIA**	**25 kg CO2e/m2 GIA**	**14 kg CO2e/m2 GIA**	**18 kg CO2e/m2 GIA**	**0 kg CO2e/m2 GIA**	**2,893 kg CO2e/m2 GIA**	**-233 kg CO2e/m2 GIA**

Notes:
1 If you have entered a reference study period in cell C12 because the assumed building life expectancy is greater or less than 60 years, then you will need to fill in this table using a 60 year building life expectancy. If you choose to, you may create a second table below and complete it using the actual assumed life expectancy. This should be clearly labelled.