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Counting the *upfront* carbon in Cat B office fit out

A cross-sector industry report that establishes the current upfront carbon performance level of a Cat B office fit out.

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Contributors to the cross-sector industry report that establishes the current upfront carbon performance level of a Cat B office fit out.

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Upfront carbon in Cat B office fit out: at a glance

Question:

What's the current upfront carbon (lifecycle modules A1-A5) performance level for Cat B office fit out?

Answer:

It's not straightforward. But if you wanted an evidenced average of the current upfront carbon performance level of Cat B office fit out, your number would be 190 kg CO_2e/m^2 (with a lot of caveats to go along side). Read on to find out more and start your next Cat B office fit out project armed with the best available data today to help reduce embodied carbon.

Why is it important?

If we're optimistic, the shell and core plus Cat A of a building are built to last 60 years and 20 years respectively. During this time, there'll be multiple Cat B fit outs. If a fit out takes place every 5 to 10 years, then the Cat B carbon impact could equal that of the shell and core plus Cat A in as little as 20 years. This cumulative Cat B carbon cost is why our research is so important.

So what do we do?

This research serves as a starting point for interested stakeholders to benchmark their own projects, and even set internal up front carbon limits. It also allows transparent discussion within the wider industry about the research that is still needed. From here, we can work with colleagues to build on our findings, refine our methodologies and further inform the wider sector on upfront carbon performance levels in office fit out projects. Ultimately, it's hoped research such as this will help us to reduce the impact of fit out over time.

Day-to-day, what part can everyone play?

1. **Set accountability:** Ensure all team members understand their responsibility for reducing and accounting for carbon emissions during project planning.
2. **Establish baselines and limits:** Understand performance relative to scope, set a baseline, and work towards an internal limit below the industry performance level of 190 kg CO_2e/m^2 GIA, adjusting for project specifics.
3. **Test the draft NZCBS*:** Participate in beta testing during summer 2024 to provide essential feedback for refining the standard.
4. **Engage stakeholders:** Discuss whole life carbon impact with all relevant parties, emphasising the impact of design, procurement and operational choices.
5. **Share and collaborate:** Get involved in further research, share internal knowledge and contribute WLCAs** to improve industry data.

These recommendations aim to integrate carbon accountability into daily practices, engage stakeholders and increase the comprehensive carbon data available for further research.

*NZCBS – Net Zero Carbon Building Standard
**WLCA – Whole Life Carbon Assessments

Counting the *upfront* carbon in Cat B office fit out

Contents

Part 2 is a supplementary document, available from Zoe.Glander@overbury.com.

1.0 Executive summary

Purpose

The aim of this research is to establish the current upfront carbon performance level of an office fit out from Cat A to Cat B. The findings have been submitted to the UK Net Zero Carbon Building Standard (NZCBS) to help inform their setting of carbon limits for the office sector going forward.

Process and key findings

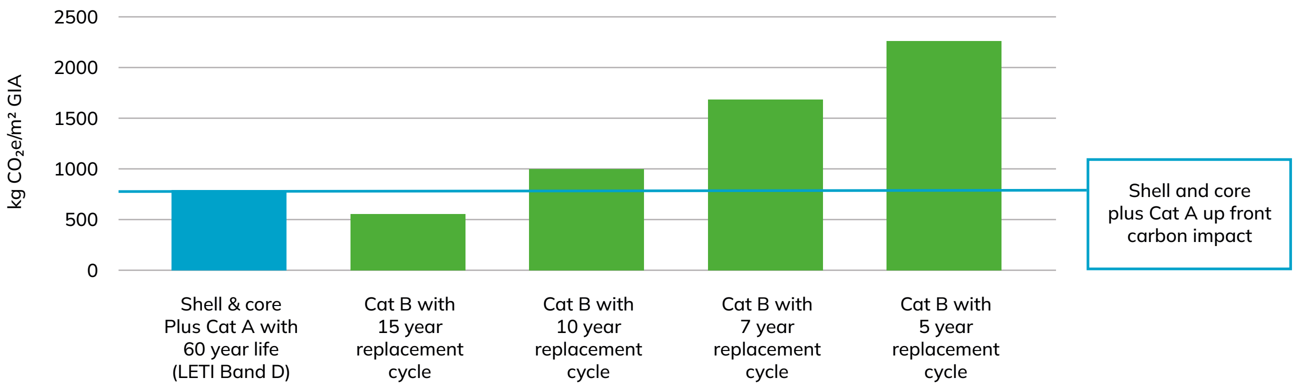
The exercise involved two main pieces of research – one for complete fit out's, another for individual building elements, ranging from joinery to MEP. The outcomes of the two research pieces were then shared between the teams to facilitate the development of an appropriate upfront carbon performance level. The research concluded that the current upfront carbon performance level of a Cat B fit out is **190 kg CO_2e/m² GIA** (based on reasonable parameters and assumptions).

The research suggests that, in terms of carbon impact, after four Cat B fit outs, the upfront carbon impact could be equivalent to that of a new building fitted to a Cat A finish.

To make this comparison we have used the LETI band D* of 775 kg CO_2e/m² GIA for shell and core plus Cat A as this represents the point between average industry performance (LETI Band E) and good design practice (LETI Band C). Comparing the performance level of 775 kg CO_2e/m² GIA for shell and core plus Cat A to 190 kg CO_2e/m² GIA for Cat B, in around four cycles of Cat B, the upfront carbon impact will be approximately equivalent to the shell and core plus Cat A.

Given that the reference study period (RSP) for a new build fitted to Cat A is typically 60 years, it follows that four Cat B fit outs in 60 years equate to a 15-year cycle for Cat B. However, research in Q1 2024 by Devono, showed average lease length in central London was 5.5 years. The report highlighted the trend towards shorter leases, noting that 20 years ago 9.3 years was the average, and 10 years ago it was 6.8 years**. After around 15 to 20 years, a Cat A and core services replacement will likely be required too. With all this in mind, a Cat B fit out can quickly produce a higher cumulative carbon cost than that of the original building. While it's important to acknowledge that decarbonisation will play a part in reducing the impact of subsequent fit outs, it has not been applied to the graph below.

Upfront Carbon Impact (A1-A5) of repeated Cat B fit outs over a 60 year period



*LETI Embodied Carbon Target Alignment https://www.leti.uk/_files/ugd/252d09_a45059c2d71043cdbcffc539f942e602.pdf
**Devono 2024 Snapshot https://www.devono.com/wp-content/uploads/2024/06/Q1-2024-Snapshot-Devono.pdf

Limitations

There are many limitations to this research, not least the challenge of finding a single upfront carbon performance level for projects that are so variable in scope.

There's also a lack of data in the fit out sector with fewer Whole Life Carbon Assessments (WLCAs), and for certain building elements, a lack of product carbon information e.g. Environmental Product Declarations (EPDs). Even where there is data, there is often lack of consistency between sources.

There's a considerable amount of detail within the analysis, and performance figures must be understood in the context in which they were calculated, along with the detail and quality of data used.

Next steps and opportunities

This research serves as a starting point for interested stakeholders to benchmark their own projects, and even set internal upfront carbon limits. It also allows transparent discussion within the wider industry about the research that is still needed. From here, the aim is to work with industry colleagues to build on the findings, refine the methodologies and further inform the wider sector on upfront carbon performance levels in office fit out projects. The industry can use this whitepaper for the many recommendations included within it. Ultimately, it's hoped research such as this will help us to reduce the impact of fit out over time.

2.0 Purpose

This whitepaper looks at the current upfront carbon performance level of a Cat B office fit out, with a view to informing the limits that will be set by the NZCBS and ultimately help limit the sector's carbon impact. The whitepaper shows our research based on a cross-section of office fit outs.

At the time of writing, the NZCBS is due to be released in draft form and for beta testing in late summer 2024. The wider aim of NZCBS is to:

- Provide a framework in which built assets can prove they meet 'net zero'.
- Create decarbonisation pathways for different construction scenarios.
- Set net zero carbon limits for whole buildings.

The NZCBS is now undertaking a balancing exercise to bring together the top-down limits and bottom-up industry performance levels. Its purpose is to set targets and limits for both operational and upfront carbon that we know are achievable and that will enable the industry to decarbonise at a pace aligned with the UK's carbon budget and therefore the 1.5°C trajectory.

3.0 Context

There's concern in the fit out sector that, when it comes to sustainability, Cat B is sometimes overlooked by the wider construction world. It's a complex area that can be misunderstood or sometimes neglected altogether. This is evident in our existing industry embodied carbon targets set by RIBA, LETI and the GLA which only address the impact of shell and core and Cat A projects. Environmental assessment schemes too have tended to prioritise new construction schemes. This led to the creation of the SKArating environmental assessment scheme which is the only assessment scheme to focus purely on fit out.

A fit out has a shorter lifespan than the shell and core of a building. This is partially down to lease length and the fact that fit out elements aren't designed to last as long as their surrounding steel and concrete frames and glazed facades. In whole life carbon terms, the long-term impact of a fit out could be higher than that of shell and core – especially if you consider both Cat A and Cat B fit outs at the same time.

Predicting the carbon impact over a building's lifespan of fit outs is a challenge, with great margins for error over time. This research aims to establish the upfront carbon performance level of an average Cat B fit out, with the hope to inform the impact of fit outs over a whole building's life cycle.

Until now, there's been limited data on the embodied carbon impact of fit outs and evaluating carbon numbers for comparison is tricky. This is largely due to the high degree of variability in the scope of different fit outs. It poses a challenge in defining an industry performance level for upfront carbon or a limit that can be widely applied without being too granular or specific to individual building elements. It also means our research has limitations, which need to be considered when interpreting the results.

4.0 Approach

This whitepaper summarises the methodology and results of our research in the form of a current upfront carbon performance level for Cat B office fit outs.

Calculations are described in kilograms of carbon dioxide equivalent emissions per square metre of gross internal area.

> You'll see this abbreviation throughout:
>
> **kg CO_2e/m² GIA**

Calculations use gross (as opposed to net) internal area to align with wider carbon reporting metrics, namely the Royal Institute of Chartered Surveyors (RICS) Professional Standard (PS), Whole Life Carbon Assessment (WLCA) for the Built Environment, 2nd edition. We advise that figures should be reported in both GIA and NIA terms for transparency.

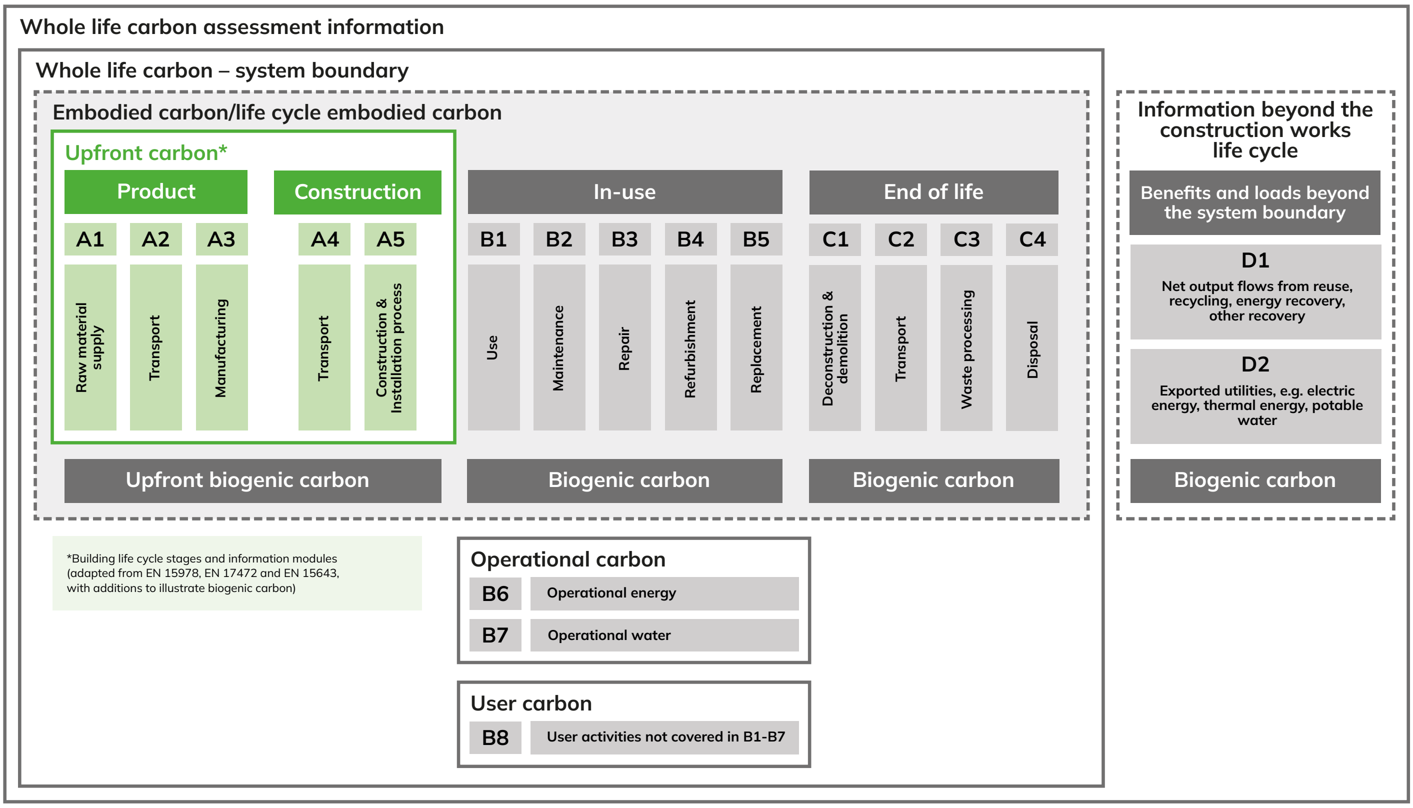
This research looks at upfront emissions only – lifecycle modules A1 to A5.

This whitepaper seeks to establish a carbon performance level for a Cat B fit out taken from a Cat A state. This can then be added to the average performance level calculated for shell and core to Cat A, which was established by separate research undertaken by the NZCBS.

The goal is to provide the NZCBS with the data needed for an upfront carbon performance level for a whole building. The NZCBS can then set limits so that whole buildings can align with net zero requirements and a 1.5°C net zero carbon trajectory.

It's hoped that the results of this research can be shared throughout the industry and serve as a tool for fit out project leaders going forward. It can be improved upon over time as better data becomes available.

The enthusiastic engagement displayed by everyone who contributed to this research – from those who submitted their project data to those who analysed the results – is testament to how important this research is deemed by our industry colleagues.



5.0 Contributors

This is the team who dedicated their time and energy to the research.

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These are the specialist elemental group research teams who dedicated their time and energy to the elemental research explained in Part 2 of this whitepaper.

Catering

Lauren Hunter – Impact-Loop

Furniture

Molly Macaulay – Overbury
Lucy Bagshaw – tp bennett
Ana Rita Martins – MCM
Phil Towle – The Furniture Practice
Veronica Baroni – tp bennett
Alex Webb – The Furniture Practice

Joinery

Elina Grigoriou – Grigoriou Interiors
Laura Salinas– Grigoriou Interiors

With special thanks to Gordon Emm, Matt Lawrence and Trevor Baker (Brown & Carroll)**, Emilie Metcalf and Sam Read** (BA Joinery)**, Gary Lynch** (Specialist Joinery Group)**, Sarah Mann** (Taylor Made Joinery) **and Paul Willingale** (Shadbolt).

MEP

Will Belfield – Hoare Lea
Alice Jackson – Hoare Lea
Andrew Moore – Hilson Moran

With special thanks to Phil Guthrie (Hydrock)

Reuse

Flavie Lowres – FIS (Finishes & Interiors Sector)
Nick Woodmore – Landsec
Alison Grant – HLW

Staircases

Akos Brandecker – Living Building Consultancy

Temporary works

Toby Sowood – Mace
Adam Bora – Mace

There is now a more detailed understanding of the performance levels and continued challenges around measuring upfront carbon for the following elements:

Catering	Furniture	Joinery	MEP	Reuse	Staircases	Temporary works

Key
- (green) Research which helped refine the Cat B upfront carbon performance level
- (grey) Research published in Part 2 for information and further development

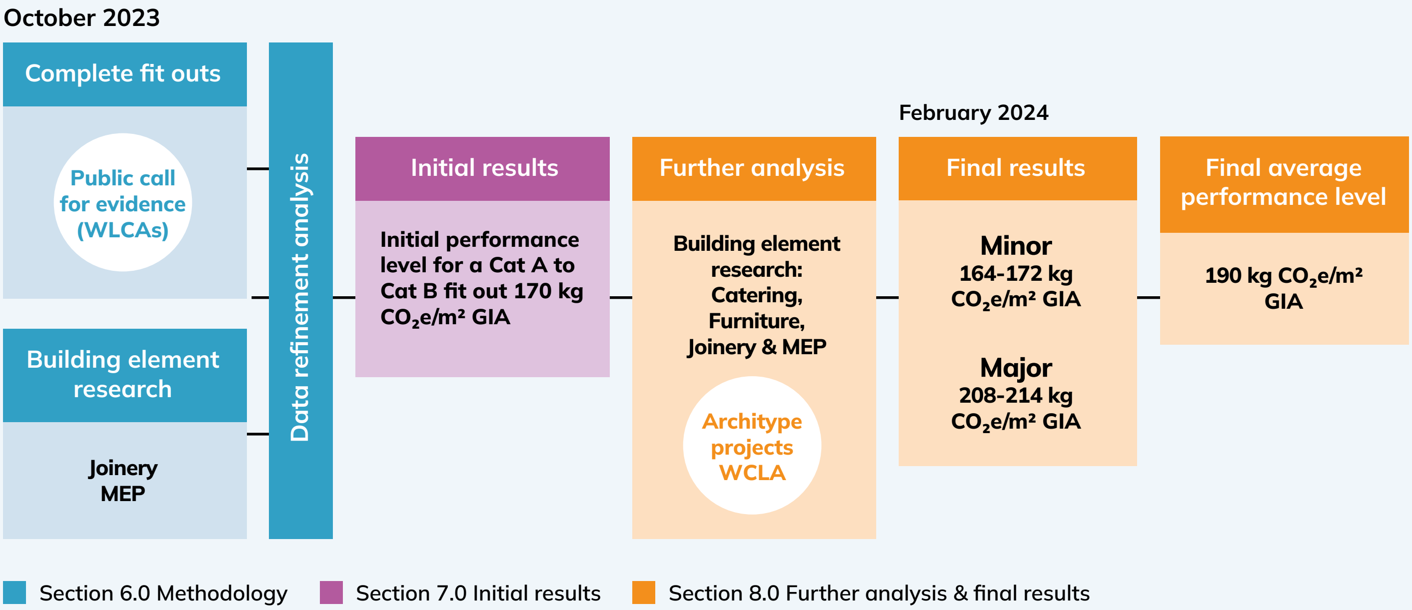
6.0 Methodology

Our research was carried out from October 2023 to February 2024.

It took the following form:

- **Complete fit outs.**
  - **Call for evidence in the form of WLCAs.** Project leaders from across the industry were asked to submit WLCAs, or other data if necessary, showing the upfront carbon performance level of their Cat B fit outs.
  - **Architype project WLCAs.** Alongside this, the expert team at Grigoriou Interiors created what they deemed to be 'typical' project case studies for Cat B fit outs – based on a 'minor fit out' and a 'major fit out' scope of works. These case studies were used to review and sense check the data received through the call for evidence.
- **Individual building elements.**
  - At the same time, sub-groups were assigned the task of looking at individual building elements of a fit out. These were elements that have a significant carbon impact or where it was anticipated the WLCAs submitted might not provide sufficient detail:
    - Mechanical, electrical and public health (MEP)
    - Furniture
    - Joinery
    - Staircases
    - Catering kitchens
    - Temporary works (TW)
    - Reuse

All the 'complete fit outs' data was then reviewed in the context of the 'individual building elements' data, using the expertise of a team of experienced Life Cycle Assessment (LCA) practitioners.



The call for evidence received WLCAs from 76 projects. These were submitted by LCA practitioners, interior designers and sustainability managers from the following companies:

- AECOM
- Cast
- CBRE
- Gensler
- Hilson Moran
- Hoare Lea
- JLL
- Knight Frank
- Mace
- Max Fordham
- Morgan Lovell
- Overbury
- Perkins & Will
- SRE
- Verte

The research team input the WLCA data into a reporting form created specifically for this research. The form was based on the supporting forms from the RICS Whole Life Carbon Assessment for the Built Environment, Professional Standard, Global 2nd edition (2023) (RICS PS WLCA 2nd edition) and the additional breakdown of elements within it, but with the understanding that projects might not have this level of granularity. Most projects had based their WLCAs on the RICS WLCA PS 1st edition.

In addition, this reporting form called for the following data:

- Fit out type
- Number of floors
- Gross internal area (GIA)
- Net internal area (NIA)
- RIBA stage
- Source of quantity information
- LCA tool
- Reference study period (years)
- Confirmation that 95% of cost was covered
- Auditing status

Some of the data received had to be refined for statistical analysis. For example:

- For consistency, it was decided to base all calculations on data for GIA. So, where NIA had been provided, this was converted to GIA by assuming NIA was 75% of GIA. This had to be done in relatively few instances.
- Interviews were undertaken with some respondents to understand why certain building elements weren't included in the WLCA. Were they absent from the project itself or only absent from the assessment?
- Projects that weren't Cat B fit outs from a Cat A state were removed. These included a.) shell and core plus Cat A, b.) Cat B from a shell and core state and c.) major retrofit or refurbishments, which include façade changes or major structural changes. We recommend studying these other project types at a later date.
- There was little confidence in some of the datasets provided for MEP and Furniture, as their carbon impact seemed too low. Instead of using the MEP and Furniture data from the WLCAs, the team turned to the research carried out by the elemental groups for these individual building elements. This changed the results as follows:
    - For Furniture, the performance level from the WLCA data was 33 kg CO_2e/m^2 GIA. The performance level from the Furniture element group was 39 kg CO_2e/m^2 GIA. This number doesn't include other FFE that's not defined as loose furniture, so it's likely to increase once other elements in the FFE category (such as fittings and serviced booths, as well as some catering and joinery items) are included. These weren't counted at the time due to lack of data when the Furniture research was being carried out.
    - For MEP, the performance level from the WLCA data was 27 kg CO_2e/m^2 GIA. The performance level from the MEP element sub-task group was 47 kg CO_2e/m^2 GIA. This was based on an estimation of altering 30% of the original Cat A MEP installation. Outliers were defined as those falling below 25 kg CO_2e/m^2 GIA (a figure deemed to reflect the most basic MEP installation). These outliers were excluded and a median (47 kg CO_2e/m^2 GIA) was applied for the MEP element for each of the WLCAs. Some WLCAs stated minimal or zero carbon associated with MEP, which was largely due to a lack of embodied carbon data for individual MEP items, as has historically been a challenge. This has improved recently, but is unlikely to have been available when most WLCAs were completed.
- There was little confidence in the data that ranked in the lowest 20% of projects. On speaking to these project leaders, it was determined that they may have only reported carbon data for certain building elements, not all. As such, the decision was made to exclude these from the initial analysis.

7.0 Initial Results

There was a requirement for the research group to provide the NZCBS with an approximate performance level for Cat B fit out in January 2024. After provision of the result from the initial analysis, there was a further three weeks available to carry out additional research to arrive at a final Cat B performance level which would then be used in the limit setting exercise by the NZCBS.

The results at this early stage of research are as follows:

	Average kg CO_2e/m² GIA	
	Data based on original WLCAs – with no replacement of FFE and MEP totals	**Data revised according to FFE and MEP averages provided by these elements' sub-groups**
All Cat A to Cat B fit outs	130	159
Cat A to Cat B fit outs excluding those in the lowest 20% of projects	145	171

It was agreed that the upper end of the data range was likely most representative of the industry's current carbon performance level. This was for the following reasons:

- Some building elements with limited product data, including audio-visual items and catering kitchens, were not fully captured. Once fully captured, the average carbon data will increase.
- It's likely that project data at the lower end of the range are less precise and/or have under accounted for items due to lack of consistent/available carbon data – e.g. items without EPDs.

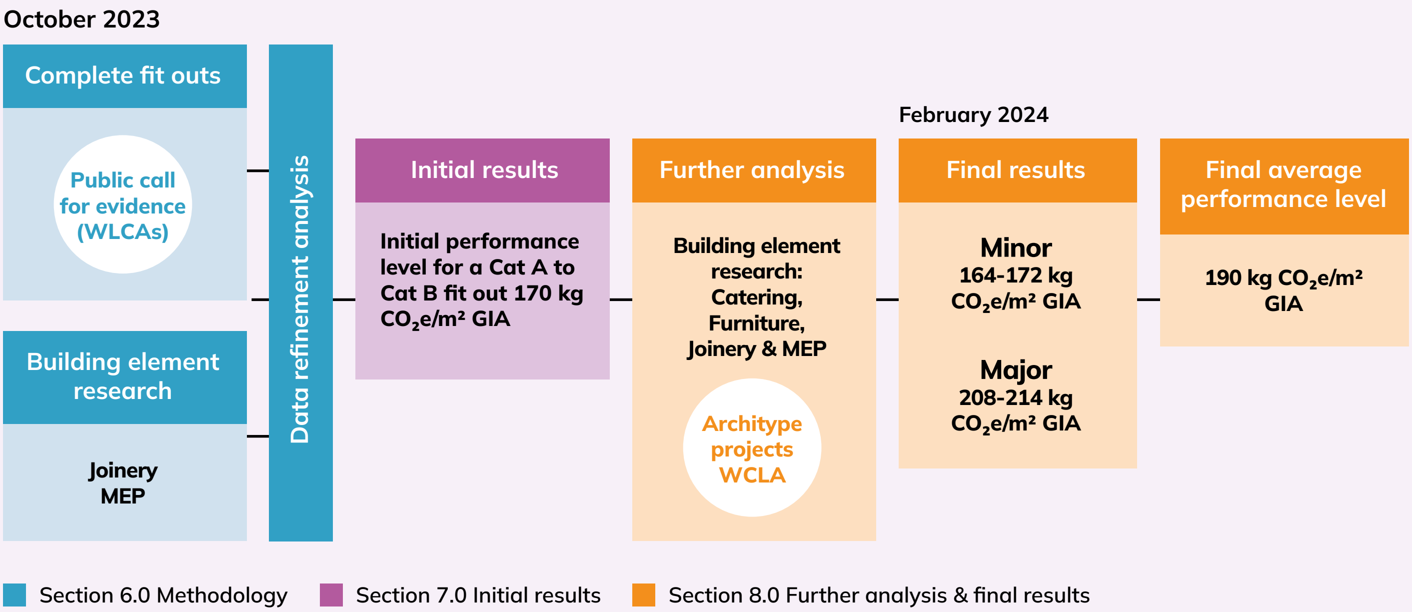
The conclusion, at this stage, was that the average upfront embodied carbon performance level for a Cat B fit out was:

171 kg CO_2e/m² GIA

For ease, this number has been rounded to:

170 kg CO_2e/m² GIA

Subsequent to the arrival at this initial result, further analysis was undertaken. The next part of the research is described on the following pages, along with the final average performance level provided to the NZCBS.



8.0 Further analysis & final results

Having presented these initial results to the NZCBS, further analysis was undertaken before a final performance level was provided for their limit setting exercise. As before, this research worked with two sets of data:

Individual building elements sub-tasks:

- Research groups were tasked to gather data for their respective building elements.
- The typical scope of a Cat B fit out was defined by dividing each building element into one of five categories:
    - Included by occupier;
    - Typically included in contractor scope;
    - Sometimes included in contractor scope;
    - Element already present – possible alteration required; or
    - Never in scope/base-build.
- The agreed carbon performance level of 170 kg CO_2e/m² GIA was broken down into a value per elemental category taken from the WLCAs, and the FFE and MEP values that had already been replaced.
- Each building element category was categorised in terms of whether the group thought the average carbon performance per element included or excluded an upfront carbon number for the sub-elements that are typically within a Cat B fit out. (See Appendix 1.)
- Each element's performance level was revisited to agree whether the value was still appropriate based on inclusion of all relevant sub-elements and suitable numbers for each.
- The data was interpreted for both a Minor and Major Cat B fit out (see below definitions) .

Architype project WLCAs:

Architype project WLCAs were created by Grigoriou Interiors and divided into two categories based on size and scope:

- **Minor fit out** (1,000m² – 2,500m²) – typically with light-touch changes, for example to lighting, small power items, fittings and joinery elements; potential retention of some existing furniture.
- **Major fit out** (10,000m² +) – typically with extensive changes, for example to centralised systems and structural alterations.

There were variables in both categories of fit out, including quality of product, location of source material and manufacturing process.

Assumptions were made to reflect current good environmental practice. This included assumptions about the amount of reuse of Cat A elements, moderate changes to MEP and moderate adaptation of the base-build.

Other factors borne in mind were waste processing and energy use during construction.

The results at this later stage of research are as follows:

	Average kg CO_2e/m² GIA	
	Minor fit out 1,000-2,500m²	**Major fit out 10,000m²+**
Data from research groups adjusted as described above	172	208
Data from architype projects	164	214

The results showed a reassuringly close relationship between calculations based on the detailed elemental review evidence and those based on the architype project WLCAs – for both sizes of fit out:

- Minor fit outs – 172 compared to 164 kg CO_2e/m² GIA
- Major fit outs – 208 compared to 214 kg CO_2e/m² GIA

At the same time, there was still a significant difference between minor and major fit outs.

In order to arrive at a single carbon performance level for all Cat B fit outs, the group followed a precedent set by the NZCBS in other cases.

This involved taking the higher number for each size of fit out and finding a median value.

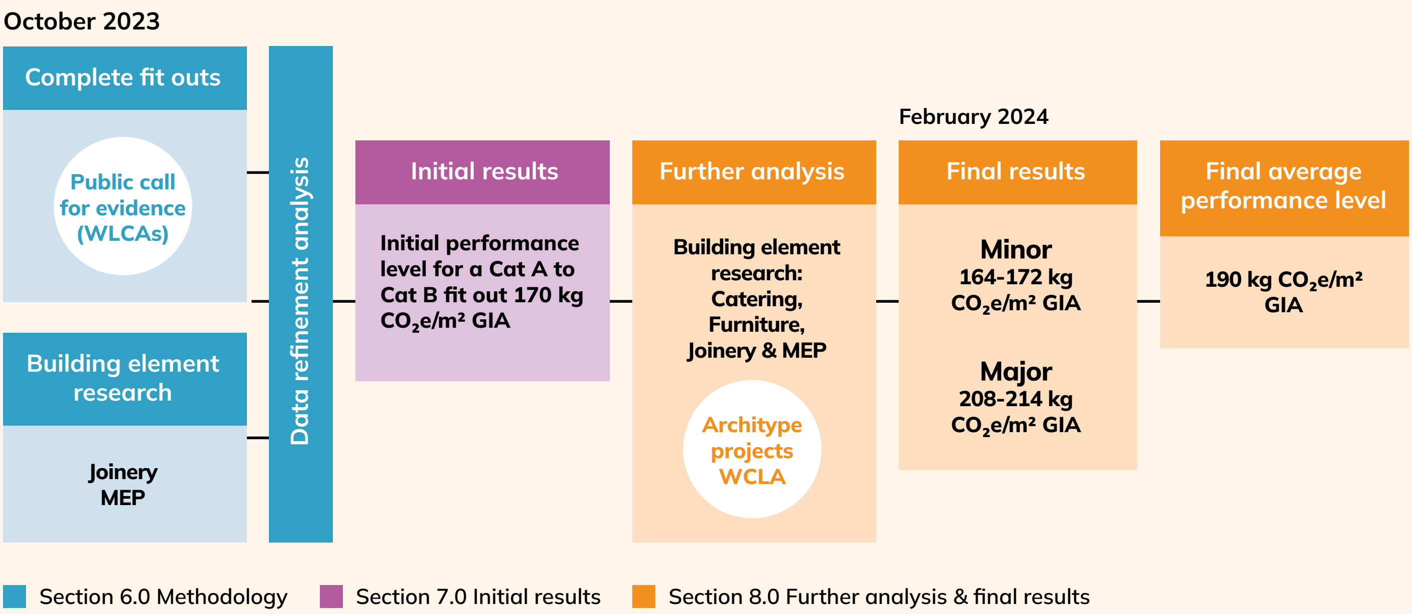
(172 + 214) ÷ 2 = 193

193 kg CO_2e/m² GIA

For ease, this number has been rounded to:

190kg CO_2e/m² GIA

Thus, based on the additional information from the early-stage research, the performance level was revised to 190 kg CO_2e/m² GIA at this later stage of research.



9.0 Practical use of results

In terms of day-to-day good practice, project leaders and organisations can immediately implement following recommendations:

- **Set accountability.** When producing a project brief, make all team members responsible for carbon emissions.
- **Set a baseline and internal limits.** It's important to understand the performance in relation to scope of works. Set a baseline and begin working to an internal limit that's below the current industry performance level of 190 kg CO^2e/m^2 GIA. This limit could vary according to size and scope of project. Then work with your team to improve on it.
- **Test the draft NZCBS.** There'll be a limited time for beta testing after summer 2024 – and a limited number of projects suitable to test. Those who can participate will be critical to providing feedback to refine the standard.
- **Talk to project stakeholders.** Discuss the issues of whole-life carbon impact with clients, landlords, facilities teams and occupants – and what these issues mean in terms of design, procurement and operation. Explain how everyone's choices and behaviours make a difference.
- **Share and collaborate.** Request to be involved in the further research suggested. Share internal knowledge and resources with the wider fit out sector. Share WLCAs produced by your organisation – especially when a process is created to review industry data.

Manufacturers should continue to produce carbon data for their products so that fit out projects can fully account for their carbon impact – especially where no such data currently exists. There are several frameworks that can help with this:

- The EU has a road map for reducing embodied carbon, as well as wider WLC processes.
- The Ecodesign for Sustainable Products Regulation (ESPR), March 2022, progressively sets performance and information requirements for key products placed on the EU market.
- The Construction Products Regulation (CPR) sets trajectories for decarbonising products and reporting.

There's also the hierarchy below which may be helpful for manufacturers in selecting a format/process for provision of product carbon data. The list is bespoke and should be reviewed for each project as more evidence options become available. Manufacturers should aim to provide carbon data that fulfils the top end of the scale.

- Product Specific Type III External EPD conforming to EN 15804, with a minimum cradle to gate scope
- Product Specific Type III External EPD conforming to ISO 21930, with a minimum cradle to gate scope
- Product Specific Type III External EPD conforming to ISO 14067, with a minimum cradle to gate scope
- Product Specific Type III External EPD conforming to ISO 14025, ISO 14040 and ISO 14044, with a minimum cradle to gate scope
- Industry-wide/generic EPD
- Product-specific Type III Internal EPD
- PEP (Product Environmental Profile)
- Product-specific LCA which conform to ISO 14025, ISO 14040 and ISO 14044, with a minimum cradle to gate scope
- TM65 Mid-Level Calculation
- TM65 Basic Calculation
- FIRA Carbon Footprint Tool
- Other embodied carbon data (generic LCAs or industry datasets)
- Other embodied carbon data (proxy product data)
- Other embodied carbon data (other types not listed above)

10.0 Elemental research: at a glance

The question:
How can performance levels for individual fit out elements inform a performance level for upfront carbon in Cat B office fit out?

Why is it important?
It is acknowledged that a single performance level for Cat B projects that are so variable in scope and scale is challenging. More granular analysis of elemental performance levels may in fact be of greater practical benefit to teams looking at carbon optioneering on fit out projects. This research sought to understand performance levels relating to some of the building elements where there is limited analysis shared to date; MEP, furniture, catering kitchens, joinery and staircases. It also sought to review the challenges of collecting data and accounting for elements of work where approaches by LCA practitioners vary, as is the case for temporary works, reused items and joinery.

So what do we do?
This research serves as a starting point for interested stakeholders to benchmark elements with their own fit out projects. It also allows transparent discussion within the wider industry about the research that is still needed to refine the process of accounting for these elements and reducing the carbon impact of each element. Ultimately, it's hoped research such as this will help us to understand the impact of individual building elements better and reduce the impact of fit out over time.

Day-to-day, what part can everyone play?
The advice varies depending on the element and the table below gives you a high-level summary. Part 2 of this report should be consulted for the knowledge gathered and important next steps for each element. Dive into the detail, volunteer to help drive knowledge about an element forward, and where a performance level exists; begin using this to inform carbon optioneering and reduction on your fit out projects.

Element	Performance Level	Research methods
Mechanical, electrical and public health (MEP)	Performance level: 47kg CO_2e/m^2 GIA	Desktop research Case Studies Architype projects
Furniture	Performance level: 37 kg CO_2e/m^2 GIA	Desktop research Case Studies Product research
Joinery	Performance levels: Tea points: 2,223 kg CO_2e/unit Bespoke tables: 599 kg CO_2e/unit Reception desks: 3,487 kg CO_2e/unit Storage shelving: 517 kg CO_2e/unit Bathroom vanities 634 kg CO_2e/unit	Manufacturer interviews Case Studies Product research
Staircases	Requires continued research to develop a performance level	Manufacturer interviews Desktop research
Catering kitchens	Performance levels: Small kitchen ($30m^2$): 4,686 kg CO_2e/m^2 Medium kitchen ($55m^2$): 2,878 kg CO_2e/m^2 Large kitchen ($98m^2$): 2,214 kg CO_2e/m^2	Achitype projects Product research
Temporary works (TW)	Requires continued research to develop a performance level	Desktop research
Reuse	Requires continued research to develop a performance level	Desktop research & Case Studies

11.0 Research limitations

There are several limitations to the research described in this whitepaper.

Limiting factors relating to WLCAs

Firstly, it's difficult for the fit out industry to achieve a high degree of accuracy in producing WCLAs.

This is due to certain challenges, which should be borne in mind when interpreting the results of this research.

- **Data relating to materials doesn't always reflect what's actually/specifically used.**
  - Data relating to the type and quantity of materials planned for a fit out (during design) may differ from the materials actually used (during construction). Much of it comes down to estimation based on the information available at the time. It's uncommon to find post-fit out WLCAs and they may not capture all the materials that were finally ordered due to the enormous administration required and/or lack of supply chain knowledge. This will improve in time.
  - Availability of product carbon data is not currently an essential parameter for specifying or choosing materials on most fit out projects.
  - There's discrepancy between projects expressing carbon intensity per square metre of gross internal area (GIA) vs net internal area (NIA). The latter is more commonly provided in contractual paperwork for tenants and, while it's helpful for NIA to be recorded, it's important to use GIA for consistency. Ideally, both types of floor area are measured as per the RICS guidance and other reporting requirements for WLCAs.
  - Multiple stakeholders may need to be consulted to obtain a true picture of fit out materials and their associated carbon. In most cases, no single contractor or stakeholder will be responsible for this procurement or data collection. For example, furniture is often procured by the client at a later stage in the build, so a main contractor's WLCA wouldn't cover these materials. This can prevent the full scope of a project being known, or even quantified, depending on when during the project the WLCA is completed. Also, given that so many sub-contractors are used in a fit out, it can be difficult to ascertain all material quantities – even when they're all appointed by the main contractor.
- **Data may be poor or variable in terms of quality and reliability.**
  - Carbon data may be missing or excluded. It may have different levels of accuracy or validity. Or it may be interpreted in different ways by different LCA practitioners.
  - Different assessments may not include all the items required. RICS WLCA PS 2nd edition, should help improve this, however it will take time to filter through to the WLCAs being produced.
- **Approach to producing WCLAs may differ between tools and practitioners.**
  - Much of the data submitted to our call for evidence takes the form of WCLAs based on RICS PS 1st edition. But not everyone follows this industry-agreed methodology and data is inconsistent. It's worth noting that, in June 2024, the RICS WLCA PS 2nd edition was implemented, and this may affect future research.
  - Some WLCAs are based on the requirements of BREEAM RFO 2014, and these tend to present a far reduced scope compared to RICS WLCA PS 2nd edition.
  - There are various tools available to complete WLCAs, including OneClickLCA & etool, as well as in-house tools like CarboniCa (by Morgan Sindall) and simple Microsoft Excel spreadsheets. Their output can vary even when the same information is submitted. An understanding of the datasets and scope of each tool is required.
  - There's been limited WLCA training to ensure practitioners complete WLCAs the same way. An optional WCLA training course was introduced in February 2024, but data was collected for this research before then.

  - There's a lack of industry-agreed guidance for undertaking audits – especially external audits. Third-party verification is recommended in RICS WLCA PS 2nd edition.

- **Few WLCAs are available for fit outs.**
  - Fit outs are often not subject to planning permission and so there's less incentive for occupiers or developers to pay for a WLCA. For GLA referable, and in some boroughs, major applications projects in London, and other UK Local Authority jurisdictions, there's a requirement to complete a WLCA. This means that shell and core, major renovation and retrofit projects are more likely to have a WLCA. In London, this often follows the GLA assessment guidance. Outside of London, there's less steer on what a WLCA should contain, if one's needed at all, and this can result in inconsistency.
  - The fast-track nature of fit out projects can preclude engagement from an LCA practitioner at the (optimal) early stage of design where low-carbon decisions have the least financial and programme impact. Where they're engaged at a much later stage, and there's less scope to make low-carbon decisions, clients may be less willing to complete a WLCA for fear it'll reflect poorly on a project's carbon impact.
  - The process of completing a WLCA for a fit out may be more laborious (due to its scale and complexity), and so more expensive and less appealing for clients. Fit outs will likely have a greater number of different products/materials. When seeking product and quantity data from RIBA stages 4+, fit out and refurbishment projects can involve collecting this from up to 45 different specialist sub-contractors. In some cases, these sub-contractors may themselves be sub-contracting portions of the work. It means the collection of data is an extensive exercise that's more costly and subject to error.
  - Lack of industry-agreed process for the collection of fit out data. Even contractor-side surveyors in the same organisation can collect product quantity data differently and in ways that will suit LCA practitioners better or worse when translating those details into a WLCA tool.
  - Certain elements may be procured by the client/tenant team occupying the space, which means additional stakeholders or differing scopes of procurement. This is typical of elements such as IT equipment.

Other limiting factors

In addition to the challenges relating to WLCAs, this research was limited by the following:

- There was a relatively small sample of projects available to study – especially when compared to the number of projects available for the shell and core plus Cat A research undertaken by the NZCBS.
- There was high deviation from the mean data, likely due to variable types and scopes of project. As data and reporting methods become more consistent, and more data is submitted, it's expected that data accuracy will improve over time.
- The data covered a wide variety of project scopes.
- It's possible that data came from projects that prioritised lower-carbon products and materials than the 'average'.
- It's likely that higher-carbon projects may have been presented as such due to their being accounted for in greater detail and with more precision. Future projects may find notably higher results for upfront carbon as auditing and accuracy improve.
- A high number of projects were based on lower value quantity data – for example, cost plans and Bills of Quantities (BoQs) rather than Building Information Modelling (BIM) and delivery notes. More as-built data, with more detailed quantities, will provide more accuracy.
- Adding a Cat B performance level to a building quantified from shell and core to Cat A isn't necessarily representative of a whole building. This is due to the complex and variable relationships between the different whole-building project phases. While there are broad definitions of Cat A and Cat B, their scope can still vary and there may be overlap between project phases. Adding a Cat B performance level to a performance level for shell and core plus Cat A is acknowledged as being imprecise. However, with the current availability of data, this is the most sensible way to summarise a whole building number – assuming all the likely building elements inside the fit out are included.
- In terms of first fit outs, this research didn't account for stripped out Cat A ceilings and services that were never used. As an industry, we should be mindful of this going forward.

12.0 Further research

This whitepaper makes the following recommendations for further action and research:

- **Develop a clear reporting form**. This type of research process would be faster and more reliable if the reporting forms specified which individual building elements are and aren't included in the WLCA. It would be even better for this reporting form to align with those of the RICS and NZCBS. It should make clear the following details about the different elements:
  - o The basis for product quantity data and related RIBA stage/project stage as per the RICS WLCA PS 2nd edition definitions. For example, a stage 3 cost plan used for a WLCA at stage 5 should be recorded as stage 3, not stage 5.
  - o Ownership of the procurement/install of each element.
  - o Explanation as to why elements are or aren't included:
    - – Not in scope of project by any party.
    - – In scope but not included due to lack of data – e.g. quantities unknown; carbon data not available; inclusion of element unknown due to project stage or lack of clear specification/scope.
    - – Any other reason.
- **A universal location of projects and data.** While the BECD is readily available for use in the construction industry, it's not widely used by the fit out sector to analyse its own specific results. In the short term, a simple reporting form fed into a spreadsheet to analyse data (in the same way that this research was undertaken) would be helpful. A fit out working group could then meet bi-annually or quarterly to review the results in light of new projects being added. Given the fast pace of fit out, it's important that a simple tool is available to track progress live. There seems to be appetite in the fit out industry to carry out this work, but we need a committed group to own and lead this initiative. Funding would also ensure this work is completed.
- **Analyse how project size affects upfront carbon emissions.** Further research on how the scope and carbon intensity of fit out projects change in relation to the size of the project, and whether the project is a single floor, partial building or whole building fit out. While this research looked at a comparison of two fit out sizes, there are further typologies that might suggest more specific performance levels for different types of project. It would be important for such research to analyse the frequency with which different project types and sizes are executed. In the first instance, a clear scope for the different typologies would need to be defined, likely in the form of a checklist of project elements/sub-elements to ensure transparency on elements included and excluded from each project type and how this varies with size of project.
- **Produce case study WLCAs of buildings for each project phase.** This data will likely be produced during beta testing by the NZCBS. It would involve collecting WLCAs for new buildings taken to shell and core, as well as Cat A fit out (if being done) and Cat B fit out for the same building. Currently, the data collected through the NZCBS's call for evidence provides shell and core and Cat A carbon performance levels as a combined total. It would be helpful to separate these numbers to allow flexibility in setting future embodied carbon limits for tenants and landlords.
- **Produce guidance documents for highest-carbon building elements.** This would show the carbon intensity range for each element and the potential carbon reduction – from what's typically installed to the lowest carbon product in that class. It could also include guidance on how to reuse and, even better, avoid installing each element in the first place. Some organisations already produce such documents internally. Their research should be shared.
- **Research the cumulative effect of fit out.** This would involve investigating different types of fit out, including how often they're stripped out and replaced and whether lease length is a reliable predictor of this. It would also mean reviewing the average lease length or fit out replacement cycle and how these vary for different sizes of project/types of client.
- **Produce an industry-agreed auditing form and process.** If this doesn't already form part of the NZCBS's plans.

- **Research other types of fit out.** Some WLCAs provided for this research fell outside of Cat A to Cat B. It would be useful to analyse these fit out typologies, including comparisons between small and large fit out projects. This should start with clear definitions of each typology, as well as a breakdown of elements and sub-elements from either NRM or BCIS forms of cost analysis. Projects might include:
    - Fit out from shell and core to Cat A
    - Fit out from shell and core to Cat B
    - Light refurbishment of on-floor services and interior fit out
    - Major refurbishment
- **Analyse whole life carbon emissions.** This would mean looking beyond upfront carbon emissions (A1-A5) and into the following lifecycle modules:
    - Material replacement and refurbishment (B1-B5)
    - End of life (C1-C4)
    - Beyond construction and into the next life phase (D)

  Attempting to calculate whole-building emissions over 60 years by only factoring in one fit out, for example, excludes the embodied carbon emissions over the course of a building's life and inaccurately reflects the total anticipated carbon impact. By designing with the end in mind and working backwards over a building's life, it's possible to set the necessary circular and low-carbon design and procurement strategies needed from the start.
- **Analyse construction site energy use and waste.** This hasn't yet been researched in sufficient detail for fit out projects.

The research described in this whitepaper is currently being reviewed by Kingston University with the intention that a number of students will reexamine the findings and expand on the scope.

13.0 Glossary and references

BREEAM: Building Research Establishment Environmental Assessment Methodology is an environmental assessment method for the built environment and infrastructure used to assess whole life sustainability performance on projects worldwide.

BS EN: BS ENs are British implementations of European standards (ENs). BSI (British Standards Institute) publishes all ENs and withdraws any conflicting British standards. Standards begin with the designation BS EN and use the relevant EN standard's number. They are not a legal requirement but following such standards indicate compliance with best practice.

Cat A fit out: any site preparation works required for the shell and core build, as well as finishes (e.g. raised access floors, suspended ceilings), MEP and fixed FF&E outside of the shell and core scope.

RICS, RICS Whole Life Carbon Assessment for the Built Environment, Professional Standard, Global 2nd edition (2023))

Cat B fit out: A Category B (Cat B) fit out follows on from a Category A fit out and typically includes bespoke partitioning, finishes, carpeting, lighting, kitchen facilities, etc. that are specific to the requirements of the occupier.

RICS, RICS Whole Life Carbon Assessment for the Built Environment, Professional Standard, Global 2nd edition (2023)

CO_2e (Carbon dioxide equivalent): A metric for expressing the impact of all greenhouse gases on a carbon dioxide basis.

RICS, RICS Whole Life Carbon Assessment for the Built Environment, Professional Standard, Global 2nd edition (2023))

Embodied carbon: The embodied carbon emissions of an asset are the total GHG emissions and removals associated with materials and construction processes, throughout the whole life cycle of an asset (modules A0–A5, B1–B5, C1–C4))

R*ICS, RICS Whole Life Carbon Assessment for the Built Environment, Professional Standard, Global 2nd edition* (2023)

EPD: Environmental product declaration. A document that clearly shows the environmental performance or impact of a product or material over its lifetime.

RICS, RICS Professional Standard Whole Life Carbon Assessment for the Built Environment, Global 2nd edition (2023)

GLA: Also known as 'City Hall', the Greater London Authority (GLA) was created after a referendum in 1998, when Londoners voted in favour of a directly elected Mayor to represent London's interests, and a London Assembly to scrutinise their work. The GLA's London Plan Policy SI 2 sets out a requirement for development proposals to calculate and reduce WLC emissions as part of a WLC assessment.

Gross internal area (GIA): the area of a building measured to the internal face of the perimeter walls at each floor level. Within the RICS Code of measuring practice, a full list of building areas that are included and excluded are provided.

RICS (2016), RICS professional standards and guidance, Global Code of measuring practice 6th edition

May_2015_Code_Of_Measuring_Practice_6th_Edition.pdf (rics.org)

ISO: International Standards Organisation. ISO Standards provide detail on a variety of topics and describe the best way to carry out a particular task or activity of the basis of known best practice. They are not a legal requirement.

LEED: Leadership in Energy & Environmental Design. A green building certification programme defining best practices for green buildings, used worldwide.

LETI: the Low Energy Transformation Initiative (LETI) is a voluntary organisation aiming to move the UK towards a zero carbon future. It aims to provide clarification to the built environment on the requirements needed to meet the UKs climate change targets.

Net internal area (NIA): the usable area within a building measured to the internal face of the perimeter walls at each floor level. Within the RICS Code of measuring practice, a full list of building areas that are included and excluded are provided.

RICS (2016), RICS professional standards and guidance, Global Code of measuring practice 6th edition,

May_2015_Code_Of_Measuring_Practice_6th_Edition.pdf (rics.org)

NZCBS: Net Zero Carbon Building Standard. The UK's first cross-industry Net Zero Carbon Buildings Standard that brings together Net-Zero Carbon requirements for all major building types, based on a 1.5°C trajectory.

Performance levels: In relation to the NZCBS these levels provide the technical evidence on what can be achieved by the individual sectors, based on benchmarking, case studies and modelling. They're not limits or targets, but will be used to inform the NZCBS limits and targets in the next stage of work.

RICS: Royal Institution of Chartered Surveyors, is a leading professional body working in the public interest to advance knowledge, uphold standards, and inspire current and future professionals. The RICS produces a number of guidance documents for its members and the wider industry that help to ensure standardisation of both construction project quantities measurement and Whole Life Carbon Assessments.

RICS Professional Standard Whole life carbon assessment for the built environment 1st and 2nd editions: The RICS whole life carbon assessment (WLCA) standard is set to become the world-leading standard for consistent and accurate carbon measurement in the built environment. The 2nd edition replaced the 1st edition on July 1st 2024.

RIBA: The Royal Institute of British Architects is a global professional membership body driving excellence in architecture. The RIBA Stages organise the process of briefing, designing, constructing and operating building projects into eight stages and explains the stage outcomes, core tasks and information exchanges required at each stage.

Shell and core: Refers to the first phase of a commercial project where the basic inside (core) and the outer building envelope (shell) are constructed, without adding things like furnishings, interior lighting fixtures, interior walls or ceilings.

RICS, RICS Whole Life Carbon Assessment for the Built Environment, Professional Standard, Global 2nd edition (2023)

SKArating: is an assessment scheme which helps landlords and tenants assess fit-out projects against a set of sustainability good practice criteria. SKA is a toolkit and assessment criteria that is free to use with costs being covered via training and certification. It was released in 2008 and over 12,000 fit out projects have gained certification since that time. **skarating.org/**

Upfront carbon: Upfront carbon emissions are greenhouse gas emissions associated with materials and construction processes up to practical completion (modules A0–A5). Upfront carbon excludes the biogenic carbon sequestered in the installed products at practical completion.

RICS, RICS Professional Standard Whole Life Carbon Assessment for the Built Environment, Global 2nd edition (2023)

WLCA: A whole life carbon assessment (WLCA) is the calculation and reporting of the quantity of carbon impacts expected throughout all life cycle stages of a project, but also includes an assessment of the potential benefits and loads occurring beyond the system boundary. Whole life carbon refers to the carbon impacts over the entire life cycle of a built asset, from its construction through to its end of life.

RICS, RICS Professional Standard Whole Life Carbon Assessment for the Built Environment, Global 2nd edition (2023)

14: Appendix 1: Cat B scoping exercise

The below table shows the scope of a Cat B defined for the research, showing elements that have been included in the performance level for Cat B upfront carbon. The elemental categories taken from RICS WLCA PS 2nd edition

Key
- ● (blue) Included by occupier
- ● (orange) Typically included in contractor scope
- ● (green) Sometimes included in contractor scope
- ● (grey) Element already present, possible alterations / removed or replaced
- ○ (white) Never in scope / base-build

Element (based on RICS WLCA PS 2nd edition) – reporting table	Typical scope for project taking full Cat A to Cat B	Should be captured within the scope of measurement	Assumed excluded due to lack of data / ability to model or likelihood of being included in scope
Onsite utility consumption (A5)	● (grey)	✓	
0.1 Demolition works / strip out (e.g. removal of soft spot etc)	● (grey)	✓	
2.1.1 Frame (vertical) – columns/structural walls & braces	● (grey)		✓
2.1.2 Frame (horizontal) – beams, joists & braces	● (grey)		✓
2.2.1 Upper floor and roof – structural slabs	● (grey)		✓
2.2.2 Upper floor and roof – non-structural slabs	● (grey)		✓
2.4.1 Stairs	● (green)	✓	
2.4.2 Ramps	● (green)	✓	
2.4.3 Safety and access ladders, chutes, slides & guarding	● (green)		✓
2.5.1 External – opaque envelope	● (grey)		✓
2.5.2 External – full height glazing systems	● (grey)		✓
2.5.3 External – roof finishes/coverings	● (grey)		✓
2.5.4 External – safety systems	● (grey)		✓
2.6.1 Windows – vertical	● (grey)		✓
2.6.2 Windows – roof or horizontal	● (grey)		✓
2.6.3 External doors	● (grey)		✓
2.7.1 Internal walls – solid	● (green)	✓	
2.7.2 Internal walls – non-structural glazed walls, windows & vision panels	● (orange)	✓	

Element (based on RICS WLCA PS 2nd edition) – reporting table	Typical scope for project taking full Cat A to Cat B	Should be captured within the scope of measurement	Assumed excluded due to lack of data / ability to model or likelihood of being included in scope
2.8 Internal doors	● (orange)	✓	
3.1 Wall finishes	● (orange)	✓	
3.2.1 Raised access floor or specialist sprung floors	● (grey)	✓	
3.2.2 Non-structural screed	● (green)	✓	
3.2.3 Floor finishes	● (orange)	✓	
3.3 Ceiling finishes	● (green)	✓	
4.1 General FFE	● (orange)	✓	
4.2 Kitchen equipment	● (orange)	✓	
4.3 Special equipment	● (green)		✓
4.4 Loose fit FFE	● (orange)	✓	
4.5 IT	● (blue)		✓
4.6 Audio and visual	● (blue)		✓
5.1.1 Sanitaryware	● (green)	✓	
5.1.2.1 Cold water systems	● (orange)	✓	
5.1.2.2 Cold water storage			✓
5.1.3.1 Surface water/rainwater/foul water drainage	● (green)	✓	
5.1.3.2 Water reuse systems			✓
5.2.1.1 Heat & hot water generation equipment	● (grey)	✓	
5.2.1.2 Heat & hot water distribution, control, ancillaries, emitters, exchangers/terminal units	● (grey)	✓	
5.2.1.3 Heat storage equipment	● (grey)	✓	
5.2.2.1 Cooling generation equipment	● (grey)	✓	
5.2.2.2 Cooling emitter, exchangers/terminal units, ancillaries and control, distribution, storage	● (grey)	✓	
5.2.3.1 Air movement	● (grey)	✓	
5.2.4.1 Air terminals	● (grey)	✓	
5.2.4.2 Duct work & ancillaries	● (grey)	✓	
5.2.4.3 Control dampers, attenuation and fire safety related to ventilation equipment	● (grey)	✓	
5.3.1.1 Internal lighting	● (grey)	✓	
5.3.1.2 External lighting (if part of works)	● (grey)	✓	
5.3.1.3 Emergency lighting	● (grey)	✓	
5.3.1.4 Other lighting	● (blue)	✓	

Element (based on RICS WLCA PS 2nd edition) – reporting table	Typical scope for project taking full Cat A to Cat B	Should be captured within the scope of measurement	Assumed excluded due to lack of data / ability to model or likelihood of being included in scope
5.3.2.1 Electrical power	● (orange)	✓	
5.3.2.2 ELV, communications, security	● (grey)	✓	
5.3.2.3 IT & data	● (blue)		✓
5.3.2.4 BMS	● (orange)		✓
5.3.2.5 Electricity back up generation	● (green)	✓	
5.3.2.6 Fire detection & alarm	● (grey)	✓	
5.5.1.1 Sprinkler system	● (grey)	✓	
5.5.1.2 Fire-fighting systems	● (grey)		✓
5.5.1.3 Lightning protection/earth bonding	● (grey)		✓
5.5.2 Fuel installations			✓
5.5.2.2 Lift, stair lift, lifting platform	● (green)		✓
5.5.2.3 Escalators and moving walkways	● (green)		✓
5.5.4 Specialised & communal waste disposal	● (grey)		✓
5.5.5 Specialist installations & maintenance	● (green)		✓
5.5.6 Builders work in connection with services	● (orange)		✓
7.1 Alterations	● (green)		✓
7.2 Repairs, cleaning, general renovation	● (green)		✓
7.3 Damp-proof courses/fungus and beetle eradication			✓
8.1.1 Roads, paths, paving, surfaces	● (green)	✓	
8.1.2 Fencing, railings, walls	● (grey)		✓
8.1.3 External fixtures	● (green)		✓

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