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# Slattery Upfront Embodied Carbon Benchmarks

## Measure to manage: Benchmarking embodied carbon in Australia

May 2022

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Embodied carbon benchmarking will play a key role in the drive towards achieving net-zero emissions targets and improving the overall environmental footprint of the built environment. In this paper, we provide insights around embodied carbon and why benchmarking can provide data to assist developers and investors to address a project's embodied carbon.

## Overview

- Embodied carbon emissions currently account for around 35-45% of a standard building's lifecycle carbon emissions.
- Benchmarking embodied carbon provides data and insights to help construction industry professionals address a project's embodied carbon, allowing quick comparisons across various building sizes, types, and portfolios.
- Until now, there was no published embodied carbon benchmarking data, based on real projects, available in the Australian marketplace.
- Slattery's Carbon Planning service measures and analyses upfront embodied carbon data so clients and design teams can make informed decisions throughout the design phase, reducing costs and carbon in the process.
- Our detailed analysis has found substructure, upper floors, columns, external walls, and windows are responsible for around 70-80% of a typical project's upfront embodied carbon.
- Slattery continues to build its upfront embodied carbon benchmarking database from real projects across various sectors including commercial, residential, health, tertiary, community, commercial office refurbishment, and tertiary fit out.

## Background to embodied carbon

Upfront embodied carbon refers to the greenhouse gas emissions generated during the manufacturing and transportation of materials and construction processes to practical completion.

In Australia, embodied carbon emissions currently account for 35-45% of a standard building's lifecycle carbon emissions. The remainder comes from operational carbon generated during the use-stage of the building, for lighting, cooling, and electricity, for example.

As the electricity grid decarbonises and energy-efficient design and operations gain traction in Australia, embodied carbon is expected to replace operational carbon as the major source of building emissions.
Embodied carbon emissions are hard to eliminate. Some of our most common building materials – like concrete and steel – require process heat and chemical reactions that can't be achieved with electricity alone.

Without taking targeted and collaborative action, embodied carbon emissions will be responsible for 85% of the built environment's carbon emissions by 2050, according to a 2021 report from the Green Building Council Australia (GBCA) and Thinkstep-ANZ, Embodied Carbon & Embodied Energy in Australia's Buildings [1].

## Why is benchmarking important?

Without benchmarking embodied carbon, net zero emissions targets will remain elusive.

Benchmarking provides data and insights to help construction industry professionals address embodied carbon, allowing quick comparisons across various building sizes, types, and portfolios.

Embodied carbon measurement and reporting is a skilled and evolving knowledge area within the Australian marketplace. There are no industry-agreed frameworks in Australia and, as a result, there are inconsistencies in methodology, scope and data sources that deliver inconsistent results. Not all professionals use the same methods or data sources. This makes comparisons and benchmarking across different businesses problematic.

Slattery has developed our methodology, informed by international frameworks, to ensure data is consistent, comparable, reproducible, precise, and complete.
We can compare our upfront embodied carbon results as we have been consistent in our approach and methodology and have developed a benchmarking database of real projects.

Slattery is currently working with GBCA, Materials and Embodied Carbon Leaders' Alliance (MECLA) and the National Australian Built Environment Rating System (NABERS) to share our experience, research, and data. Our aim is to assist the development of an industry agreed embodied carbon framework and methodology for measurement and reporting.

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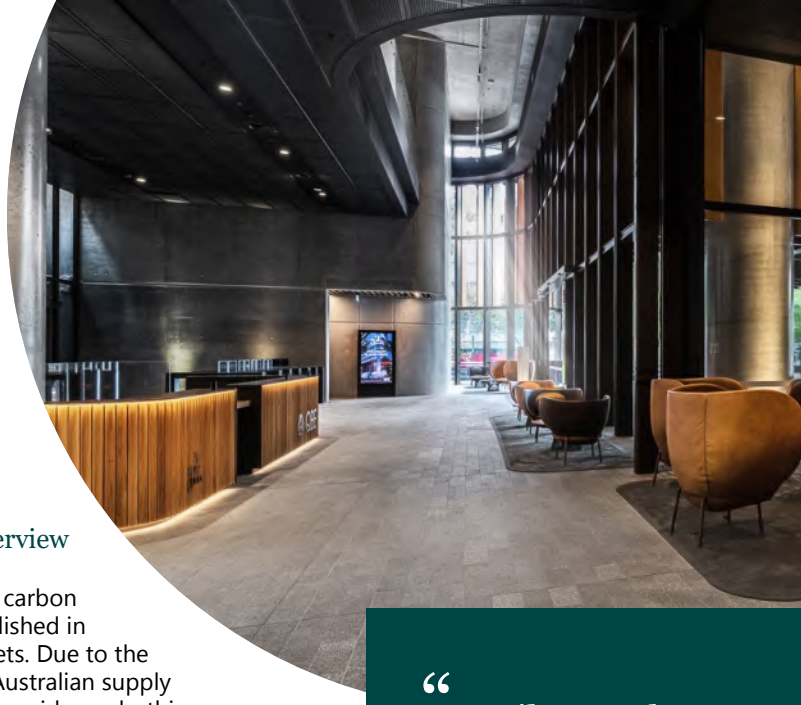


## Australian market overview

Until now, there was no published embodied carbon benchmarking data based on real projects available in the Australian marketplace. NABERS is currently developing a framework to measure, benchmark, and certify embodied carbon of building materials and construction [2].

NABERS is collaborating with industry stakeholders, including Slattery, to assist with this initiative. However, the framework is not expected to be finalised for at least another 12 to 18 months. It is expected the framework will be rolled out nationally as voluntary for commercial buildings, with the potential to support mandatory planning policy in the future.

## International overview

Upfront embodied carbon data has been published in international markets. Due to the differences in the Australian supply chain and electricity grid supply, this benchmarking data does not apply to the Australian market.

In the UK, the London Energy Transformation Initiative (LETI) has published the total embodied carbon targets and a rating system across various building portfolios [3]. This data does not apply to the Australian market but it does provide an idea of the ranges of results. The results are presented in kgCO2eq/m2 of gross floor area (GFA) as shown in **Figure 1 below**. The rating system has some limitations as there are discrepancies among life cycle analysis inputs, product LCA data sources, project assumptions, and exclusions. These affect the final figures reported.

Therefore, consistent assessment methodologies and reporting are critical to allow direct comparisons between projects and simplify the future analysis of projects [3].

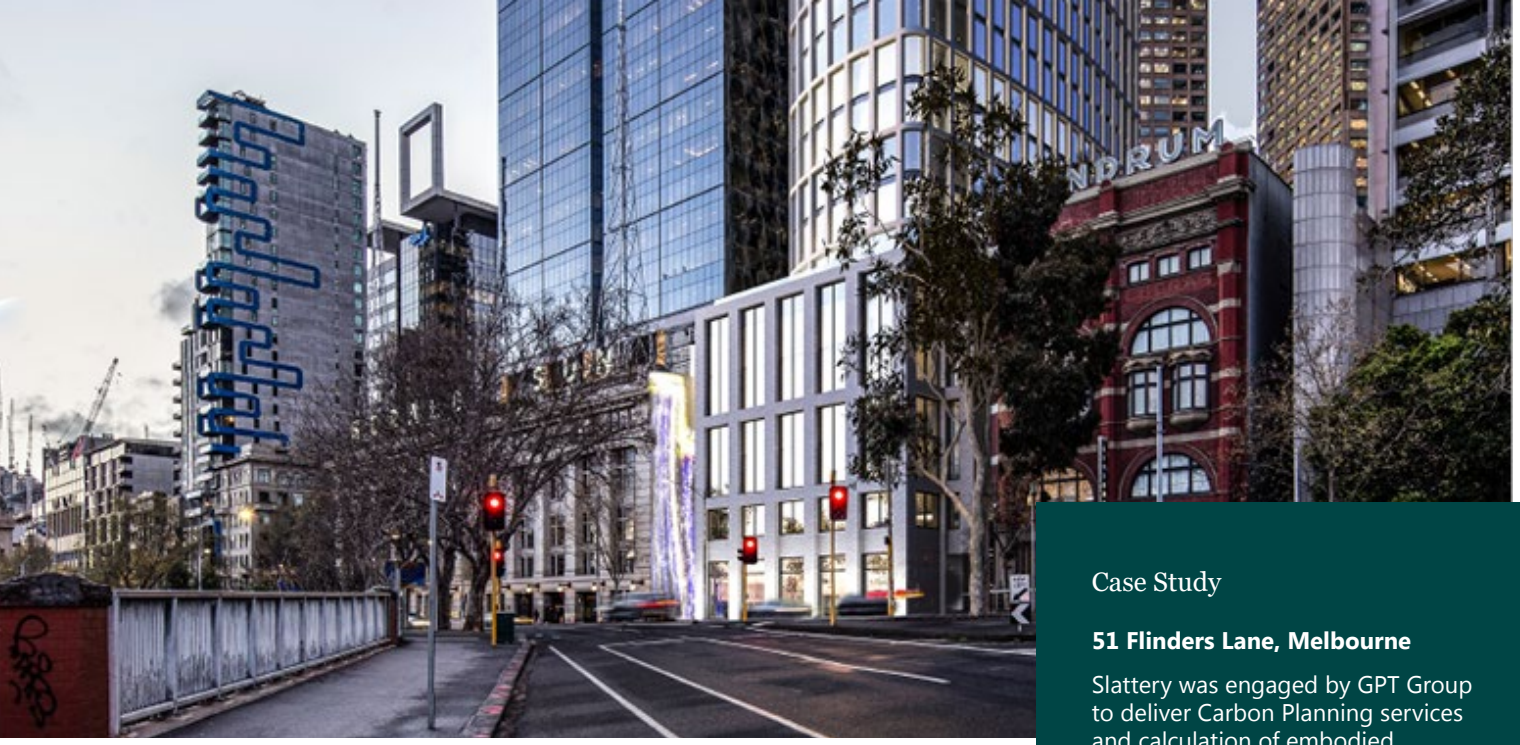
> “Until now, there was no published embodied carbon benchmarking data based on real projects available in the Australian marketplace”

**Image Credit:**
32 Smith Street, Parramatta
*Richard Crookes Construction, Fender Katsalidis, GPT Group*

| | Band | Office | Residential (6+ storeys) | Education | Retail |
|---|---|---|---|---|---|
| | A++ | <100 | <100 | <100 | <100 |
| | A+ | <225 | <200 | <200 | <200 |
| LETI 2030 Design Target | A | <350 | <300 | <300 | <300 |
| | B | <475 | <400 | <400 | <425 |
| LETI 2020 Design Target | C | <600 | <500 | <500 | <550 |
| | D | <775 | <675 | <625 | <700 |
| | E | <950 | <850 | <750 | <850 |
| | F | <1100 | <1000 | <875 | <1000 |
| | G | <1300 | <1200 | <1100 | <1200 |

**Figure 1**

Figure 1 LETI’s Upfront Embodied Carbon Rating, A1-5 (excluding sequestration) [3]



*International overview cont.*

In 2017, an embodied carbon benchmark study was carried out by the University of Washington to establish an embodied carbon database for buildings using the results from more than 1,000 buildings around the world [4].

The study was based on data from various sources such as engineering firms, architectural firms, and institutes, as well as data compiled by the University of Washington team. **Figure 2** shows the embodied carbon per square metre of all the collected data, sorted by different building uses and scope.

As the authors note, there are limitations to the results including data source discrepancies, scope inclusion criteria (such as whether the structure, enclosure, and the interior are considered or the structure only), data entry errors, and omissions.

Therefore, the validity of this data is problematic, and, again, the results should not be applied for Australian benchmarking purposes.

## Case Study

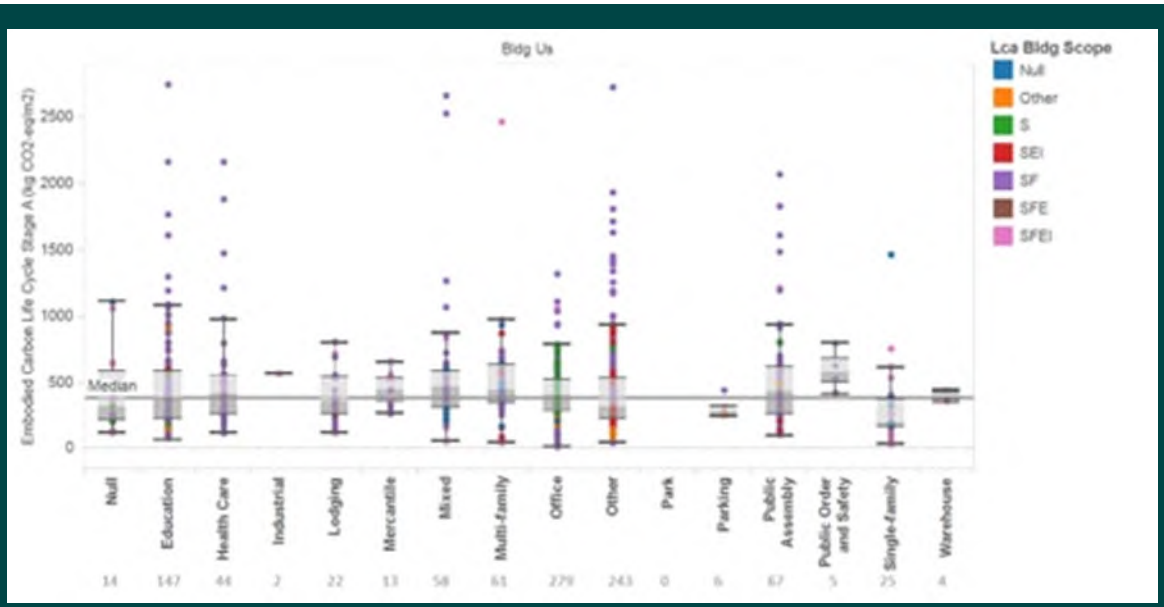
### 51 Flinders Lane, Melbourne

Slattery was engaged by GPT Group to deliver Carbon Planning services and calculation of embodied carbon on the 51 Flinders Lane development.

### Key Lesson

Cold shell office fit-out avoids unnecessary wastage of materials, labour, cost and carbon from tenants pulling out and re-installing to meet their needs. Lean structure and column spacing is an important consideration for embodied carbon.

Image: Bates Smart




(S S=Structure, SEI=Structure/Enclosure/Interior, SF=Structure/Foundation, SFE=Structure/Foundation/Enclosure, SFEI=Structure/Foundation/Enclosure/Interiors)

**Figure 2**

Embodied Carbon per m2, no removal of outliers (1007 buildings) [4]

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## What is Slattery doing and what does our benchmark look like?

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 the design, material selection, and procurement. In addition to upfront embodied carbon, other factors also need to be considered in 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 various sectors, including commercial, residential, health, tertiary, community, commercial office refurbishment, and tertiary fit out.

Slattery's Carbon Planning Service measures the total upfront embodied carbon for a project.

To standardise results to compare projects of different sizes, we divide the total upfront embodied carbon by the GFA (total area for landscaping projects), aligning with NPWC measurement guidelines. The benchmarking data below is GWP total (including sequestration) divided by squared metres of gross floor area (or kgCO2eq/m2 of GFA).

As shown in **Figure 3 below**, landscaping projects have the lowest upfront embodied carbon. This is because landscaping projects use fewer materials per square metre and subsequently have significantly less upfront embodied carbon. A typical new build project has large quantities of concrete, steel reinforcement, excavation, structural steel, façades, and other carbon-intensive materials. This explains why the tertiary, 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.

Commercial office refurbishments have relatively low upfront embodied carbon compared to new-build commercial office building benchmarks. This highlights the potential carbon savings that could be achieved by refurbishing an existing building when compared to demolishing and rebuilding a new commercial office building.

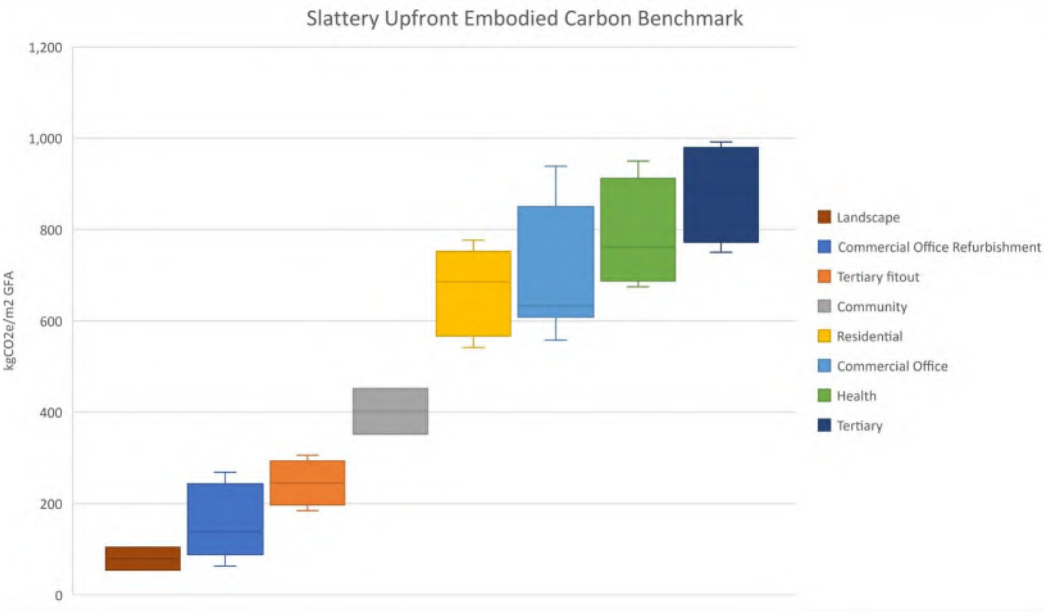


**Figure 3**

Slattery Upfront Embodied Carbon Benchmark

"We believe that hybrid buildings are the future of our built environment in a way that enhances quality of living whilst caring for the planet. Those ambitions must also be balanced with the reality of the cost implications. When designing a hybrid tower one can find themselves constantly balancing the impact of cost over a traditional build vs the social and environmental benefits of embedded carbon and reducing our industry's impact on the Planet.

We found Slattery instrumental in genuinely partnering with us through many many redesigns to make sure this mix was right, in that the project would be viable to build today AND be carbon negative through there QS & Carbon accounting integrated approach"

**James Dibble**
**Managing Director**
Grange Development
*C6, 6 Charles Street South Perth*

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## Embodied carbon benchmark of building elements and typologies

In addition to benchmarking whole projects in kgCO2eq/m2 of GFA, Slattery also collects benchmarking data on all the building elemental categories such as substructure, upper floors, columns, wall finishes, and mechanical services - just to name a few. This shows the client and design team what elements of the project are more or less carbon intensive relative to our benchmarking projects.

Based on Slattery's benchmarking data, the upfront embodied carbon from different building elements for a typical project is:

- Substructure: 10-30% (depending on the extent of basements)
- Superstructure: 40-70%
  - Upper floors and columns: 30-50%
  - External walls, windows, and external doors: 8-25%
- Finishes: 4-8%
- Building services: 5-8 %

Therefore, if we focus our attention on the substructure, upper floors, columns, external walls and windows, we are capturing approximately 70-80% of the project's upfront embodied carbon.

This is a powerful illustration of why identifying and focusing on the 'carbon-intensive hot spots' at an early stage can drive meaningful change to the design and therefore reduce the environmental footprint of the project.

## Scope of Slattery's embodied carbon measurement

Slattery's upfront embodied carbon assessments have been developed in reference to the following documents:

- The European standard EN 15978: 2011 System Boundary A1-A5 (product and construction stages) to ensure consistency of results
- Australian National Life Cycle Inventory Database (AusLCI)
- Whole building lifecycle assessment software, eToolLCD
- Environmental Product Declaration Australasia, as all EPDs registered with EPD Australasia are independently verified to ISO 14025: 2006

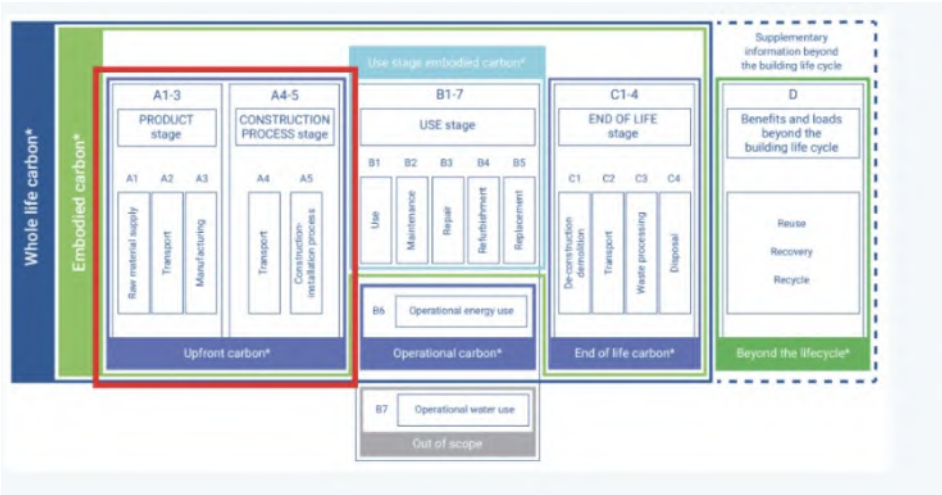


**Figure 4**

System Boundary: EN 15978
Display of modular information for the different stages of the building assessment [5]

## Conclusion

With the ongoing expansion of carbon planning services, Slattery continues to develop our upfront embodied carbon benchmark database using consistent measuring methodology and data sources to provide a meaningful comparison for various projects and building typologies.

## Slattery carbon contacts

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


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**Bibliography**


[1] J. Vickers, S. Warmerdam, S. Mitchell, N. Sullivan, J. Chapa and S. Qian, "Report on embodied carbon and embodied energy in Australia's buildings," 2021. [Online]. Available: https://www.thinkstep-anz.com/resrc/reports/embodied-carbon-and-embodied-energy-in-australias-buildings-gbca

[2] D. Murray, "Embodied carbon is coming to NABERS and planning in NSW," The Fifth Estate, 29 October 2021. [Online]. Available: https://thefifthestate.com.au/business/government/embodied-carbon-is-coming-into-nabers-and-planning-policies-in-nsw/

[3] London Energy Transformation Initiative, "Defining and Aligning: Whole Life Carbon & Embodied Carbon," [Online]. Available: https://www.leti.london/carbonalignment

[4] The Carbon Leadership Forum; Department of Architecture; University of Washington, "Embodied Carbon Benchmark Study: LCA for Low Carbon Construction Part One," Carbon Leadership Forum, 2017.

[5] GRESB "What you need to know about Embodied carbon" 9 March 2021 https://gresb.com/nl-en/faqs-about-embodied-carbon/

**Image Credit:**
Slattery 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. We understand the importance to drive innovation and productivity.

Slattery's Kaizen Papers focus on sharing 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.

We invite you to 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.

This new service is available in conjunction with Cost Planning to assist our clients in achieving their Net Zero and sustainability targets. The focus of the carbon plan will address and educate clients on the embodied carbon of their current and future developments.

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

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