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Slattery embodied carbon: Methodology

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Methodology

Slattery's carbon planning process

As the first quantity surveying firm in Australia to launch a carbon planning service, Slattery assists our clients to achieve their net zero and sustainability targets.

Slattery's Carbon Planning Service measures the upfront embodied carbon of a project early enough in the design phase to highlight the 'carbon-intensive hot spots' and enable meaningful change to design, material selection, and procurement.

Choices about upfront embodied carbon are made alongside other design decisions including capital costs, life cycle costs and carbon, operational efficiency, and project aesthetics.

The Slattery Carbon Plan runs in parallel with our cost planning process throughout the design. The process begins by setting the carbon budget during the project feasibility stage. This carbon budget is based on Slattery's real project benchmarks across a wide range of sectors and building types, including commercial, residential, healthcare, community and education, and across fitouts, refurbishments and new builds.

Our approach

Comparable, consistent and replicable benchmark data is at the heart of informed decision-making. For this reason, we have developed a methodology in alignment with international best practice frameworks and the NABERS Embodied Emissions Initiative, which is currently in development.

LCA methodology

Our carbon planning calculations and benchmarked data are captured using a process life cycle assessment (LCA) methodology. We use detailed measures of materials from project cost plans or bill of quantities to define the quantities of all materials and products in a design. We then utilise process-based LCA data for stages A1-A5 (product and construction stages), which applies a bottom-up approach to measure the life cycle impacts of each of these materials. Aggregating all LCA data of the materials within the design enables us to measure and report on the total building lifecycle impacts.

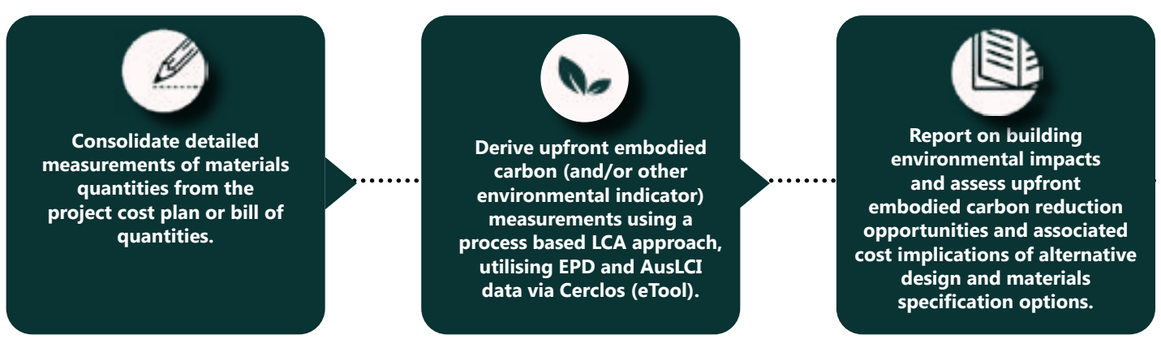
Environmental Product Declarations

Environmental Product Declarations (EPDs) are fast becoming the cornerstone of strategies to reduce upfront embodied carbon. EPDs got off to a slow start in Australia's construction industry (Mortensen, 2022). Today a growing number of companies understand the value of EPDs for their high quality, credible, transparent and third-party verified environmental impacts data that complies with international standards.

EPDs allow quantitative comparison of different products and services, and their environmental impacts. EPDs are typically provided by the product manufacturer, and are independently verified.

Product-specific process LCA data such as EPDs result in relatively low levels of uncertainty, and are widely considered to be at the top of the hierarchy of embodied carbon data sources (for example, they are used in the GBCA Upfront Carbon Emissions calculation guide).

Image:
Slattery carbon planning methodology



Slattery embodied carbon benchmarking: methodology
Slattery Carbon Planning

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Slattery incorporates as many EPDs as possible into our carbon calculations. We encourage our clients to specify products with EPDs to improve the accuracy of the upfront embodied carbon data as well as incentivise manufacturers to provide EPDs for their products. To ensure clarity and transparency of data, our carbon plans report on the data source of each item, and the percentage of the total project Gross Warming Potential (GWP) derived from EPDs. On average, 20-50% of a building's upfront embodied carbon data is derived from EPDs across our projects. EPD availability across the whole supply chain is limited, however we continue to endeavour to incorporate as many EPDs as possible into our carbon plans moving forward.

The NABERS embodied emissions consultation paper preferences process life cycle assessment data from EPDs where this is available. The NABERS technical report (chapter 16) outlines a sound rationale for this: process based LCAs are a much more common approach internationally than other methodologies such as hybrid LCAs.

Slattery believes we should aim to align with international standards, as Australia lags other countries and lacks a national framework.

Australian National Life Cycle Inventory Database

In addition to EPDs, the upfront embodied carbon benchmarking data is developed using the Australian National Life Cycle Inventory Database (AusLCI). AusLCI is a national, publicly accessible database, providing information on the environmental impacts of a wide range of Australian products and services. It takes a process-based approach to provide industry averaged embodied carbon coefficients, and is a useful tool in the absence of EPDs or product/material specifications.

Image:
Slattery upfront embodied carbon data hierarchy

Embodied carbon metrics and considerations

Slattery's embodied carbon figures are calculated based on project cost plans at varying design stages. Carbon plans typically capture more than 95% of material construction costs, which demonstrates that carbon plans are highly representative of the whole project.

To standardise results to compare projects of different sizes, we divide the total upfront embodied carbon by the gross floor area (GFA). The benchmarking data is displayed in total Global Warming Potential (GWP), divided by square metres of gross floor area, or GFA (or kg CO2eq/m2 of GFA).

The benchmarking data encompasses projects at different stages of design, ranging from concept to pre-tender estimate, with a sample size in excess of 80 projects.

The role of carbon sequestration in managing upfront embodied carbon emissions is still up for debate. For this reason, we display the benchmark data including carbon sequestration impacts. Because some materials, notably timber, absorb carbon, their net GWP is negative. In our methodology, carbon sequestration is accounted as negative GWP, and is applied as a 'credit'.

Given that most of the new build benchmarked projects are made from traditional concrete and steel structures, sequestered carbon does not have a large impact on most projects. Excluding the sequestered biogenic carbon from the upfront embodied carbon calculations of new builds results in an increase of 4-12% of the total GWP.

Slattery has chosen to exclude external works and services, and demolition impacts from the upfront embodied carbon benchmarking. This is because each of these factors varies considerably between projects; some have no external grounds and landscaping; others have no existing buildings to demolish. For this reason, we remove them from the GWP/m2 figures to ensure the benchmarks can accurately compare different buildings.

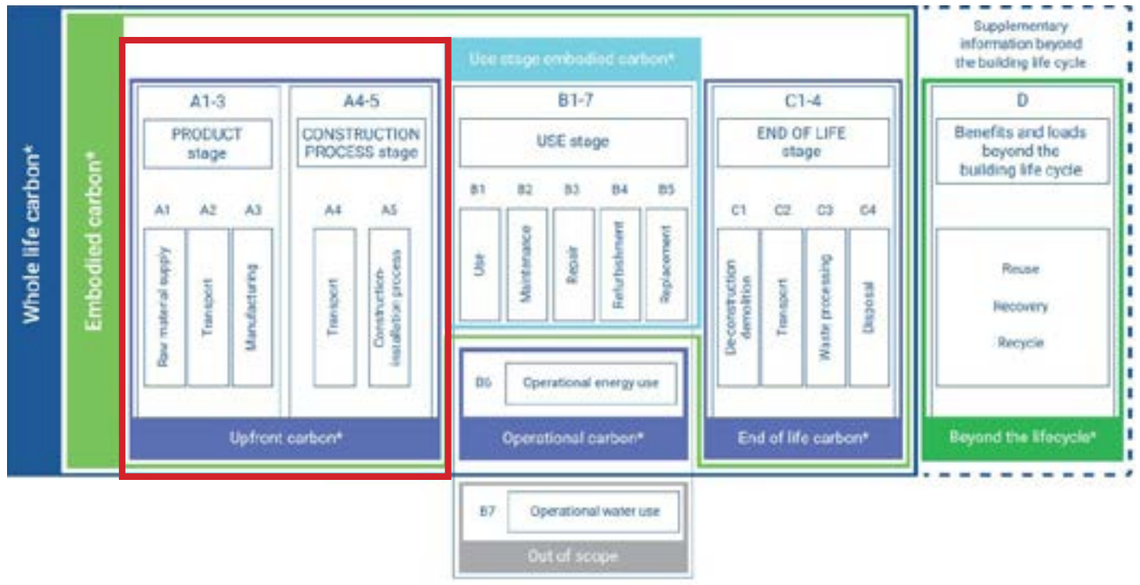

Figure 1: Buildings LCA stages according to EN 15978.

Scope of Slattery's embodied carbon measurement

Slattery's upfront embodied carbon assessments have been developed in reference to the following documents, which widely align with international standards:

- EN 15978 System Boundary A1-A5 to ensure consistency of results
- Royal Institution of Chartered Surveyors (RICS) Professional Statement – Whole life carbon assessment for the built environment, November 2017
- RICS Methodology to Calculate Embodied Carbon of Materials
- London Energy Transformation Initiative (LETI) Embodied Carbon Primer, January 2020
- LETI Embodied Carbon Target Alignment 2021
- eTool comprehensive reports with outputs compliant with international standards ISO 14044 and EN 15978
- International Cost Management Standard (ICMS): Global Consistency in Presenting Construction Life Cycle Costs and Carbon Emissions 3rd Edition, November 2021
- Climate Active Guideline: Upfront Embodied Carbon for Buildings October 2022.

The benchmarks show that landscaping projects have the lowest upfront embodied carbon, as they require far fewer materials per square metre than new builds and fitouts.

Commercial office fitouts and refurbishments and tertiary education fitouts have relatively low upfront embodied carbon per square metre of GFA compared to new-build benchmarks.

Typically, the most carbon-intensive items in a new build project, accounting for 70-80% of the upfront embodied carbon, are concrete, reinforcement and steel in the substructure and structure, and glass and aluminium in the façade. Extending the life of existing structures through retrofitting and reuse is the most effective strategy to minimise embodied carbon and meet sustainability targets. The contrast between the GWP/m2 rates of fitouts and new builds highlights the potential carbon savings that can be achieved by refurbishing existing buildings.

As a typical new build project has large quantities of concrete, steel reinforcement, excavation, structural steel, façades and other carbon-intensive materials, the tertiary, education, health, commercial, and residential sector benchmarks have relatively high upfront embodied carbon. The main embodied carbon contributors in these sectors are the substructure, upper floors, columns, and internal and external walls.

We have also chosen to segregate the new build benchmarked data to only include the cold shell building scope, excluding biogenic impacts.

This benchmarking approach is in alignment with a proposed methodology (Option 1) in the NABERS Embodied Emissions Initiative currently in development, which excludes most finishes and services and sequestered carbon.

Isolating the cold shell component of the new builds in each sector highlights the significant impact of the key carbon-intensive elements (substructure, upper floors, columns and external walls and windows).

Across all of the sectors benchmarked, the cold shell scope is responsible for 82-91% of the total building GWP.

The benchmarked projects encompass a range of design stages and represent developers with varying degrees of environmental sustainability intent. Values at the lower ranges of each sector generally indicate an effective application of upfront embodied carbon reduction principles. The higher range values typically represent a "business as usual" approach to sustainable design.

Since the initial release of the first embodied carbon benchmarking paper, we have observed a shift towards lower GWP/m2 rates across most new build sectors. This is an early and positive sign that Australia's property and construction industry is moving towards systemic upfront embodied carbon management.

> "… we have observed a shift towards lower GWP/m2 rates across most new build sectors. This is an early and positive sign that Australia's property and construction industry is moving towards systemic upfront embodied carbon management."

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Definitions

Biogenic emissions: The release of greenhouse gases, such as carbon dioxide and methane, from natural biological processes, including plant growth, animal digestion, and decay of organic matter.

Carbon budget: The amount of carbon that can be emitted while still achieving a specific climate goal, such as limiting global warming to 1.5°C.

Carbon offsetting: The process of compensating for carbon emissions by funding projects that reduce or remove carbon from the atmosphere.

Carbon sequestration: The process of capturing and storing carbon from the atmosphere in vegetation, soils or geological formations.

Circular economy: An economic model that aims to minimise waste and resource consumption by sending products and materials around in a 'closed loop'.

Decarbonisation: The process of reducing or eliminating carbon emissions.

Embodied carbon emissions: The carbon emissions associated with the production, transportation and construction of building materials and products, including end of life demolition.

Environmental Product Declaration (EPD): A standardised document that provides transparent and comparable information about the environmental impact of a product, including carbon emissions over its entire life cycle.

Global Warming Potential (GWP): A measure of the warming effect of a greenhouse gas, relative to carbon dioxide, over a specified period of time, often used to compare the climate impact of different gases and emissions.

Life cycle assessment (LCA): A method used to quantify the environmental impact of a product or process from the raw materials stage to the end of its useful life, including disposal and recycling.

Upfront embodied carbon emissions: The amount of greenhouse gases emitted during the product manufacture and construction phase of a building, including the production of materials and transportation.

Whole-life carbon assessment: An assessment that considers the embodied carbon, operational carbon and end-of-life carbon of a building.

References

Green Building Council of Australia (August 2021). Embodied Carbon & Embodied Energy in Australia's Buildings. Retrieved 5 May 2023.

Mortensen, J. (December 2022). Counting the Cost of Construction with EPDs. EPD Australasia. Retrieved 5 May 2023.

NABERS, NABERS Embodied Emissions Public Consultation, 12 Dec 2022. Retrieved 3 July 2023.

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If you have any questions arising from this thought leadership paper, please reach out to our Slattery carbon leads for more information.

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Image:
New Days and Old Days, Titjikala, 2020
by Doris Thomas
Slattery Warrang (Sydney) Collection

About Slattery and Kaizen

Slattery is a property and construction advisory firm specialising in quantity surveying, cost management and early phase project advisory, with an outstanding history spanning more than 40 years.

We work hand-in-hand with governments, institutions and organisations as well as planners, developers, architects and design teams on a broad range of property and construction projects.

A commitment to excellence and innovation, and an ability to become an integral part of the project team, has earned Slattery the trust and respect of clients and project teams alike. Slattery adds value by taking control and ownership of the cost management process from the outset.

Slattery's Kaizen papers share knowledge, ideas and pertinent cost information related to our industry. Kaizen is the Japanese word for improvement, and a business philosophy that strives for continuous improvement in process. We produce papers across the sectors we work with, which are shared with our clients and made available on our website for all to view.

Explore our knowledge sharing further at www.slattery.com.au/thought-leadership

Slattery Carbon Planning

Slattery is proud to be the first quantity surveying firm in Australia to launch a carbon planning service.

Our service is available in conjunction with cost planning to assist our clients to address upfront embodied carbon on current and future developments, and to achieve their net zero and sustainability targets.

Read more about Slattery's carbon planning offering at www.slattery.com.au/carbon-planning

Our team is pleased to hold memberships to the following industry groups:

AIQS | MECLA | Green Building Council Australia

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