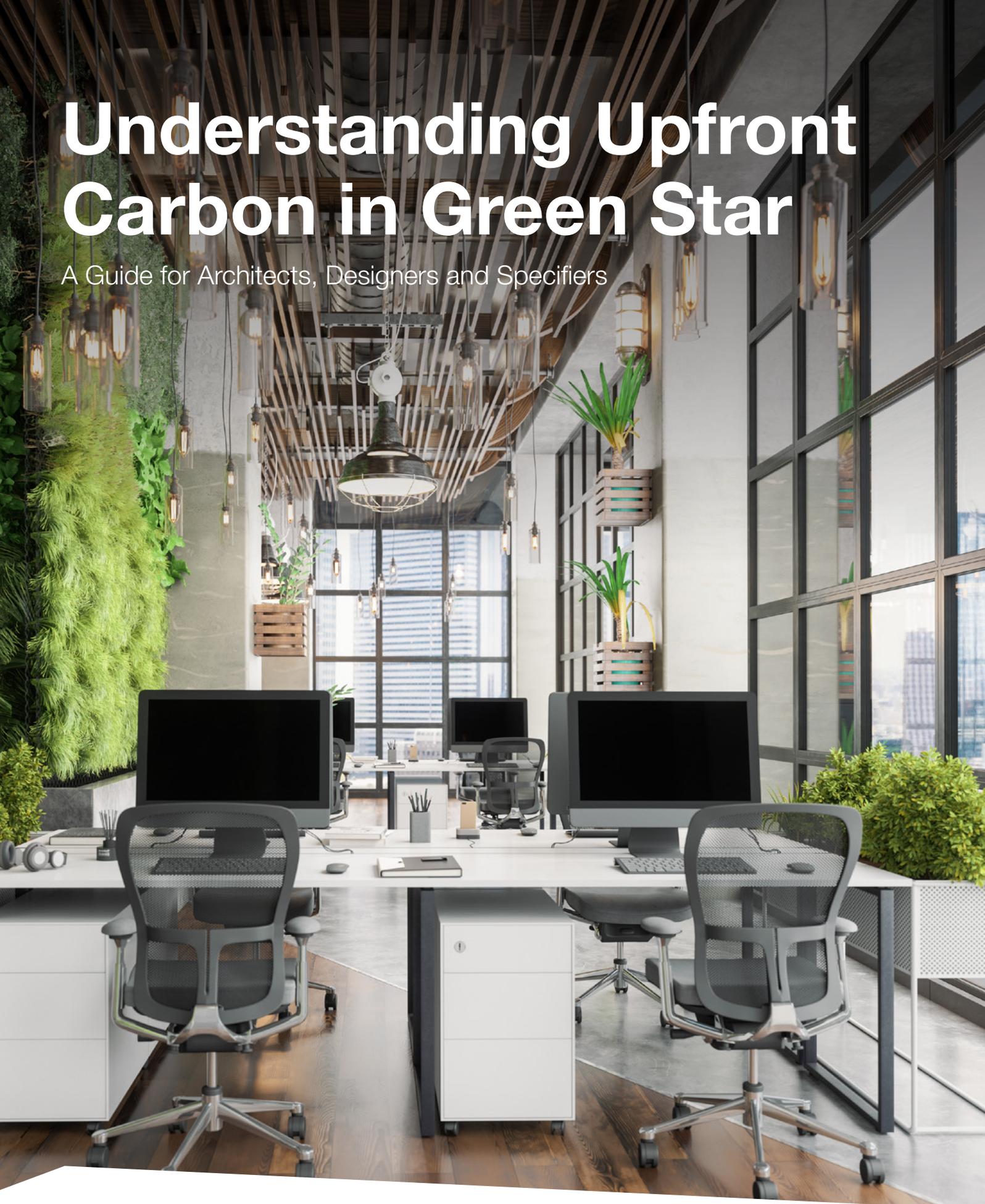


# Understanding Upfront Carbon in Green Star

A Guide for Architects, Designers and Specifiers



## INTRODUCTION

Previously a side topic in the conversation about net zero buildings, architects, designers and specifiers now need to be knowledgeable about upfront carbon—the carbon associated with the production of building materials and construction activities.

The reason for this is simple. Discussions about decarbonising the building sector have traditionally focused on operational efficiency through better-performing building envelopes, climate-sensitive design and switching to renewable energy sources. Soon, improvements in operational emissions will reach a point of diminishing returns and upfront carbon will take up a greater proportion of the building sector's total carbon footprint.

Accordingly, tackling upfront carbon is one of the design and construction industry's biggest challenges. Jorge Chapa, Chief Impact Officer at Green Building Council Australia (GBCA) explains: "A quarter of a building's emissions are locked in on the first day the occupants walk through the front doors. Every project team gets just one shot to reduce the upfront carbon of their next building."<sup>1</sup>

The GBCA notes that if we do not make better decisions about the materials we use and the way we construct buildings, Australia's upfront carbon emissions will soar from 16% to 85% of total building emissions by 2050.<sup>2</sup>

In this whitepaper, we help architects, designers and specifiers understand the distinction between embodied and upfront carbon, the GBCA's Climate Positive Roadmap, the importance of upfront carbon in Green Star, and what you can do to reduce the carbon impact of your projects.

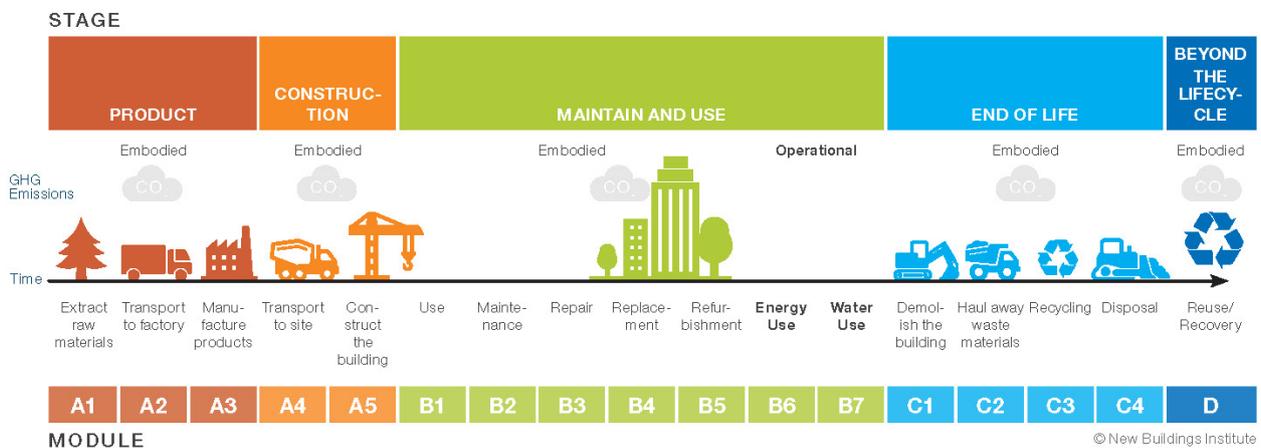




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**FIGURE 1: LIFECYCLE STAGES**

Data source: BS EN 15978:2011



Source: [https://newbuildings.org/code\\_policy/embodied-carbon/](https://newbuildings.org/code_policy/embodied-carbon/)

## WHAT IS UPFRONT CARBON?

The GBCA makes a distinction between “embodied carbon” and “upfront carbon”. Upfront carbon refers to the greenhouse gas emissions associated with the initial stages of a building's life cycle (from extraction of raw material to construction) while embodied carbon includes upfront carbon but also extends to the full life cycle of the building including end of life emissions (excluding operational energy).

Up to 80% of a building's embodied emissions are generated upfront<sup>3</sup> during the production of building materials and construction activities before its use.<sup>4</sup> This covers the emissions involved in the extracting, transporting, and manufacturing of building materials, transporting materials to site and constructing the building, and testing and optimising the building's systems.

Note that some definitions of embodied carbon include operational energy, however, traditionally, this is excluded.

EN 15978 specifies the calculation method, based on Life Cycle Assessment (LCA) and other quantified environmental information, to assess the environmental performance of a building. This European Standard provides that embodied carbon includes both upfront carbon (A1 to A5, the “Product” and “Construction Process” stages) and emissions during the use and end-of-life of a building (stages B1 to B5 and C1 to C4, respectively).<sup>5</sup>

In summary, upfront carbon represents ‘past actions’ rather than future potential reductions.<sup>6</sup> GBCA's Jorge Chapa suggests that at least 25% of a typical building's total carbon footprint over its lifetime (including operational emissions) are incurred during the upfront carbon stage.<sup>7</sup> This figure can vary depending on the types of materials used, the size of the project, location, environmental factors and so on.

## THE CLIMATE POSITIVE ROADMAP

Australia committed to keeping global warming below 1.5°C to 2°Cs as set out by the Paris Climate Agreement.<sup>8</sup> State and territorial governments have also committed to decarbonising their economies by 2050 or shortly thereafter.<sup>9</sup>

Published by the GBCA, 'A Climate Positive Roadmap for the Built Environment' establishes the steps required for new and existing buildings and fitouts to achieve decarbonisation of the building sector. This document establishes high-level outcomes, actions and targets, as well as changes to the GBCA's Green Star rating tool to help lead the industry through the next decade.

To meet the 1.5°C target, the roadmap outlines various actions and updates to Green Star to support new

buildings and fitouts in addressing emissions by 2030 and existing buildings and fitouts by 2050.<sup>10</sup> For example, since 2020, a 10% decrease in upfront carbon has been required of all new construction projects aiming for a Green Star rating. Currently a 20% reduction is required for buildings chasing 5 and 6 star accreditation and a 40% reduction in upfront carbon will be the standard by 2030.<sup>11</sup>

The Climate Positive Roadmap's objectives align with the goals stated in the World Green Building Council's seminal report, Bringing Embodied Carbon Upfront,<sup>12</sup> which demanded a 40% decrease in embodied carbon with significant upfront carbon reductions by 2030 and zero embodied and operational carbon by 2050.<sup>13</sup>

## UPFRONT CARBON IN GREEN STAR AND CLIMATE ACTIVE

To obtain a rating under the scheme, Green Star requires all projects to reduce their upfront carbon. The current general requirements are as follows:

- Any project seeking a rating under Green Star Buildings must reduce its upfront carbon by a minimum of 10% (Minimum Expectation).
- Any project seeking higher ratings will require a reduction of 30% (Credit Achievement worth 3 points).
- Over time, all future registered projects will be required to meet a 40% reduction (Exceptional Performance worth an additional 3 points).

In addition, the GBCA has collaborated with the Australian Government's Climate Active program to develop a way to recognise carbon neutrality in building operations, and carbon neutrality of the upfront carbon emissions for the design and construction of new buildings, fitouts and communities.

In accordance with this method, entities can seek Climate Active carbon neutral certification for the delivery phase of a building project and certification for the development phase either on building completion or prior to building completion.



The One Sydney Harbour is targeting 5 Star Green Star. Siniat is supplying Opt2Act carbon neutral plasterboard and metal products to help Lendlease reduce the embodied carbon of this development. Image supplied by Lendlease.

## HOW IS UPFRONT CARBON MEASURED?

According to the GBCA's "A practical guide to upfront carbon reductions", the upfront carbon for a building can be calculated by multiplying the quantity of a specific product and its specific product emissions, adding all product emissions together (modules A1 to A3), plus the associated construction emissions (modules A4 to A5).<sup>14</sup>

The GBCA notes that an LCA will help provide a more thorough calculation. LCAs typically cover more information than just upfront carbon, including opportunities for not only upfront carbon reductions but also carbon reductions across the entire building life cycle. There are a range of data sources available when doing calculations, including:

- product-specific Environmental Product Declarations (EPDs);

- industry-specific EPDs;
- generic material data delivered from process-based or hybrid LCA studies; and
- literature data from top-down LCA studies.

It is important to be aware of data limitations. For example, top-down LCA studies estimate impact by allocating the total environmental burden of a product class, so they are comprehensive but can be too conservative and broad. Process-based LCA studies can be more specific and targeted but are subject to other constraints.

Building information modelling (BIM) tools now offer plugins that enable the live assessment of design changes on upfront carbon results.<sup>15</sup>

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## CALCULATING UPFRONT CARBON REDUCTIONS

The GBCA sets out two accepted methods for calculating upfront carbon reductions:<sup>16</sup>

- **Comparison against a Fixed Benchmark.** This approach directly compares the Proposed Project's upfront carbon rate to a benchmark that is relevant to the building's scale and function.
- **Comparison against a Reference Project.** This approach compares the upfront calculations of the Proposed Project (the current building design) against the Reference Project (a hypothetical building of the same size, shape and function).

GBCA and NABERS (the National Australian Built Environment Rating System, an initiative by the Australian government) are working on a consistent method for calculating upfront carbon emissions reductions. While an industry-agreed fixed benchmark is not yet available in Australia, this project is anticipated to provide one.



## WAYS TO REDUCE UPFRONT CARBON

### Before construction

Adaptive reuse is a logical place to start when attempting to lower upfront carbon. Repurpose an existing structure, or make the most of the repurposing of existing building elements, keeping the envelope and structure intact.

### Sustainable design

One of the main factors influencing the upfront carbon of a building is its structure. Optimise the shape and design of the building, focusing on reducing the quantity of materials, increasing durability and maximising future adaptability.

### Material selection

Low carbon materials can reduce upfront carbon in material specifications. Case study analysis revealed that replacing materials with alternatives with lower embodied carbon saves 19–46% of embodied carbon (which includes upfront carbon) at a less than 1% cost premium.<sup>17</sup> Look for carbon neutral certified products and collaborate with suppliers to identify opportunities to reduce the project's carbon footprint throughout the entire supply chain.

### Efficient construction practices

The implementation of efficient construction practices, such as just-in-time delivery, modular building methods and the use of low-carbon construction equipment, helps reduce the project's carbon footprint during the construction phase.

## AMPLIFY YOUR CLIMATE AMBITION WITH SINIAT'S OPT2ACT®

Siniat is a flagstone brand of the global manufacturer Etex and is renowned for providing locally made plasterboard and metal framing products to the Australian market. Siniat has become a trusted partner in developing sustainable answers to the demand for more and better living spaces.

By opting in for carbon neutral Siniat products under Siniat's Opt2Act® program, Australian specifiers and contractors can reduce their building's upfront carbon emissions by up to 7%. The Opt2Act® program is available on a wide range of plasterboard and metal products and opted-in products are certified carbon neutral by Climate Active.

As a sustainable supplier, Etex already reduce the emissions of their Siniat plasterboard and metal framing products across their entire life cycle. To compensate for what's left, opted in materials are supplied carbon neutral using high quality offsets.

Etex Australia has invested in many different strategies to decarbonize the production process of their plasterboard and metal framing products, including the installation of solar plants at their Altona and Matraville factories.

It has set an ambitious target to reduce their greenhouse gas emissions intensity (CO<sub>2</sub>e emissions of Scopes 1 and 2) by 35% by 2030, compared to their 2018 baseline.

Systems to recycle onsite plasterboard scrap have also been installed at the Altona and Matraville factories, and all onsite steel waste is recycled at the rollforming plant in Beenleigh, Queensland.

A wide range of locally made Siniat plasterboard is also GreenTag GreenRate Level A certified. The GreenRate program is a product rating system designed to meet the requirements of the GBCA's Green Star 'Sustainable Products' credits. Furthermore Siniat has EPDs available for both its plasterboard and metal products.

For more information on Siniat's Opt2Act® program, visit [siniat.com.au/en-au/about-us/sustainability/opt2act](https://siniat.com.au/en-au/about-us/sustainability/opt2act).



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- <sup>9</sup> Ibid.
- <sup>10</sup> Ibid.
- <sup>11</sup> Above n 1.
- <sup>12</sup> World Green Building Council. "Bringing Embodied Carbon Upfront." WorldGBC. <https://worldgbc.org/article/bringing-embodied-carbon-upfront> (accessed 13 May 2024).
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