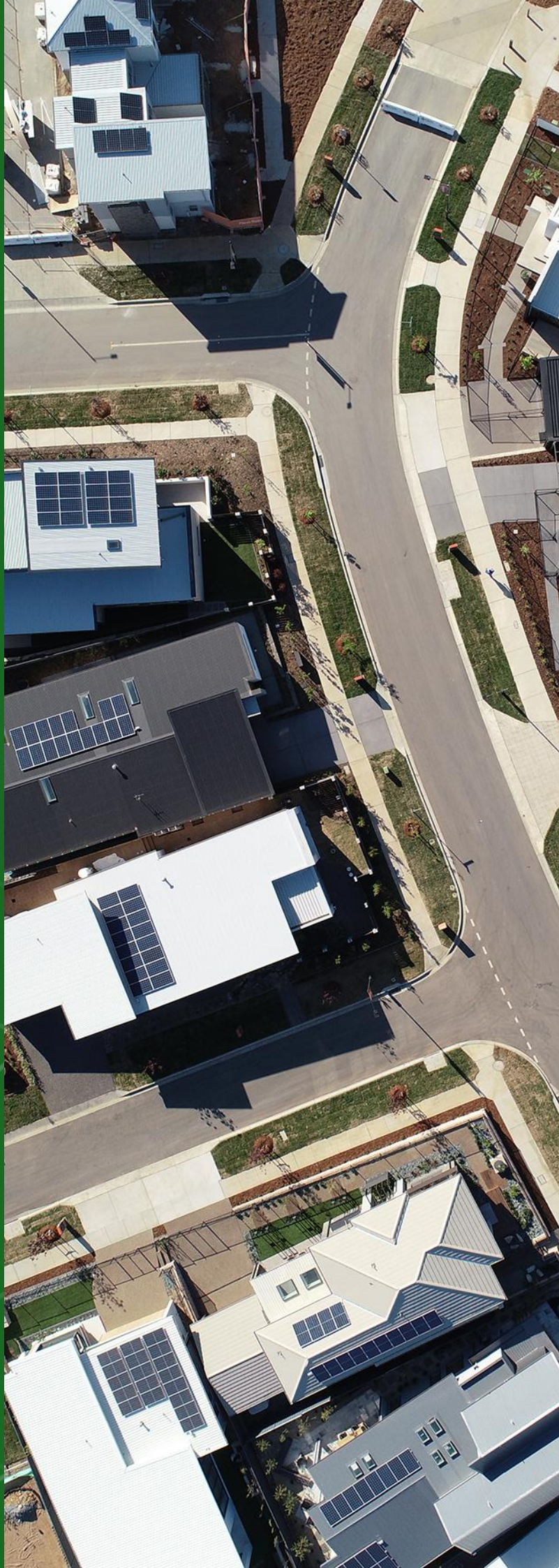
Green Building Council Australia

# Our homes weigh a tonne*

***(of carbon per square metre)**

## A report quantifying the upfront carbon in Australian houses

May 2025



Green Building Council Australia

Established in 2002, Green Building Council of Australia (GBCA) is the nation's authority on sustainable buildings, communities and cities. Our vision is for healthy, resilient and positive places for people. Our purpose is to lead the sustainable transformation of the built environment. GBCA represents more than 550 individual companies with a combined annual turnover of more than $46 billion.

## TECHNICAL PARTNER

TSA Riley

TSA Riley is an independent global advisor on built assets and projects. We help clients plan, procure, deliver, optimise and decarbonise their assets and operations. Our services include strategic, commercial and operations advice; project and cost management; carbon advice; and dispute resolution. This broad capability – across the project lifecycle – means we understand interdependencies at every stage. With recognised expertise in low-carbon solutions and over 9,500 global data points benchmarking all asset classes, we combine data-driven insights, and hands-on experience to drive greater value, impact and certainty for our clients' projects.

## FUNDING PARTNERS

cefc

The CEFC is Australia's specialist climate investor, helping cut emissions in the race towards net zero by 2050. We invest in the latest technologies to generate, store, manage and transmit clean energy. Our discounted asset finance programs help put more Australians on the path to sustainability, in their homes and on the road. CEFC capital is also backing the net zero transformation of our natural capital, infrastructure, property and resources sectors, while providing critical capital for the emerging climate tech businesses of tomorrow. With access to more than $32 billion from the Australian Government, we invest to deliver a positive return for taxpayers.

*The modelling contained in this report was co-funded but not prepared by the CEFC. The recommendations & conclusions derived from the modelling do not necessarily represent the views of the CEFC.*

DevelopmentWA

DevelopmentWA is the WA Government's land and property development agency, leading the creation of exceptional places for Western Australia. Operating state-wide, we are responsible for delivering major residential, commercial and industrial developments and revitalisation projects. Our expertise enables us to undertake long-term, complex and transformative projects which include the creation of new cities, diverse communities, precinct-scale urban renewal and the revitalisation of shared community destinations. Using innovative solutions, we place environmental and community wellbeing at the forefront of our developments, to positively shape the future of WA.

LANDCOM

Landcom is a proud partner of the GBCA's Upfront Carbon research and has been a leader in creating sustainable communities for over 20 years. Through our Sustainable Places Strategy, we are committed to achieving carbon neutral, zero waste, water positive, and net positive ecological outcomes by 2028, while planning for our journey to Net Zero. Our dedication to sustainability is reflected in our numerous achievements, including receiving an overall score of 95/100 in the GRESB Real Estate Assessment in FY24 and ranking in the top 6 most sustainable residential development organisations in Oceania, while remaining committed to our target for all new projects to achieve a certified Green Star rating.

# Acknowledgements


Henley

We would like to thank Henley for sharing the details of their home design which forms the basis of this research.

Henley Properties Group was founded in 1989 with a vision to make home ownership more affordable for Australian families. That vision has seen us build over 60,000 homes across Victoria, Queensland, New South Wales and South Australia under the brands Henley, Plantation Homes, and Edgewater Homes. Our vision has never been to be the biggest, but to deliver homes with a sustainable business model to a consistently high standard. Since 2009, we have continued to operate as a local builder with the security and financial backing of our parent company, the Sumitomo Forestry Group. Being backed by a $7 billion parent company provides us with the resources to confidently and continually invest in innovation, well ahead of the market.

## CONSULTATION PARTICIPANTS

We would like to thank all our stakeholders that have provided feedback in the development of this report. This includes the members of the stakeholder consultation workshops, the reference panel and our funding partners.

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- MECLA
- NABERS
- NSW Department of Planning, Housing and Infrastructure
- NSW Government Architect Office
- SA Department for Housing and Urban Development
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# Executive summary

Our homes weigh a tonne — of carbon per square metre.

Before a single appliance is switched on, the materials and construction of a typical Australian single-family home (Class 1a under the National Construction Code) already lock in more carbon than the home will ever emit through daily operation.

The **upfront carbon emissions** from construction materials and activities range from **1.00 – 1.29 tonnes of $CO_2$ equivalent per $m^2$** of conditioned floor area ($tCO_2$-e/$m^2$ CFA). This is equivalent to an average total upfront carbon of **185 tonnes of $CO_2$ equivalent** ($tCO_2$-e). Meanwhile, as the grid decarbonises, the **operational emissions** of a house built today will be approximately **24 tCO2-e** over its lifetime (with a typical lifetime of approximately 60 year). Therefore the total operational emissions of new homes will now account for only **12%** of the home's total lifecycle carbon. Upfront carbon is **over seven times** more significant—and it's locked in at construction.

Yet, while operational carbon has been the focus of policy and industry action for years, upfront carbon remains largely overlooked. Unlike operational emissions, which can be reduced over time, upfront carbon is irreversible once materials are manufactured, and construction is complete.

**What does this report do?**

This report bridges the knowledge gap by quantifying the upfront carbon intensity of single-family dwellings (Class 1a buildings in National Construction Code parlance), identifying key sources of emissions, and outlining practical pathways for reductions. It also informs the policy recommendations outlined in the accompanying "Call to action" paper to integrate upfront carbon considerations into Australia's construction sector, ensuring that the homes we build today don't lock in emissions that undermine our climate goals.

Upfront emissions from Class 1a buildings remain largely unaddressed in current policy and industry practices. With national construction forecasts expecting an average of 119,000 new detached homes to be built annually in the next 5 years and detached housing accounting for 45% of all building construction activity, upfront carbon reductions must be addressed in this sector to enable Australia to achieve its net zero carbon emissions by 2050 target.

**Upfront carbon in Australian single dwellings**

A reference home was selected to represent average construction practices, and a life cycle assessment (LCA) was conducted to measure upfront carbon emissions (modules A1 to A5). The analysis, covering 95% of building materials and costs, identified an average upfront carbon intensity of 1.16 $tCO_2$-e/$m^2$ CFA and 0.79 $tCO_2$-e/$m^2$ GFA. Regional variations of approximately ±10% were observed, driven by differences in material use, supply chains, and design practices. These results align with findings from previous studies that used smaller boundaries.

The substructure, external walls, and external works were identified as the top three contributors to upfront carbon emissions, collectively accounting for 51% of the total emissions on average. The key materials contributing to these emissions include concrete, brick and steel reinforcement.

An average of 119,000 new detached homes are expected to be built over the next five years which is equivalent to 22 $MtCO_2$-e per year and a total of total of approximately 113 $MtCO_2$-e upfront carbon between 2024 and 2029.

**Opportunities for reductions**

Achieving significant reductions will require both low-carbon supply chains and optimised design strategies, as reliance on low-carbon materials alone is insufficient to meet Australia's 2030 climate targets. A combined approach has the potential to achieve a 25% reduction in upfront emissions across states in the short to medium term.

# Contents

# 1. Introduction

Decarbonising the built environment has become a critical goal, as outlined in the IPCC's Global Warming of 1.5°C report. In Australia, embodied carbon currently accounts for 16 per cent of building emissions, but as the grid decarbonises, this is expected to rise to 85 per cent by 2050 (GBCA, 2022)[1]. While the commercial property sector has made strides in quantifying and reducing upfront carbon, the residential sector, particularly single-family dwellings, remains less engaged. This gap is compounded by fragmented knowledge and limited financial incentive for homeowners to reduce upfront carbon in their homes, unlike in energy efficiency for example.

As the National Construction Code (NCC) enhances energy efficiency and renewable energy requirements, focus should expand to include reducing carbon in materials and construction methods in homes to ensure the sector meets the Paris targets. However, to date, inconsistent measurement methods and a lack of robust policy development have hindered progress in the residential sector.

Residential construction sector plays a significant role in the Australian economy making up 32% of all construction in the September quarter 2024 (by cost) nationally. Detached housing, which accounts for approximately 60% of new residential construction (Master Builder Australia, 2024)[2], is characterised by large homes—Australia's average size is around 235 $m^2$ GFA, the largest globally (ABS, 2023)[3]. This, combined with material choices, drives high upfront carbon intensity. Understanding this profile is essential to developing effective mitigation strategies that do not impact affordability.

Commissioned by the Green Building Council of Australia (GBCA), and in consultation with key stakeholders, this research seeks to address critical gaps in knowledge surrounding the upfront carbon intensity of typical Australian single dwelling (Class 1a) construction. Specifically, it aims to:

1. **Quantify upfront carbon intensity:** Provide a detailed assessment of the upfront carbon associated with common single dwelling (Class 1a) construction practices, using a range of typical building materials from each Australian state and territories.
2. **Understand regional variability:** Examine how regional material preferences, construction methods, supply chain constraints, and climate conditions influence the carbon footprint of residential construction and identify the most effective approaches for localised carbon reduction.
3. **National level overview:** Forecast the results at the national level over the next few years and express the potential outcomes both in terms of the construction sector alone and in the context of the National greenhouse reduction goals.
4. **Identify mitigation potential:** Investigate alternative low-carbon materials and construction methods, analysing their potential to reduce upfront carbon emissions without compromising on performance, affordability, or regulatory compliance.
5. **Inform policy strategy:** Develop insights that can help shape policy measures and industry strategies to reduce upfront carbon in single dwellings, supporting efforts such as the Green Star Homes standard and the work of the MECLA Homes working group.
6. **Support supply chain improvements:** Identify key areas for improvement across the residential building supply chain, providing actionable recommendations that can drive carbon reductions and support sustainable building practices across the sector.

By addressing these objectives, this research will contribute to a deeper understanding of the carbon implications of residential construction in Australia and provide the data needed to guide meaningful, scalable solutions for carbon mitigation in the sector.

[1] Green Building Council Australia (GBCA) (2022) Upfront Carbon Emissions calculation guide – interim, version 1.

[2] Master Builders Australia (MBA) (2024) Building and construction industry forecast, September 2024, Australia. The percentage is calculated based on the number of new units delivered in 2023-2024.

[3] Australian Bureau of Statistic (ABS) (2023) Average Floor Area of New Residential Dwellings.

# 2. Assessment methodology

The methodology is informed by a review of previous Life Cycle Assessment (LCA) studies for Class 1a buildings, industry-recognised standards including Royal Institution of Chartered Surveyors (RICS), National Australian Built Environment Rating System (NABERS), and Green Building Council of Australia (GBCA), and consultations with a wide range of industry experts. The detailed methodology is described in Appendix C, while this section provides a summary of the key elements.

The assessment covers the upfront carbon emissions (modules A1 to A5) of a Class 1a single residential dwelling. The building elements included align with International Cost Management, Third edition (ICMS-3) (2023) [4] and RICS WLCA v2 (2024)[5], covering 95% of the reference home by quantities and cost, including internal components and external works.

The assessment is based on the reference home's bill of quantities, cost information and drawings. We followed the data hierarchy outlined in the Upfront Carbon Emissions calculation guide – interim, version 1 from GBCA to the best extent as stated below:

- The use of NABERS' National Emission Factors Database that covers an extensive list of Environmental Product Declarations (EPDs) released by NABERS and other EPDs; subject to EPDs being suitable & valid for specified products.
- Industry generic values for other materials are drawn from a range of sources, including, but not limited to, NABERS' National Emission Factors Database default values / AusLCI / EPiC / ICE 3.0 / IELab or ABS EEIO rates / industry generic information. All industry generic data will be assessed and utilised based on: country / location of manufacture relevance / product relevance / data quality.
- Input-Output (IO) data has been used to fill the gaps when quantities are not available.

Preference has been given to NABERS rates and process data sources when available due to the alignment with Green Star tools and NABERS data. Refer to Section 3.5 that covers a critical review on the utilisation of the NABERS rates and IO data for the study.

## 2.1 Functional Area

The functional area for the Class 1a residential home has been finalised based on the discussions and feedback during the stakeholder consultations. Table 1 and section 2.2 below highlight the functional area units utilised for this study:

*Table 1: Area of definition of the Class 1a home*

| Area | Definition of area |
|---|---|
| Gross floor area (GFA) | The total enclosed and unenclosed covered area of the building is measured between the normal outside face of any enclosing walls, balustrades and supports as defined by the Australian Institute of Quantity Surveyors (AIQS) in the Australian Cost Management Manual, Volume One, 2022. It excludes the external area outside the enclosing walls of the building but a part of the site boundary. |
| Conditioned floor area (CFA) | The conditioned floor area in relation to a dwelling as defined by Building Sustainability Index (BASIX) and NatHERS, is the measure of the total floor area of the dwelling, excluding:<br>a) floor area that is not fully enclosed;<br>b) bathrooms (but not ensuites) and laundries, with a ventilation opening; and voids, storerooms, garages and carparks. |
| Net floor area (NFA) | The net floor area of a building is a measure of the amount of useable space in a building as defined by the International Property Measurement Standards (IPMS). |

[4] International Cost Management Coalition (2023) ICMS: Global Consistency in Presenting Construction Life Cycle Costs and Carbon Emissions, 3rd edition.

[5] Royal Institution of Chartered Surveyors (RICS) (2023) Whole life carbon assessment (WLCA) standard, version 2.

The functional areas covered in Table 1 above are used to calculate the total upfront embodied carbon intensities of the Class 1a home and its variants.

The conditioned floor area has been selected as the preferred functional unit in this study, based on stakeholder consultation feedback. This metric helps avoid the potential distortion caused by larger, unoccupied areas (such as garages and bathrooms), focusing instead on the efficiency of functional living spaces.

A detailed summary of the acronyms used in this report is provided in section 8.2.

*Figure 1: Floorplan of the Class 1a home*


## 2.2 The reference home

According to the Australian Bureau of Statistics (ABS), new detached homes account for approximately 60% of all residential building activity in Australia during 2024–25 (Master Builders Australia, 2024). Additionally, the ABS report on the average floor areas new Class 1a homes over 15 years (2008–09 to 2022–23), revealing that the average gross floor area of these homes is typically around 235m² across Australia.

The reference home for this study has been chosen to reflect the characteristics of an average home as described by the ABS. It is a single storey detached home based on a Henley homes design and has been selected by GBCA. The floorplan is provided in Figure 1. The reference home consists of 4-bedrooms, 2 bathrooms with a laundry area, living

area, kitchen, porch, alfresco area and a 2-car park garage. The area breakdown of the selected Class 1a home is highlighted in Figure 1 and is as follows:

- Gross floor area ($m^2$) – 234 $m^2$ (area within orange boundary)
- Conditioned floor area ($m^2$) – 160 $m^2$ (highlighted in dark green)
- Net floor area ($m^2$) – 181 $m^2$ (highlighted in dark and light green)

The reference home also features external area including landscaped areas at the front and rear, soft scaping, a driveway, and timber fencing around three sides of the property. The external area is not included in the gross floor area provided above but is included as a part of the upfront carbon calculation for the Class 1a home.

*Figure 2: Front elevation of the reference home (rendered)*

## 2.3 Variations in construction materials across states

This study examines how regional material preferences, supply chain constraints, and climate conditions influence the carbon footprint of residential construction. The methodology used to define regional variations is summarised in this section, with further details provided in Appendix C.

The reference home floor plan has been utilised for the analysis and modified to align with regional construction methods, construction assemblies and materials while maintaining consistent wall, floor, window ratios and overall design as per the reference design. The analysis accounts for variations in building practices across states and territories, targeting the most populated areas within each region to ensure representative results. Additionally, the adjustments align with different climate zones and comply with the National Construction Code (NCC) 2022, aiming for the equivalent of a 7-star NatHERS energy efficiency rating.

The study identifies seven regional variations across Australia which are as follows:

- Victoria (VIC),
- Australian Capital Territory (ACT) and Tasmania (TAS),
- New South Wales (NSW),
- Northern Territory (NT) and Far North Queensland (FNQ),
- Queensland (QLD),
- South Australia (SA), and
- Western Australia (WA).

Regions with similar construction methods and material use, such as the ACT and TAS or the NT and FNQ, have been combined for the analysis.

The key differences across the different states and territories are highlighted in Table 2 and a comprehensive summary of the same is presented in Appendix B. These insights draw on data from the CSIRO Australian Housing Data Dashboard, public literature, and extensive consultation with industry experts. Stakeholder engagement was integral to this analysis, ensuring the findings are relevant, accurate, and aligned with current industry practices.

*Table 2: State variants for Class 1a buildings*

| States / regions | Building elements | | | | | |
|---|---|---|---|---|---|---|
| | **Substructure** | **Roof** | **External walls** | **Windows** | **Internal walls** | **Internal finishes** |
| VIC | Waffle pod slab | Timber truss with roof tiles | Brick veneer | Double glazed | Plasterboard walls | Engineered timber carpet and ceramic tiling |
| ACT & TAS | Waffle pod slab | Timber truss with corrugated steel roof sheeting | Brick veneer | Double glazed | Plasterboard walls | Engineered timber, carpet, and ceramic tiling |
| NSW | Waffle pod slab | Timber truss with corrugated steel roof sheeting | Brick veneer | Double glazed | Plasterboard walls | Engineered timber, carpet, and ceramic tiling |
| NT & FNQ | Slab on ground | Timber truss with corrugated steel roof sheeting | Concrete blockwork | Single glazed low-e | Plasterboard walls | Ceramic tiling and carpet |
| QLD | Slab on ground | Timber truss with corrugated steel roof sheeting | Brick veneer | Single glazed low-e | Plasterboard walls | Engineered timber, carpet, and ceramic tiling |
| SA | Slab on ground | Timber truss with corrugated steel roof sheeting | Brick veneer | Double glazed | Plasterboard walls | Engineered timber, carpet, and ceramic tiling |
| WA | Slab on ground | Timber truss with corrugated steel roof sheeting | Double brick wall | Double glazed | Brick walls | Engineered timber, carpet, and ceramic tiling |

Please note:

- 110mm thick brick veneer is used for the analysis and it includes the timber stud framing, waterproofing, insulation and internal plasterboard lining with paint finish.
- Building elements that do not vary across state variants are excluded from Table 2. These include structural walls, doors, services, external works and joinery; they are based on the reference home design.
- The following building elements which are typically included in the Standard Method of Measurement as outlined by ICMS-3 / RiCS have been excluded from the scope of the life cycle assessment: demolition, fire services and preliminaries as no data is available.

# 3. Upfront carbon results

This section presents the upfront carbon results for the Class 1a home across Australian states and territories. It covers the key differences in the construction methodologies, building elements, materials and finishes across all the models.

This analysis also provides an insight about the upfront carbon impacts of different construction methodologies. It also serves as a basis for developing strategies and policies for reducing upfront carbon emissions in residential construction.

The reference home design as discussed in section 2.2 is utilised to calculate the total upfront carbon for the Class 1a home and the results of the same are presented in Appendix A.

The national average represents the total average of the upfront carbon results of all the state and territories variants. A national average is beneficial because it provides a unified benchmark to compare regional performance, guides policymaking and helps identify trends at a national level.

The reference home has been utilised to develop the nominated variants for each state/ territory across Australia. There are seven nominated variants for each state / territory across Australia as discussed in section 2.3 above.

## 3.1 Summary of upfront carbon results of all states and national average

The total upfront carbon in the nominated variants is in the range of about ~160 to ~206 $tCO_2$-e absolute (A1-A5) with a national average of ~185 $tCO_2$-e absolute (A1-A5).

The total carbon intensity in all the states and territories variants in terms of the conditioned floor area is in the range of 1.00 to 1.29 $tCO_2$-e/$m^2$ CFA with a national average of 1.16 $tCO_2$-e/$m^2$ CFA.

The WA variant has a significantly different construction methodology as compared to the rest of the states and territories. If it was not considered as a part of the national average, the total upfront carbon across all states and territories would be only about 2% lesser and about ~182 $tCO_2$-e absolute (A1-A5) or 1.14 $tCO_2$-e/$m^2$ CFA.

The building element breakdown of the total upfront carbon across the various states and territories variants are presented in Table 3 below.

The scope coverage and definition for each building element is provided in section 8.4.

*Table 3: Total upfront carbon in $tCO_2$-e CFA by state*

| Element | Inclusion | VIC | ACT & TAS | NSW | NT & FNQ | QLD | WA | SA | National average |
|---|---|---|---|---|---|---|---|---|---|
| Site preparation | ✓ | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| Substructure | ✓ | 43.3 | 43.3 | 43.3 | 25.6 | 25.6 | 25.6 | 25.6 | 33.2 |
| Superstructure | ✓ | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 | 3.8 |
| Roof | ✓ | 13.0 | 10.3 | 10.3 | 8.4 | 10.3 | 8.1 | 10.3 | 10.1 |
| PV System | ✓ | 9.0 | 9.0 | 9.0 | 9.0 | 9.0 | 9.0 | 9.0 | 9.0 |
| Windows | ✓ | 7.3 | 7.3 | 7.3 | 6.0 | 6.0 | 7.3 | 7.3 | 6.9 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| External walls | ✓ | 37.0 | 37.4 | 37.0 | 25.9 | 37.0 | 55.1 | 37.0 | 38.1 |
| Internal walls | ✓ | 8.8 | 8.8 | 8.8 | 8.8 | 8.8 | 25.3 | 8.8 | 11.2 |
| Wall finishes | ✓ | 4.1 | 4.1 | 4.1 | 4.1 | 4.1 | 4.1 | 4.1 | 4.1 |
| Ceiling finishes | ✓ | 12.6 | 12.6 | 12.6 | 8.0 | 8.0 | 8.0 | 12.6 | 10.6 |
| Floor finishes | ✓ | 11.6 | 11.6 | 11.6 | 15.1 | 11.6 | 14.4 | 11.6 | 12.5 |
| Doors | ✓ | 3.6 | 3.6 | 3.6 | 3.6 | 3.6 | 3.6 | 3.6 | 3.6 |
| Fittings & sundries | ✓ | 7.3 | 7.3 | 7.3 | 7.3 | 7.3 | 7.3 | 7.3 | 7.3 |
| Mechanical | ✓ | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 | 2.5 |
| Electrical | ✓ | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 | 3.3 |
| Hydraulics | ✓ | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 | 6.0 |
| External Works | Partial | 21.8 | 21.8 | 21.8 | 21.8 | 21.8 | 21.8 | 21.8 | 21.8 |
| Furniture (Appliances) | Partial | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 |
| Absolute Total | | **196** | **194** | **194** | **160** | **170** | **206** | **176** | **185** |
| Intensity - $tCO_2$-e/$m^2$ GFA | | 0.84 | 0.83 | 0.83 | 0.69 | 0.73 | 0.88 | 0.75 | **0.79** |
| Intensity - $tCO_2$-e/$m^2$ CFA | | 1.23 | 1.21 | 1.21 | 1.00 | 1.06 | 1.29 | 1.10 | **1.16** |
| Intensity - $tCO_2$-e/$m^2$ NFA | | 1.08 | 1.07 | 1.07 | 0.89 | 0.94 | 1.14 | 0.97 | **1.02** |
| % Variance from national average | | 106% | 105% | 105% | 87% | 92% | 111% | 95% | - |
| % Variance from national average excl. WA | | **108%** | **107%** | **107%** | **88%** | **94%** | **0%** | **97%** | - |

**Please note:** All the building elements covered in Table 3 above are utilised to calculate the total absolute upfront embodied carbon following the ICMS-3 and RICS building elements scope and the total intensity is calculated in $tCO_2$-e per GFA, CFA and NFA.

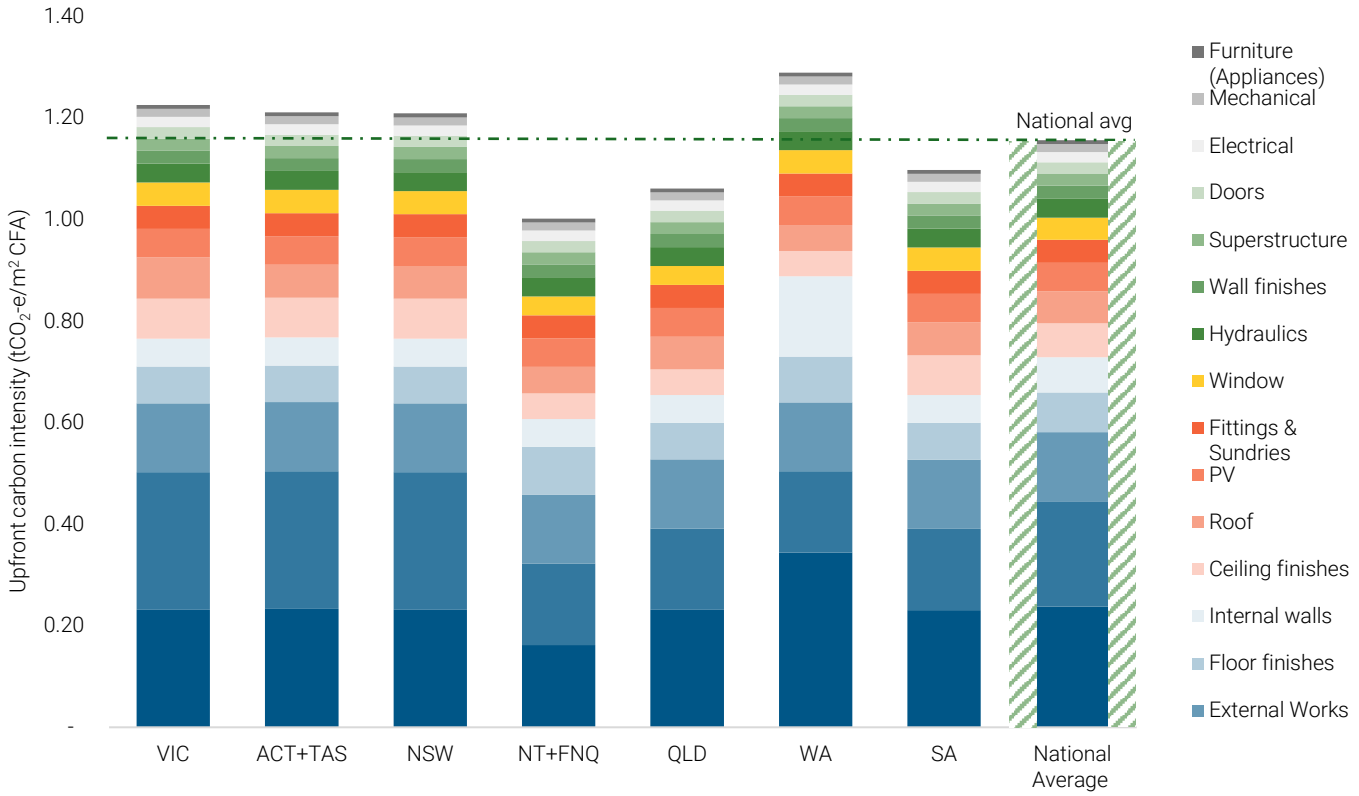
The key observations the Class 1a associated states and territories are as follows:

- There is a +/- 10% variation in the total upfront carbon contribution across all states and territories, excluding WA. Including WA, this variation increases to +/- 15%.
- The percentage difference between the state with the highest upfront carbon contribution (WA) & the lowest upfront carbon contribution (NT & FNQ) is 22%.

- There are key differences in the construction methodology, material and finishes use of the following building elements across the states and territories: substructure, roof, external walls, windows, internal walls and internal finishes.
- Building elements such as structural walls, doors, services, external works and joinery as they are based on the reference home design and do not vary across the different variants.
- The concrete path and driveway, the boundary fencing, and the external works costs have been included for the external works building element.
- The variation in upfront carbon intensity across Australia is primarily driven by local material and design practices, rather than differences in NatHERS or NCC thermal performance requirements. Analysis indicates that the percentage variation associated with NatHERS compliance nationwide falls within the overall margin of error.

The building element breakdown of the total upfront carbon on an intensity basis across all the states and territories are presented in Figure 3.

*Figure 3: Total upfront carbon intensity per element in tCO2-e/m2 CFA by state*




The following key observations are made for the Class 1a associated states and territories variants:

- The WA variant has the highest upfront carbon among the reference variants with a contribution of ~206 $tCO_2$-e absolute (A1-A5) or 1.29 $tCO_2$-e/$m^2$ CFA. This is primarily attributed to the double brick external walls and internal brick walls, which differ from the wall assemblies used in the other variants.
- The NT & FNQ variant has the lowest upfront carbon among the reference variants with a contribution of ~160 $tCO_2$-e absolute (A1-A5) or 1.00 $tCO_2$-e/$m^2$ CFA. This is primarily attributed to the concrete blockwork external walls, and single low-e glazed windows which differ from the wall assemblies used in the other variants.
- The ACT&TAS and NSW variants have the same total contribution of ~194 $tCO_2$-e absolute (A1-A5) or 1.21 $tCO_2$-e/$m^2$ CFA.
- The VIC variant is similar to the ACT & TAS and NSW variants, but it has a slightly higher upfront carbon contribution due to the use of concrete roof tiles. The total carbon emissions for this variant are about ~196 $tCO_2$-e absolute (A1-A5) or 1.23 $tCO_2$-e/$m^2$ CFA.
- The QLD and SA variants have a similar total upfront carbon contribution however the external wall and ceiling insulation vary for both the variants. So, the total upfront carbon contribution for the QLD variant is ~170 $tCO_2$-e

absolute (A1-A5) or 1.06 $tCO_2$-e/m² CFA and the total upfront carbon for the SA variant is ~175 $tCO_2$-e absolute (A1-A5) or 1.10 $tCO_2$-e/m² CFA.

- Some of the building elements such as doors, fittings and sundries, services (electrical, mechanical and hydraulic services), external works and appliances have the same carbon contribution across all the state / territory models as they are subjective to provided reference design details provided.

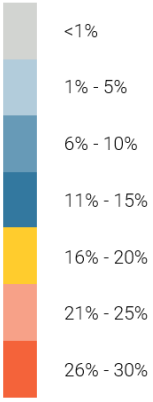
## 3.2 Major contributing building elements

Effectively reducing the total upfront carbon of project homes requires focussing on the major contributing building elements. Targeting these key elements will allow to plan and implement effective upfront carbon reduction strategies that helps in achieving a lower total upfront carbon footprint.

The percentage contributions of the major building elements are presented for all states and territories in addition to the national average in Table 4 below.

*Table 4: Comparative analysis for major building elements by state*

| Element | VIC | ACT & TAS | NSW | NT & FNQ | QLD | WA | SA | National average |
|---|---|---|---|---|---|---|---|---|
| Site preparation | <1% | <1% | <1% | <1% | <1% | <1% | <1% | <1% |
| Substructure | 22% | 22% | 22% | 16% | 15% | 12% | 15% | 18% |
| Superstructure | 2% | 2% | 2% | 2% | 2% | 2% | 2% | 2% |
| Roof | 7% | 5% | 5% | 5% | 6% | 4% | 6% | 5% |
| PV | 5% | 5% | 5% | 6% | 5% | 4% | 5% | 5% |
| Window | 4% | 4% | 4% | 4% | 4% | 4% | 4% | 4% |
| External wall | 19% | 19% | 19% | 16% | 22% | 27% | 21% | 20% |
| Internal walls | 4% | 5% | 5% | 5% | 5% | 12% | 5% | 6% |
| Wall finishes | 2% | 2% | 2% | 3% | 2% | 2% | 2% | 2% |
| Ceiling finishes | 6% | 6% | 6% | 5% | 5% | 4% | 7% | 6% |
| Floor finishes | 6% | 6% | 6% | 9% | 7% | 7% | 7% | 7% |
| Doors | 2% | 2% | 2% | 2% | 2% | 2% | 2% | 2% |
| Fittings & Sundries | 4% | 4% | 4% | 5% | 4% | 4% | 4% | 4% |
| Mechanical | 1% | 1% | 1% | 2% | 1% | 1% | 1% | 1% |
| Electrical | 2% | 2% | 2% | 2% | 2% | 2% | 2% | 2% |
| Hydraulics | 3% | 3% | 3% | 4% | 4% | 3% | 3% | 3% |
| External Works | 11% | 11% | 11% | 14% | 13% | 11% | 12% | 12% |
| Furniture (Appliances) | 1% | 1% | 1% | 1% | 1% | 1% | 1% | 1% |




The following key observations are made for the Class 1a models for all associated states and territories:

- The substructure, external walls and the external works are the top three building elements and as an average contribute to about 51% (combined) of the total upfront carbon of the Class 1a states and territories.

- The total average of external walls across all states and territories is 21%. There are three types of external wall assemblies utilised across the states and territories as highlighted below:
  - A 110mm brick veneer wall assembly with timber framing including varying insulation thicknesses, waterproofing and an interior plasterboard lining is utilised in the states of VIC, ACT & TAS, NSW, QLD and SA.
  - A 150mm thick blockwork wall assembly (140mm blockwork and 10mm render finish) with timber framing including insulation, waterproofing and an interior plasterboard lining is utilised in the state of NT & FNQ.
  - A 230mm double brick wall assembly with timber framing including insulation, waterproofing and an interior render finish is utilised for WA. The external wall has the highest building element contribution for WA with a contribution of 27%.
- The total average of substructure across all states and territories is 18%. There are two types of substructure assemblies (ground floor slab) utilised across the states and territories as highlighted below:
  - A 385mm waffle pod assembly including 85mm concrete slab, steel reinforcement mesh and bars, 300mm deep polystyrene formwork, footings, aggregates and waterproofing membrane is utilised in the states of VIC, ACT & TAS and NSW.
  - A 125mm concrete slab on ground including concrete, steel reinforcement mesh and bars, edge beams, footings, aggregates and waterproofing membrane is utilised in the state of NT & FNQ, QLD and SA.
- A 150mm concrete slab on ground for all external hardstand (covered in the external works element) including concrete, steel reinforcement mesh, formwork, aggregates and waterproofing membrane is utilised for all variants and has an average contribution of 12%.
- The internal finishes (combined) vary slightly from one state variant to another and have an average total upfront carbon of 15% including floor, ceiling and wall finishes. There are differences between the internal finishes in all the states and territories variants.
  - The ceiling finishes vary between different state and territories variants due to insulation thicknesses.
  - The floor finishes consist of a variety of materials, including ceramic tiling, engineered timber boards, carpet tiles, concrete tiling, and concrete sealer. The total area allocated to each of these finishes varies from one state/ territory to another, reflecting regional preferences and construction practices.
- The internal wall element contributes to an average of 6% but for WA have a significant contribution of 12%. It consists of a 90mm single skin brick wall with a render finish on both the sides as compared to timber framed plasterboard walls in the other states and territories.
- The roof element contributes to an average of 5%. Concrete roof tiles with timber framing have been utilised for the VIC variant and have a contribution of 7%. The rest of the states have timber framed metal cladding and insulation with varying thicknesses.
- The roof PV contributes to an average of 5% across all the states and territories and has a total upfront carbon contribution of 9 $tCO_2$-e absolute (A1-A5).
- To effectively reduce the total upfront carbon of project homes across different states and territories, prioritising the elements with the highest carbon contributions is crucial. By concentrating on these building elements in addition to the construction methodologies and materials, targeted strategies can be developed to achieve substantial reductions in the overall upfront carbon footprint.

## 3.3 Insights on assessment boundary

The building envelope, structure and internal walls account for 61% of the total upfront carbon emissions in Class 1a reference home. The external work and the internal elements have a significant contribution with 12% and 22% respectively. While some life cycle assessments only cover cold shell elements for ease of measurement, it is important to note that, for Class 1a buildings, this approach captures only a portion of the total emissions. Interior elements and external work are also significant contributors.

## 3.4 Major contributing building materials

*In addition to the major building elements, it is critical to prioritise upfront carbon reduction strategies for the major contributing building materials and finishes utilised in the Class 1a home, with a focus on low carbon alternatives and a sustainable supply chain. Figure 4 and*

Table 5 identifies the materials and finishes that contribute most to emissions across all models in each state and territory, presents the aggregated national average, and provides details on their use.

*Figure 4: Percentage contribution for major building materials*

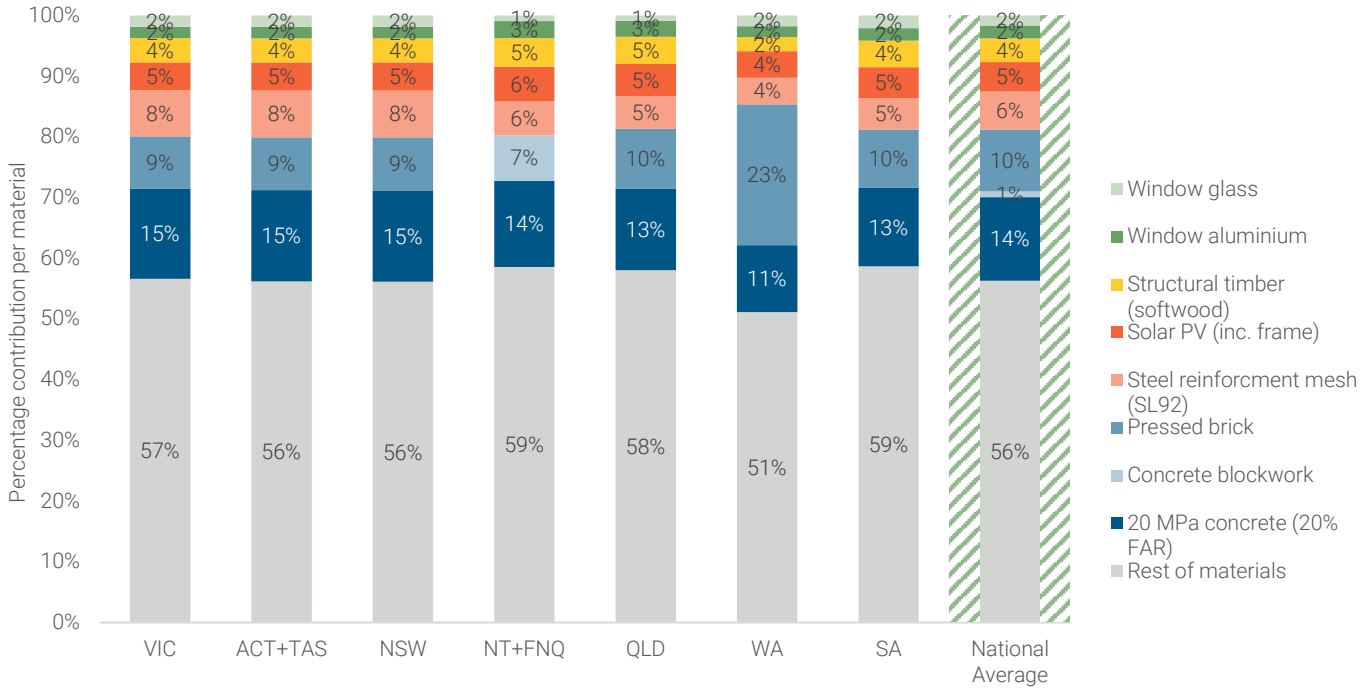



*Table 5: Percentage contribution for major building materials*

| Material | VIC | ACT & TAS | NSW | NT & FNQ | QLD | WA | SA | National average |
|---|---|---|---|---|---|---|---|---|
| 20 MPa concrete with 20% fly ash replacement | 15% | 15% | 15% | 14% | 13% | 11% | 13% | **14%** |
| Concrete blockwork | 0% | 0% | 0% | 7% | 0% | 0% | 0% | **1%** |
| Pressed brick | 9% | 9% | 9% | 0% | 10% | 23% | 10% | **10%** |
| Steel reinforcement mesh (SL92) | 8% | 8% | 8% | 6% | 5% | 4% | 5% | **6%** |
| Solar PV (inc. frame) | 5% | 5% | 5% | 6% | 5% | 4% | 5% | **5%** |
| Structural timber (softwood) | 4% | 4% | 4% | 5% | 5% | 2% | 4% | **4%** |
| Window Aluminium | 2% | 2% | 2% | 3% | 3% | 2% | 2% | **2%** |
| Window Glass | 2% | 2% | 2% | 1% | 1% | 2% | 2% | **2%** |
| Rest of materials | 57% | 56% | 56% | 59% | 58% | 51% | 59% | **56%** |

The major building materials including concrete, brick, steel, timber, aluminium and glass contribute on an average of 43% to the total upfront carbon. All the remaining materials and finishes utilised in the Class 1a home contribute to about 57% of the total upfront carbon.

Some key details regarding the top contributing materials and finishes across all the models are covered below:

- The highest upfront carbon material contributor across all states and territories, apart from WA, is concrete. It is the second highest contributing material for WA. The percentage of concrete in all the models ranges between 11 to 15% with an average contribution of 14%. The concrete is utilised for the ground slab assemblies and the external hardstand areas.
- This is followed by the single skin pressed brick utilised for the external walls across all states and territories apart from ACT & TAS and WA. Pressed brick is the highest upfront carbon contributor for WA as it is utilised for the double skinned external and single skinned internal walls with a contribution of 23%. The percentage of brick in all the models ranges between 9 to 23%.
- For the NT and FNQ variants, concrete blockwork for the external wall component contributes about 7%.
- The mortar for the external and internal brick walls in the WA variant accounts for approximately 5% of the total upfront carbon, compared to a minimal 2-3% contribution for external walls in other states and territories.
- The steel reinforcement mesh utilised for the ground slab assemblies and external hardstand contributes between 4 to 8% followed by the solar PV (including the framing) ranging between 4 to 5% across all states and territory models.
- The structural timber (softwood) is utilised for the roof framing (quantities vary with cladding type), window lintels and both external and internal wall framing across the states and territories contribute about 2-5% to the total upfront carbon.
- The single and double-glazed window assemblies have been split into the aluminium and glass components, with the total carbon contribution for both the window types being approximately 4% of the total upfront carbon of the entire home. The total upfront carbon in the single glazed aluminium framed window has about 20% lesser upfront carbon as compared to a double-glazed aluminium framed window.

On average, all other materials and finishes contribute to about 46% of total upfront carbon of the home. It is therefore essential to consider design optimisation strategies and not only low carbon supply chain to drive reduction. A detailed overview on this is covered in Section 5 of this report.

## 3.5 Critical review

The total upfront carbon results for the reference home and its associated states and territories are presented based on data collected from the construction documentation and the detailed bill of quantities provided. A +/- 10% accuracy factor needs to be considered to account for the total upfront carbon calculations and scope coverage.

### 3.5.1 Comparison to other studies

A review of past studies on Class 1a buildings in Australia and New Zealand was undertaken to provide a comparative analysis and inform the methodology for this study. Details of the literature review are provided in Appendix C as a part

of the methodology report, covering studies by Pullen (1995)[6], Mackley (1998)[7], Schmidt (2020)[8], Carre (2011)[9], and thinkstep-anz (2022)[10]. A summary of the findings is shown in Table 6 below.

The scope of building elements included in each study varies. While all studies address the building structure, envelope, and internal walls, coverage of internal finishes and building services is limited, with no inclusion of external works. As outlined in Section 3.2, the structure, envelope, and internal walls account for approximately 60% of total emissions.

This study, however, assesses 95% of building elements by cost and quantity, exceeding the scope of previous studies. As a result, the measured upfront carbon emissions are higher. Proportionally, the findings align closely with the results of Mackley and Schmidt, based on the percentage of building elements covered. Some differences are observed when compared with thinkstep-anz, likely due to variations in methodology, scope, and carbon factors.

*Table 6: Comparing results from this study with past studies*

| Study element | Pullen | Mackley | Schmidt | Carre | thinkstep-anz | National average (this study) |
|---|---|---|---|---|---|---|
| Coverage of building included & accuracy[11] | ~70% | ~60% | ~85% | ~50% | ~45% | ~95% |
| Upfront carbon emissions intensity (A1-A5) in $tCO_2$-e/$m^2$ NFA for brick veneer façade. | 0.48 | 0.54 | 0.76 | 0.81 | 0.25 | 1.02 |

### 3.5.2 NABERS national emissions factors database

As outlined in Section 4, the NABERS National Emission Factors Database has been used to assess the upfront embodied carbon of the selected reference home and its associated state and territory variants. While this database is not specifically designed for Class 1a detached homes, it provides carbon coefficients for primary construction materials applicable across various building typologies.

The use of NABERS coefficients was maximised to incorporate materials from the National Emission Factors Database. However, a significant portion of the building elements is not covered due to the database's scope being limited to cold-shell elements and specific asset types. For the reference home and its associated state and territory variants, the application of NABERS coefficients contributes to around 50% of the building's overall carbon emissions. The detail per state is shown in Table 7 below.

*Table 7: Upfront carbon percentage contribution from the NABERS rates*

| Variants | VIC | ACT & TAS | NSW | NT & FNQ | QLD | WA | SA |
|---|---|---|---|---|---|---|---|
| Upfront carbon percentage contribution from NABERS rates | 48% | 47% | 47% | 46% | 46% | 52% | 45% |

[6] Pullen, S. (1995) Embodied Energy of Building Materials in Houses, University of Adelaide, Department of Architecture.

[7] Mackley, C. (2002) Economics of Sustainable Building, RAIA BDP Environment Design Guide, Gen 44.

[8] Schmidt, M., Crawford, R. H. and Warren-Myers, G. (2020) Quantifying Australia's life cycle greenhouse gas emissions for new homes.

[9] Carre, A. (2011) A Comparative Life Cycle Assessment of Alternative Constructions of a Typical Australian House Design. Forest and Wood Products Australia (FWPA).

[10] thinkstep-anz (2022a) Cost-neutral, low carbon residential construction, on behalf of Ministry of Business, Innovation and Employment (MBIE).

### 3.5.3 Input-Output (IO) coefficients

The primary approach to account for the total upfront carbon is through utilising the physical quantities and multiplying it with its related carbon coefficient. Where a quantity could not be determined, the dollar cost of that item is multiplied by the relevant IO sector coefficient. The percentage range for the use of IO coefficients is in the order of 8 to 10% for the reference home and its associated states and territories. This is highlighted below in Table 8.

*Table 8: Upfront carbon percentage contribution from the NABERS rates*

| Variants | VIC | ACT & TAS | NSW | NT & FNQ | QLD | WA | SA |
|---|---|---|---|---|---|---|---|
| Upfront carbon percentage contribution from IO rates | 9% | 9% | 9% | 11% | 10% | 8% | 10% |

# 4. Australian construction forecast

This section explores upfront carbon emissions in Class 1a buildings across Australia, providing insights into the total impact of the housing sector. It highlights housing trends in each state and territory and considers how these trends may influence upfront carbon emissions. By examining available data, the report offers estimates of the upfront carbon footprint of new Class 1a buildings at both a national level and within individual states and territories.

## 4.1 Housing trend in each state

The historical and forward estimates of dwelling commencements and completions and are drawn from both ABS (2022)[12] and Master Builders Australia (2024)[13] Australian construction forecasts. It shows and forecasts the total of number of new detached dwellings commencing construction in each Australian state and territory from 2021 to 2029.

Between 2024 and 2029, approximately 600,000 new detached homes will be built, which aligns with the annual construction rate of 100,000 to 130,000 homes per year. This implies that the average number of homes built each year within this period will be roughly 119,000 homes annually.

*Figure 5: Summary of historical and forecast detached house commencements to 2028 by state*

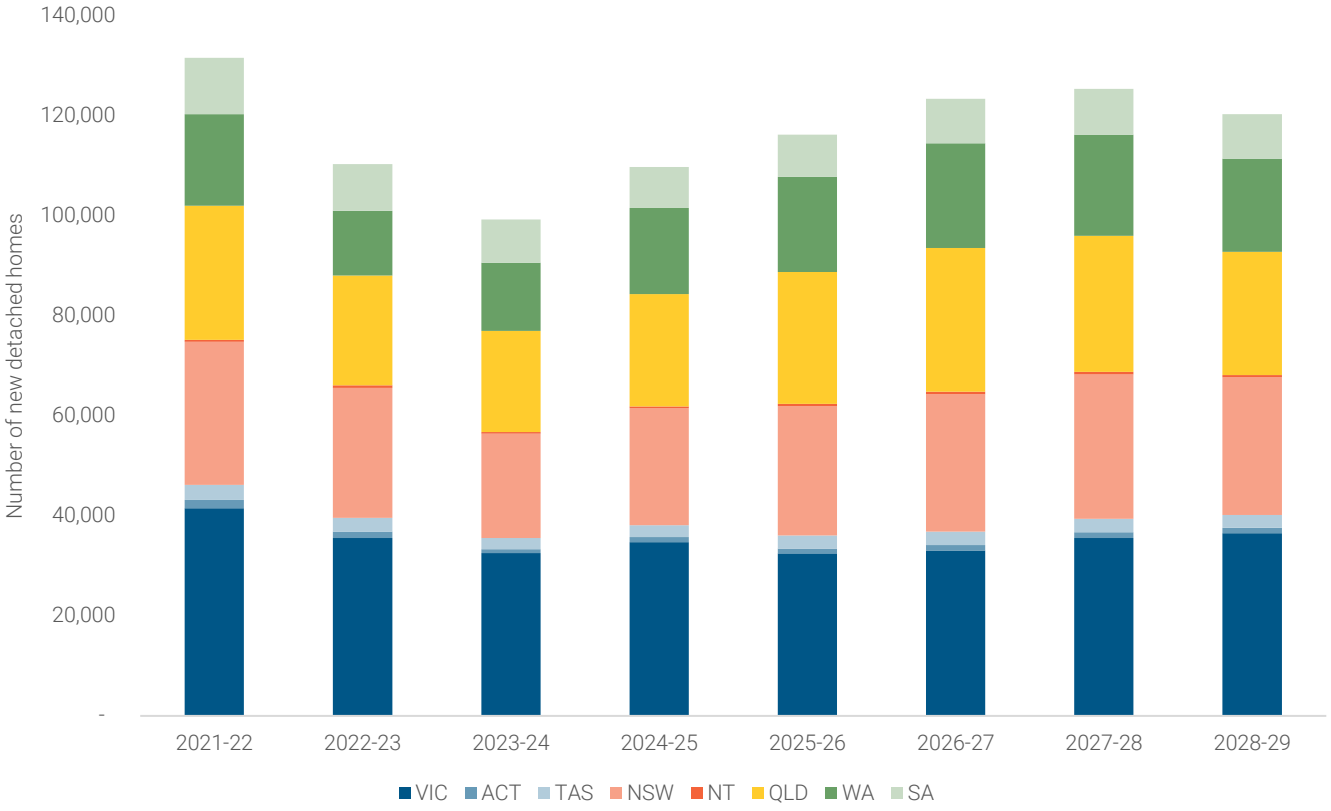



Table 9 provides an overview of the distribution of new detached homes built across Australia between 2024 and 2029. It highlights that Victoria will lead with the highest number of cumulative new detached homes, accounting for 29% of the total. New South Wales follows closely with 22%, while Queensland also contributes 22%. In contrast, the Australian Capital Territory, Northern Territory, and Tasmania represent the smallest shares, collectively comprising only 3% of the new detached homes.

[12] ABS (2024) Building Approvals, Australia | Australian Bureau of Statistics. Available at: https://www.abs.gov.au/statistics/industry/building-and-construction/building-approvals-australia (Accessed: May 23, 2024).

[13] Master Builders Australia (MBA) (2024) Building and construction industry forecast, September 2024, Australia.

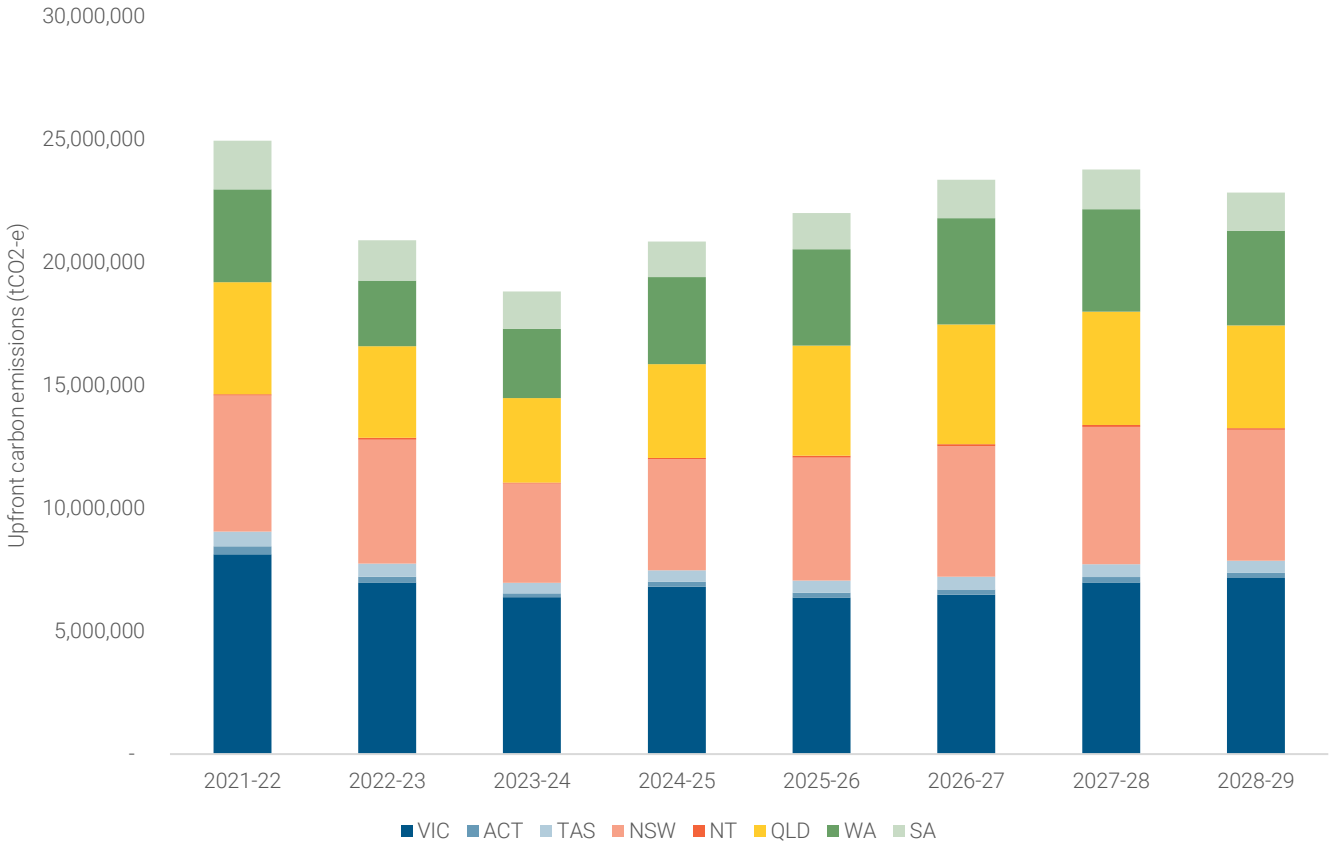
*Table 9: Cumulated number of new detached homes between 2024 and 2029.*

| State and territories | VIC | ACT | TAS | NSW | NT | QLD | WA | SA |
|---|---|---|---|---|---|---|---|---|
| Cumulated new detached homes | 172,322 | 5,288 | 12,946 | 133,033 | 2,310 | 129,209 | 95,962 | 43,542 |
| Share of each state and territory | 29% | 1% | 2% | 22% | 0% | 22% | 16% | 7% |

## 4.2 Upfront carbon emission from Class 1a in Australia

The reference home LCA model and associated state variations form the basis of predictive mitigation models at the national scale. The results are extrapolated based on the housing trends listed above and presented in Figure 6.

*Figure 6: Upfront carbon emission forecast for new detached house from 2021 to 2029 by state*




Based on Table 9 and Figure 6 above, Table 10 below presents the cumulative upfront carbon emissions by state between 2024 and 2029 based on the Australian housing forecast and housing trends.

*Table 10: Cumulated upfront carbon emissions by state between 2024 and 2029 (in millions $tCO_2$-e)*

| State and territories | VIC | ACT | TAS | NSW | NT | QLD | WA | SA | Total |
|---|---|---|---|---|---|---|---|---|---|
| Cumulated emissions between 2024 and 2029 (in millions $tCO_2$-e) | 33.82 | 1.02 | 2.51 | 25.75 | 0.37 | 21.90 | 19.80 | 7.63 | 112.89 |
| Share of each state and territory | 30% | 1% | 2% | 23% | <1% | 19% | 18% | 7% | - |

Key findings are as follows:

- Overall results: On average, the upfront carbon emissions from Class 1a buildings are 22 million $tCO_2$-e per year, based on 95% coverage of building costs and quantity elements. A total of approximately 113 million $tCO_2$-e upfront carbon will be emitted from Class 1a buildings between 2024 and 2029.
- Cold shell boundary: Structural elements, building envelope and internal wall together account for approximately 12.8 million $tCO_2$-e per year.
- State contribution: Upfront carbon emissions from each state reflect the distribution of new dwellings, with Victoria (30%) leading, followed by New South Wales (23%), Queensland (19%), and Western Australia (18%).

The residential sector contributes a significant portion of Australia's total greenhouse gas emissions. As a comparison, Australia's greenhouse gas emissions were estimated to be 436 million tonnes in the year ending December 2024[14]. Detached house construction, which accounts for 60% of residential building activity and 45% of all building activity[15], presents a critical opportunity for targeted emissions reduction.

[14] Department of Climate Change, Energy, the Environment and Water (2024) National Greenhouse Gas Inventory Quarterly Update: September 2024. Available at: https://www.dcceew.gov.au/climate-change/publications/national-greenhouse-gas-inventory-quarterly-update-september-2024 (Accessed: April 1, 2025)

[15] Infrastructure Australia (2024) Embodied Carbon Projections for Australian Infrastructure and Buildings

# 5. Low carbon solutions

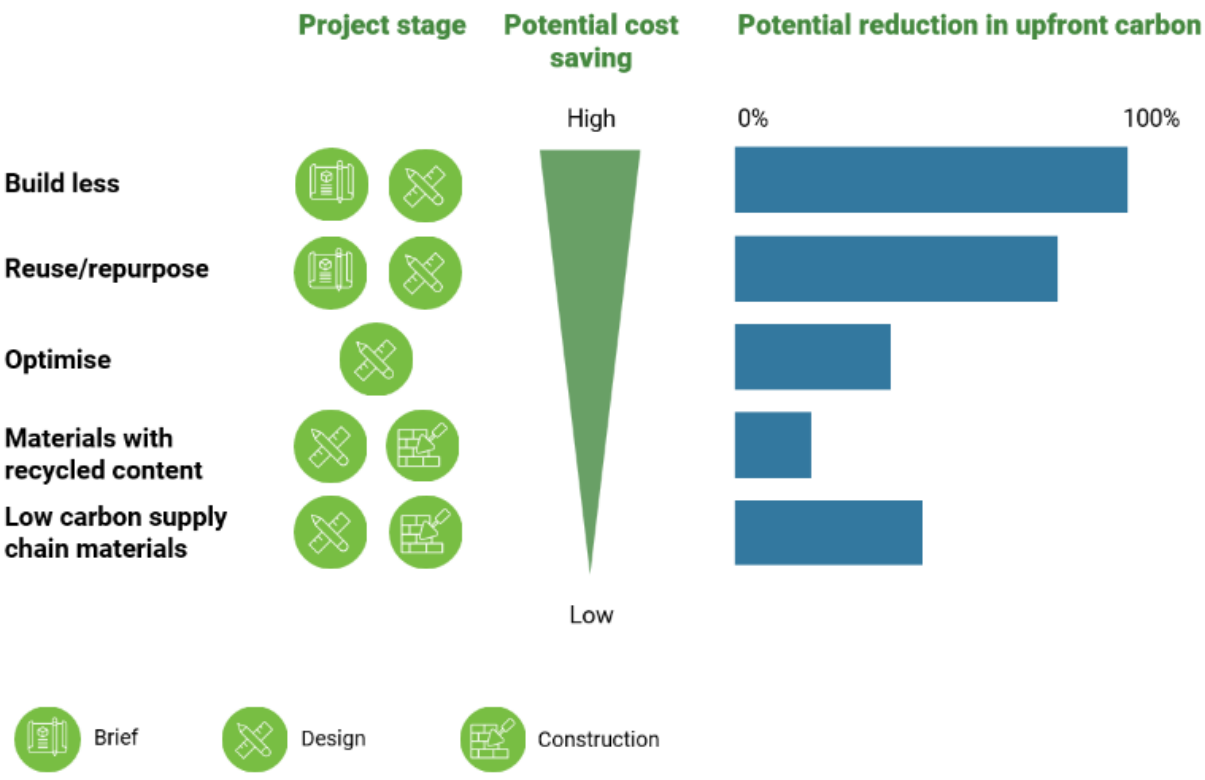
The study outlines carbon reduction pathways to mitigate upfront carbon emissions in Australian homes. It evaluates alternative low-carbon materials and construction methods, focusing on their potential to lower emissions while maintaining performance, affordability, and regulatory compliance. The analysis identifies adaptable low-carbon solutions for integration into home design and procurement strategies, ensuring they align with functional and aesthetic requirements.

This section outlines carbon reduction principles and presents a suite of low-carbon initiatives that can be tailored to meet varying functional requirements and design preferences. These initiatives provide flexible options that can be combined to address specific project constraints. Finally, the study proposes a clear reduction pathway and recommends achievable emission reduction targets.

## 5.1 Carbon reduction principles

The potential to reduce upfront carbon in any building project is highest during the project inception when the brief is set and reduces overtime. Figure 7 highlights key carbon reduction principles in order of when the decision should be made, the potential cost saving and the carbon reduction potential.

*Figure 7: Upfront carbon principles to achieve targeted reductions*




The key recommendations in line with Figure 7 above are as follows:

- Build less: This principle can be included in the brief and implemented at early design stage and includes strategies such as retaining or renovating any existing buildings where possible, optimising the overall building height and also floor to floor height if applicable, the form of the building, utilising the site layout and building in co-ordination to the same and optimising the building sizing (highlighted in section 5.1.1)
- Reuse / repurpose: This principle can be included in the brief and implemented at early project stage and includes strategies such as repurposing existing structures into modern homes and repurposing materials from other buildings.

- Optimise: This principle can be implemented during design stage and includes strategies such as prioritising material optimisation, flexibility, and modular design. Enhancing efficiency in structural components and façade layouts can significantly lower the carbon footprint. Flexible designs allow for easy reconfiguration, reducing future renovation needs. Additionally, modular construction enables off-site fabrication, minimising labour costs and material waste while speeding up construction.
- Materials with recycled content and low carbon supply chain materials: This principle can be considered and designed for during the design stage and implemented during construction. Materials with recycled content or low carbon supply chain materials may have different material properties to standard practice materials which should be considered in the design. Further suggestions can be found below in section 5.1.2 and 5.1.3).

### 5.1.1 Building smaller homes

With an average home size of 235m$^2$ GFA, Australian homes are large[16]. The ABS data also highlights that 84% of detached homes have at least one spare bedroom. This trend reflects cultural preferences for spacious living and functional designs that accommodate work, relaxation, and entertainment, particularly following the COVID-19 pandemic. The demand for larger homes is supported by Australia's relatively abundant land availability and the shift toward suburban and regional living.

Smaller homes are a practical solution to reducing embodied carbon, material and construction costs, and energy use. Reducing the homes GFA by 5 to 10% will deliver meaningful carbon reduction savings. Areas such as second living spaces, car parking and spare bedrooms can be downsized or removed based on the functional requirements and project location.

Compact homes are also more energy-efficient, needing less heating and cooling, which lowers operational energy use. Additionally, they support sustainable land use by reducing urban sprawl and preserving green spaces, aligning with environmental and financial priorities.

### 5.1.2 Low carbon design and assemblies

Prioritising sustainable practices and materials significantly reduces the upfront carbon emissions associated with residential construction. This approach not only mitigates environmental impact but also enhances energy efficiency, resulting in long-term cost savings for homeowners. By integrating low carbon design principles and materials/ products, the construction industry can play a vital role in fostering a more sustainable future while delivering substantial economic benefits to residents.

Table 11 below highlights key examples of building assemblies, along with their estimated carbon savings illustrating the significant impact of adopting low carbon design and material strategies in residential construction.

*Table 11: Low carbon design and material assembly examples*

| No. | Typical home assembly | Low carbon assembly | Building element | Estimated saving (%) over overall project |
|---|---|---|---|---|
| 1 | Waffle pod slab assembly | Concrete slab on ground with steel fibre mesh | Substructure | 9% |
| 2 | Brick veneer cladding | Fibre cement cladding (would also eliminate need for mortar) | External wall cladding | 7% |
| 3 | Single skin brick veneer wall with timber framing and plasterboard lining | Use of precast panels (autoclaved concrete) for external walls | External walls | 6% |
| 4 | Standard plasterboard wall with timber framing | Lightweight acoustic panel with plasterboard on either side | Internal wall | 2% |

[16] Commonwealth Bank of Australia (2020) CommSec Home Size Trends Report.

| | | | | |
|---|---|---|---|---|
| 5 | DGU - 4/12/4mm toughened glass units | DGU – 4/12/4mm toughed glass unit with low carbon aluminium framing<br>OR<br>DGU – 4/16/4mm uPVC window unit | Windows | 2% |

In addition to the table above, there are design strategies that can be adopted to reduce the total upfront carbon of the residential Class 1a home.

- Window to external wall ratio: Optimising the window to wall ratio and orientation to reduce the total upfront carbon contribution and improve energy efficiency.
- Home sizing (Refer to section 4.4): Reviewing the size of the home will help in reducing embodied carbon, material use, construction costs and energy use. This approach would in turn contribute to a more economical and efficient living space.
- Restrict tiling to wet areas: Limiting the use of tiles to bathrooms and kitchens reduces material usage and associated carbon emissions, while also lowering installation costs. And replace tiling by engineered timber boards, polished concrete or carpet tiles (whatever is suitable based on climate zones) to reduce the total carbon emissions by 2-5%.
- Reduce hardscaping area: Minimising paved surfaces and opting for permeable materials can enhance drainage and reduce heat islands, contributing to a more sustainable and low carbon external hardstand. This strategy also helps reduce heat island effect.

### 5.1.3 Low carbon supply chain

Low carbon supply chains for Class 1a buildings contribute significantly reduce the overall carbon footprint associated with construction. By sourcing materials from suppliers committed to sustainable practices, builders can minimise environmental impact through the use of recycled materials and energy-efficient production methods. Additionally, selecting local suppliers decreases transportation emissions, further enhancing sustainability while potentially lowering costs.

Table 12 below highlights low carbon supply chain materials, along with their estimated carbon savings illustrating the significant impact of adopting low carbon design and material strategies in residential construction.

*Table 12: Low carbon supply chain examples*

| No. | Material | Applicability in a house | Estimated saving (%) over the BAU material[17] | Estimated saving (%) over the overall project |
|---|---|---|---|---|
| 1. | Low carbon concrete | Substructure, external work and superstructure (if applicable) | 10 – 40% | 8 – 10% |
| 2 | Carbon neutral concrete (via carbon offsets) | Substructure, external work and superstructure (if applicable) | 100% | 12 -14% |
| 3 | Low carbon aluminium | Applied only for windows on this project but can be used for doors, cladding, curtain walls, fencing, etc | 30 – 60% | 1 - 2% |
| 4 | Carbon neutral brick (via carbon offsets) | External walls | 100% | 9% |
| 5 | Low carbon brick | External walls | 35 - 50% | 5% |

[17] Estimated based on NABERS National Emission Factors Database default value and local EPDs.

| | | | | |
|---|---|---|---|---|
| 6 | Steel fibre reinforcement | Substructure and external work | 40 - 55% | 2 - 4% |
| 7 | Low carbon timber | Superstructure, roof, external walls and internal walls | 20 – 30% | 1 - 2% |
| 8 | Internal finishes | Internal finishes | Specific to finishes selection | Specific to finishes selection |

In addition to the table above, a not-to-exceed (NTE) target can be established for primary materials such as concrete, steel, timber, and aluminium. This approach ensures the use of a low carbon supply chain in the construction process, significantly reducing the total carbon impact. By setting these NTE targets, builders can prioritise use of sustainable practices and materials for Class 1a buildings. A key example of this is highlighted in section 4.5.

In conclusion, implementing effective carbon reduction principles is essential for minimising the upfront carbon contribution of Class 1a buildings. It will also encourage designers, builder sand policymakers to collaborate in further reducing the total upfront carbon footprint of these homes.

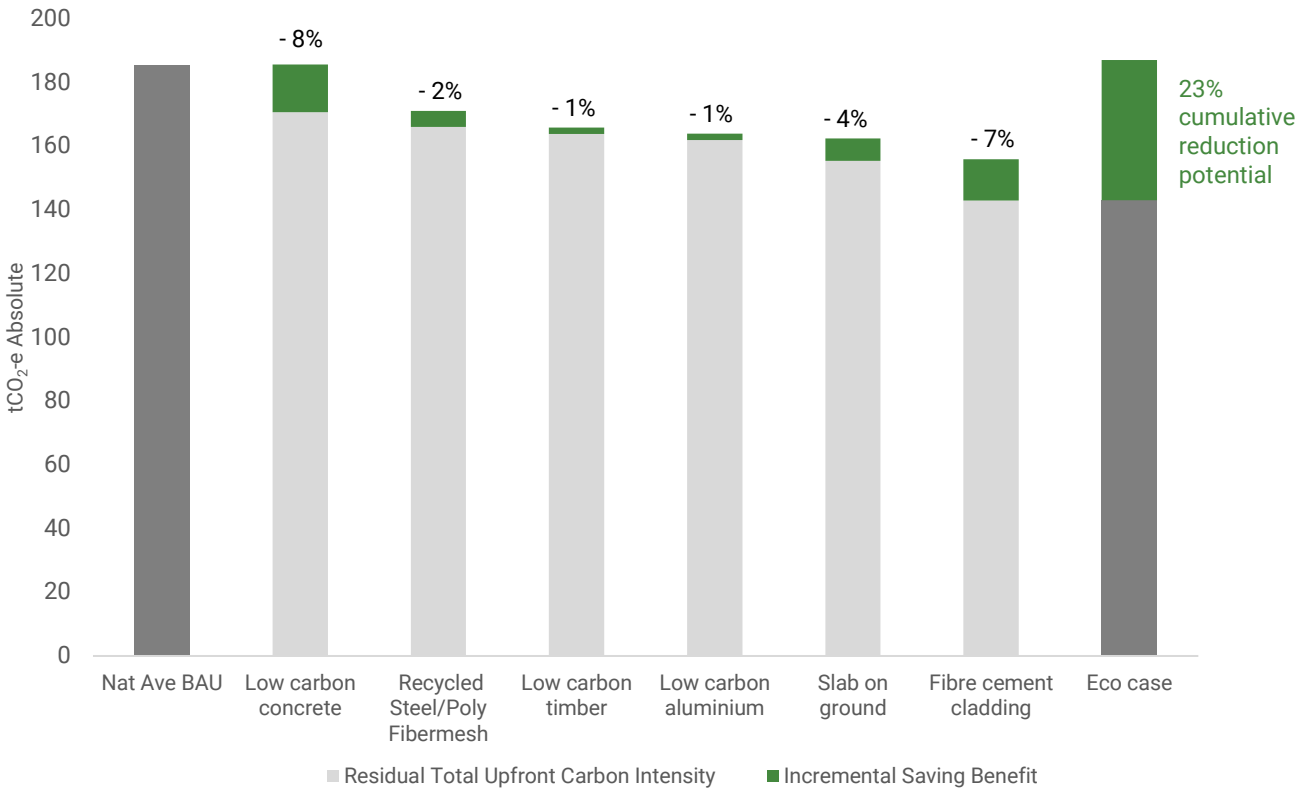
## 5.2 Low carbon pathway and target

Based on the carbon reduction principles presented above, this section covers an example of the incremental carbon saving benefit that can be achieved for Class 1a buildings. It covers some of the initiatives discussed above in section 4.1, 4.2 and 4.3. It does not cover any carbon reduction initiatives achieved through paying for carbon offsets and procuring carbon neutral products.

The pathway example is flexible and not prescriptive. The potential for carbon reduction will vary based on the project's design, climate zone, and structural requirements. Advances in manufacturing technology that may reduce the upfront carbon of materials have also not been accounted for.

Figure 6 below presents the incremental carbon saving benefit for a Class 1a home based on some of the low carbon material initiatives first, and then design optimisation initiatives. They are summarised below in detail.

*Figure 8: Carbon reduction pathway for Class 1a buildings*




The not-to-exceed targets have been considered for the following materials: concrete, timber, steel reinforcement and aluminium based on list of initiatives covered in section 4.3 to promote the use of low carbon materials with a sustainable supply chain. A summary of each of the material low carbon initiatives is covered below:

- A not-to-exceed target is set at 50% lower upfront embodied carbon for concrete compared to the industry standard average, resulting in 200 $kgCO_2$-e/$m^3$ for 20 MPa concrete. This target can be further reduced over time through improvements in material production and design, with a goal of 150 $kgCO_2$-e/$m^3$ by 2030.
- For the steel reinforcement utilised in the substructure, an assumption of 100% recycled steel or plastic fibre mesh is considered. However, there would be some associated upfront carbon contribution by concrete.
- A not-to-exceed target of 30% lesser upfront embodied carbon for timber (softwood) than an industry standard average is considered based on an increase in offcuts making it into fuel for timber processing.
- A not-to-exceed target for aluminium is considered on the assumption of a mandatory 50% recycled content of all framing or 100% aluminium capped at <15 $tCO_2$-e /t for the extruded frame. This would mainly apply to windows frames.

After reviewing the low carbon material examples, targeting some of the top contributing materials that have an overall average contribution of 54% (covered in section 4.3) can result in an upfront carbon reduction of only 12%. However, there is associated upfront carbon with the rest of the materials utilised in the Class 1a home. To maximise the total percentage of upfront carbon reduction, it is essential to also consider design optimisation and performance target setting for Class 1a buildings.

Below is a summary of design optimisation initiatives from the list in Section 4.2 that are considered in the carbon reduction pathway example:

- The change from waffle pod slab to slab on ground when suitable based on structural requirements can also delivered meaningful reduction with a reduced usage of concrete, steel and no polystyrene.
- A single skin, brick veneer utilised for the external walls across all states and territories apart from ACT & TAS and WA. There will be upfront carbon reduction achieved if the external brick veneer cladding is to be replaced by a

lightweight fibre cement cladding. For climate zone that requires high thermal mass, recycled brick, and autoclaved aerated concrete (AAC) should be considered.

In summary, the combined initiatives result in an approximate 23% cumulative reduction in total upfront carbon emissions of the Class 1a building. The example above indicates that to maximise the carbon reductions, it is crucial to not only focus on low-carbon materials and supply chains but also to align these efforts with design optimisation.

# 6. Policy landscape

The challenge of reducing upfront carbon emissions in single dwellings (Class 1a) is significant, as outlined in Section 5. Reports such as Embodied Carbon & Embodied Energy in Australia's Buildings (GBCA and thinkstep-anz, 2021)[18] and Embodied Carbon Projections for Australian Infrastructure and Buildings (Infrastructure Australia, 2024) [19] demonstrate that Class 1a homes account for a substantial share of upfront carbon emissions in the building sector, surpassing all other asset class. Despite their significant impact on Australia's carbon footprint, emissions from Class 1a dwellings remain largely overlooked in current policy and industry practices.

This section provides an outline of the existing policy landscape for upfront carbon, both local and international.

## 6.1 Upfront carbon landscape in Australia for Class 1a buildings

### 6.1.1 Implications of the study results

The study establishes a national average for upfront carbon emissions in Class 1a dwellings, drawing on results from all states and territories. The analysis indicates a variation of ±5% in total upfront carbon emissions across states and territories relative to the national average, apart from Western Australia (WA). When WA is included, the variation increases to ±10%. This percentage variation is within the margin of error for life cycle assessment (LCA) calculations, suggesting minimal regional differences. Consequently, the findings support the feasibility of implementing uniform national targets and policies at the federal level.

The study also reveals that upfront carbon emissions from Class 1a dwellings are significantly higher than previously estimated. As detailed in Section 3, this analysis covers 95% of building material quantities and costs, compared to typical assessments which address only 60% by focusing on the building shell and internal walls. Based on the expanded scope of this study, the estimated upfront carbon emissions from Class 1a dwellings amount to an average of 22 $MtCO_2$-e annually, accumulating to 112 $MtCO_2$-e over the period from 2024 to 2029. With the 2023 National Housing Accord, and the 2024-2025 Australian Government budget allocating additional funding to accelerate housing supply, these emissions are likely to increase further. These findings highlight that emissions from Class 1a dwellings have been significantly underestimated, revealing the magnitude of the challenge and the pressing need for immediate action.

The Paris Agreement, adopted in 2015, aims to limit global warming to well below 2°C above pre-industrial levels, with a preferred target of 1.5°C. Achieving this goal requires global greenhouse gas (GHG) emissions to peak as soon as possible and reach net-zero by 2050. While the Paris Agreement does not specify uniform reduction targets, Australia's Nationally Determined Contribution (NDC) commits to a 43% reduction in emissions below 2005 levels by 2030, with a long-term goal of achieving net-zero emissions by 2050. Additionally, the World Green Building Council's (WorldGBC) Bringing Embodied Carbon Upfront report challenges the global building and infrastructure sector to reduce embodied carbon emissions by 40% by 2030 and achieve 100% net-zero emissions by 2050, in alignment with the Paris Agreement.

### 6.1.2 Existing reporting framework

There is currently limited reporting on upfront carbon emissions for Class 1a buildings in Australia, with existing frameworks being state-specific and covering only a portion of emissions due to their limited scope. The recently released NABERS Embodied Carbon tool does not cover Class 1a dwellings.

Mandatory frameworks include:

[18] Green Building Council Australia (GBCA) and Thinkstep-anz (2021) Embodied Carbon and Embodied Energy in Australia's Buildings.

[19] Infrastructure Australia (2024) Embodied Carbon Projections for Australian Infrastructure and Buildings.

- BASIX Materials Index: This is applicable only in New South Wales, where it helps assess the environmental impact of building materials, including carbon emissions from the top materials. It is part of the broader BASIX requirements focused on sustainability in new residential buildings.
- Climate-related Financial Disclosures Legislation: This Act mandates relevant entities to disclose their climate-related plans, risks, and opportunities, including Scope 3 emissions and upfront carbon, in accordance with the Australian Sustainability Reporting Standards (ASRS). Large home builders and developers will need to report on upfront carbon emissions between 2026 and 2028, depending on the business group's reporting timeline.

Currently, there is no comprehensive, national mandatory reporting standard for upfront carbon emissions in Class 1a dwellings.

### 6.1.3 Prevailing challenges

The residential construction sector in Australia is highly fragmented, primarily due to the prevalence of sub-contracting. However, the Housing Industry Association[20] indicates that the top 100 home builders have consistently accounted for 31–39% of new residential dwellings. This concentration of market share presents a clear opportunity for larger home builders to drive meaningful change in reducing upfront carbon emissions.

Given that upfront carbon considerations may be relatively new to many residential industry players, there is a significant opportunity for upskilling. Training and capacity-building within the industry will be essential to help stakeholders understand and implement carbon reduction strategies effectively. The larger, more institutional builders, who are already familiar with performance-based requirements such as those found in NCC Section J and BASIX, are well positioned to lead this change.

At the same time, the residential sector faces significant challenges, including concerns that additional compliance requirements could increase costs. This may not be well received, especially in the current market environment, which is already grappling with the pressures of a housing crisis. As the industry is still coming to terms with new concepts such as upfront carbon, upskilling will be crucial. Addressing these knowledge gaps and ensuring that compliance measures are effectively supported will help reduce barriers, both in terms of time and cost, while also encouraging wider adoption of low-carbon practices.

Despite these opportunities, the ongoing housing crisis remains a significant barrier. There is concern that additional compliance requirements could result in higher costs, which may not be well received in the current market environment. Therefore, it is crucial to strike a balance between environmental objectives and affordability. Providing targeted support, such as consultancy services for navigating approvals and compliance, will be essential to overcoming time and cost-related challenges. This approach will ensure that sustainability goals can be integrated effectively without putting undue pressure on housing affordability or supply.

## 6.2 Net zero building policy pathway examples

There are numerous successful policies that have been implemented both locally and internationally to reduce energy consumption and upfront carbon emissions. Effective policy implementation can be achieved by adopting strategies and frameworks that have already proven successful in similar contexts. By replicating these established approaches, policymakers can accelerate progress and ensure more predictable, impactful outcomes.

### 6.2.1 Performance based target vs prescriptive approach

The Performance-Based Target approach provides flexibility compared to the Deemed-to-Satisfy (DTS) Provisions. The DTS method relies on established construction techniques to meet performance requirements. In contrast, a Performance Solution allows alternative materials and methods, if the performance outcomes are met.

[20] Housing Industry Association (HIA) Colorbond® Steel Housing 100 report

A performance-based approach can be more suitable in a market with limited carbon footprint data for materials. By focusing on upfront carbon intensity emissions in $tCO_2$-e/ $m^2$ of floor area, it can facilitate quicker deployment and potentially lower costs, especially in the face of material and capacity constraints.

Other performance targets, such as percentage reductions and overall building carbon caps, have been considered. Percentage reduction targets are dependent on the establishment of a reference case, which can lead to variability and challenges in maintaining consistent compliance. Additionally, a performance target with a carbon cap for the overall building, irrespective of its size, may encourage smaller homes but could create difficulties in meeting the functional needs of families and potentially compromise build quality. To address these challenges, an offset scheme could be considered for larger homes to help facilitate compliance while maintaining design flexibility.

To simplify compliance, a carbon intensity target based on upfront carbon emissions (A1-A5), expressed in $kgCO_2$-e/$m^2$ of conditioned floor area (CFA) and gross floor area (GFA), is recommended. This approach is likely to be the most cost-effective and efficient option for Australia, given current material and capacity constraints.

### 6.2.2 Examples of successful policies

Several countries have adopted performance-based policies to address carbon emissions in buildings, with a focus on measurable targets rather than prescriptive standards. These policies allow for flexibility in design and construction while ensuring that environmental goals are met. Below are examples of successful policies from different regions.

**UK Net Zero Building Policy (2024)**

The UK's Net Zero Building Policy, set to begin its pilot phase in 2025, establishes a performance-based target for reducing upfront carbon emissions in new buildings. The policy sets a defined carbon intensity target ($kgCO_2$-e/$m^2$) for new residential and commercial buildings. The carbon intensity target will progressively decrease every four years, providing a long-term approach to emissions reduction. This performance-based model is designed to be flexible and cost-effective, allowing the building industry to meet emissions targets while maintaining innovation in design and construction methods.

**Danish National Strategy for Sustainable Construction (2021)**

In 2021, the Danish National Strategy for Sustainable Construction introduced upfront carbon limits to new buildings over 1,000$m^2$. An initial value of 12 kg $CO_2$-e/$m^2$/year was set however from 2025, four different limit values depending on the building size and sector, varying from 4 to 8 kg $CO_2$-e/$m^2$/year, have been introduced. Other European regulations have followed with Finland and Estonia proposing to introduce limit values in 2026 and 2027 respectively[21].

**NABERS Embodied carbon rating tool**

The NABERS Embodied Carbon rating tool allows eligible new buildings and partial rebuilds to measure and compare their upfront embodied carbon with reference buildings. It provides a certified upfront carbon intensity measure, covering material, transport, and construction emissions. The tool helps track and benchmark performance, promoting transparency and improvements in design and construction practices for more sustainable buildings. This initiative supports standardised carbon assessments across the Australian built environment. The use of the NABERS Embodied carbon tool is integrated into the NSW Sustainable Buildings State Environmental Planning Policy (SEPP) requirements.

The policies highlighted above illustrate the success of performance-based frameworks in reducing building sector emissions. By setting measurable targets rather than prescriptive standards, these approaches offer flexibility while ensuring environmental goals are met. They provide a practical and scalable model for addressing upfront carbon emissions in the construction industry, demonstrating the potential for similar strategies in other regions.

[21] Nordic Sustainable Construction (2024) Danish Political Agreement Tightens the Limit Values for New Buildings and Extends the Impact. Available at: https://www.nordicsustainableconstruction.com/news/2024/june/tillaegsaftale-paa-engelsk (Accessed: April 1, 2025)

# 7. Conclusion

In conclusion, the residential sector, particularly Class 1a single dwellings, is a significant contributor to Australia's greenhouse gas emissions, accounting for approximately 22 $MtCO_2$-e annually. Detached house construction comprises 30% of all building construction activity, making it a key area for emissions reduction.

Upfront carbon emissions in Australian homes are on average 1.16 tCO2-e/m² CFA and 0.79 $tCO_2$-e/m² GFA, based on 95% coverage of building costs and quantity elements. These emissions are higher than those reported in previous studies, indicating considerable potential for mitigation. The variance in emissions across the nation is approximately +/- 10%, influenced primarily by local material and design practices, rather than by variations in NatHERS or NCC thermal performance requirements. The variance in NatHERS compliance nationwide falls within the overall margin of error.

Modelling shows that reducing the carbon intensity of key materials such as concrete, cement, steel and timber contributes to a 13% reduction in the overall carbon footprint. However, greater reductions will not be achievable through material changes alone and must be complemented by a mandatory performance target at the building level, in the form of a national upfront carbon intensity target.

The current reliance on NABERS National Emission Factors Database and Environmental Product Declarations (EPDs) covers only approximately 50% of the emissions in a typical Australian project home, meaning it cannot serve as the sole source of upfront carbon data. A combined approach to measurement is necessary, incorporating NABERS alongside other tools, such as online or spreadsheet-based calculation methods, provided they align with NABERS measurement protocols. Additionally, there is a need for national mandates on Carbon Product Declarations (PCF or EPD) for all construction products, contingent on the availability of cost-effective options.

Addressing emissions in the single dwelling sector is critical for Australia to meet its sustainability targets and ensure long-term environmental and societal benefits.

# 8. Definitions

## 8.1 Carbon definitions

The definitions below have been established by the Materials and Embodied Carbon Leaders' Alliance (MECLA), please refer to the MECLA Dictionary of Carbon for further detail on the definition references.

Carbon Dioxide Equivalents ($CO_2$-e): A measure that quantifies the global warming effect of different greenhouse gases in terms of the amount of carbon dioxide that would deliver the same global warming effect to standardise the climate effects of various greenhouse gases.

Carbon Footprint: The total set of GHG Emissions and their impacts caused by an organisation, event or product in a set time.

Carbon Intensity: The amount of $CO_2$-e emitted as a unit of production or output e.g. per $ revenue, full-time equivalent or $m^2$ floor area. Refer also to Greenhouse Gas Intensity.

Carbon Neutral: Having a balance between emitting Greenhouse Gases and absorbing carbon dioxide from the atmosphere in carbon sinks.

Carbon Offsets: An action intended to compensate for the emission of CO2-e into the atmosphere due to industrial or other human activity, especially when quantified and traded as part of a commercial scheme.

Embodied Carbon: The emissions associated with materials and construction processes throughout the whole life cycle of a building. This includes upfront carbon, in-use and end-of-life emissions.

Emission Factors: Emission factors are used to convert a unit of activity into its GHG Emissions equivalent. (e.g. a factor that specifies the kilograms of GHG Emissions per unit of activity).

Greenhouse Gases (GHG): Greenhouse gases are those gaseous constituents of the atmosphere, from both natural and anthropogenic sources, which contribute to the greenhouse effect, as detailed in the IPCC Glossary. GHG emissions are often referred to as 'carbon emissions' in general usage.

In-Use Embodied Carbon: The emissions caused in the materials production and construction works to maintain, repair, replace and/or renovate the building (Modules B1 to B5 as defined in EN 15978). This does not include operational energy and water (Modules B6 and B7).

Life Cycle Assessment (LCA): An analysis of the environmental and/or social impacts of a product, process or a service for its entire life cycle. It looks at the raw material extraction, production, manufacture, distribution, use and disposal of a product. Also known as Life Cycle Analysis.

Low Carbon Materials: Materials that have been produced with a low Embodied Carbon content across life cycle modules A1-A3 relative to their equivalents in the market.

Scope 3 Emissions: Indirect GHG Emissions other than Scope 2 Emissions that are generated in the wider economy. They occur because of the activities of a facility, but from sources not owned or controlled by that facility's business. Some examples are extraction and production of purchased materials, transportation of purchased fuels, use of sold products and services, and flying on a commercial airline by a person from another business.

Upfront Carbon Emissions: The emissions caused in the materials production and construction phases (Modules A1-A5) of the lifecycle before the building or infrastructure begins to be used.

Whole Life Carbon: The total of all GHG Emissions and removals, both operational and embodied, over the lifecycle of an asset, including its disposal (Modules A–C). Potential benefits or loads from future energy recovery, reuse and recycling are reported separately (Module D).

## 8.2 List of acronyms

| | |
|---|---|
| ABS EEIO | Australian Bureau of Statistics (ABS) Environmental-Economic Accounts (EEIO): they are a part of the broader Australian System of national accounts. These accounts integrate environmental and economic data to provide a comprehensive view of the interactions between the economy and the environment. |
| AIQS | Australian Institute of Quantity Surveyors: the peak professional organisation for quantity surveying professionals in Australia. |
| AUSLCI | Australian Life Cycle Inventory Database: a publicly accessible resource offering extensive environmental data on various Australian products and services throughout their life cycle. |
| BASIX | Building Sustainability Index: a sustainability assessment tool for residential buildings in New South Wales, Australia, aiming to reduce the environmental impact of new homes by setting standards for water and energy efficiency, and thermal performance. |
| EPD | Environmental Product Declaration: a standardised document that provides transparent and comparable information about the environmental impact of a product throughout its life cycle. |
| EPiC | Environmental Performance in Construction database: a comprehensive, open-access Life Cycle Inventory (LCI) database that provides environmental flow coefficients for construction materials. |
| ICE | Inventory of Carbon and Energy (ICE) database: a comprehensive resource for embodied carbon data and energy consumption data related to building materials. |
| ICMS | International Cost Management Standard: a global standard for cost management in construction and infrastructure projects. |
| IPCC | Intergovernmental Panel on Climate Change: a United Nations body for assessing the science related to climate change. |
| IPMS | International Property Measurement Standard: provides standards for measuring property consistently across the globe. |
| NatHERS | Nationwide House Energy Rating Scheme: an Australian scheme for rating the energy efficiency of residential buildings. |
| NCC | National Construction Code: Australia's primary set of technical design and construction provisions for buildings. |
| RICS | Royal Institution of Chartered Surveyors: a global professional body promoting and enforcing the highest international standards in the valuation, management, and development of land, real estate, construction, and infrastructure. |

## 8.3 Functional area definitions

Gross floor area (GFA): The total enclosed and unenclosed area of the building is measured between the normal outside face of any enclosing walls, balustrades and supports as defined by AIQS. It excludes the external area outside the enclosing walls of the building but a part of the site boundary.

Conditioned floor area (CFA): The conditioned floor area in relation to a dwelling as defined by Building Sustainability Index (BASIX) and NatHERS, is the measure of the total floor area of the dwelling, excluding:

a) floor area that is not fully enclosed;
b) bathrooms (but not ensuites) and laundries, with a ventilation opening; and
c) voids, storerooms, garages and carparks.

Net floor area (NFA): The net floor area of a building is a measure of the amount of useable space in a building as defined by the IPMS.

## 8.4 Building element scope definitions

The table 13 below provides a definition and scope coverage, in accordance with the Standard Method of Measurement as outlined by ICMS-3 / RiCS, for all the building elements included to calculate the total upfront carbon across the reference home and all the states and territories variants.

*Table 13: Building measurement allocation and scope of inventory for Class1a building*

| Building Element | Definition | Scope covered |
|---|---|---|
| Demolition | The process of dismantling, removing and clearing site for new construction. | Removal of existing structures and disposal of debris. |
| Site preparation | The process of preparing a construction site for building work, ensuring it is safe and ready for construction activities. | Clearing the site, grading the land, compacting the soil, and setting up necessary infrastructure. |
| Substructure | The part of a building below ground level that supports the superstructure. | Foundations, footings, piling, retaining walls and ground floor slab. |
| Superstructure | The part of a building above ground level that includes all structural elements. | Columns, beams, and structural walls. |
| Roof | The covering on the top of a building that provides protection from the elements. | Structure, cladding, waterproofing, fascia, barges, soffits, downpipes and fittings, insulation and waterproofing. |
| PV | Systems that convert sunlight into electricity using photovoltaic panels. | Panels, framing and electrical connection. |
| External Walls | The outer walls of a building that provide structural support and protection. | External and internal cladding, stud frame, waterproofing, and insulation. |
| Windows | Windows located on the exterior walls of a building. | Structure, frame, and joinery. |
| Internal Walls | The walls within the interior of a building that divide spaces and provide support. | Stud frame, cladding, waterproofing, insulation, and finishes. |
| Wall Finishes | The final surface treatment of walls for internal side of external walls and both faces of the internal walls. | Lining and finishes. |
| Ceiling Finishes | The overhead interior surface of a room. | Structure, frame, cladding, lining, and finishes. |
| Floor Finishes | The final surface treatment of floors. | Flooring type, waterproofing and surface treatment. |
| Doors / Frames | Doors and their supporting frames. | Core, frame, and hardware. |
| Fittings & sundries | Miscellaneous items and fixtures within a building. | Bathroom fittings & partitions, sundry fittings, cabinetry, and fixed joinery. |
| Mechanical | Systems used for heating, cooling, and ventilating a building. | Services, systems, and fittings. |
| Electrical | Electrical systems and components within a building. | Cabling, fittings, services, and installations. |
| Hydraulics | Systems for water supply and drainage. | Pipework, sanitary fittings, and services. |

| | | |
|---|---|---|
| External & Ancillary Works | Works outside the main building structure. | All external pavements, landscaping, fencing, retaining walls and services outside the external wall of the building but included within the site boundary. |
| Furniture (Appliances) | The process of making interior spaces suitable for occupation. | Base build appliances and fittings. |

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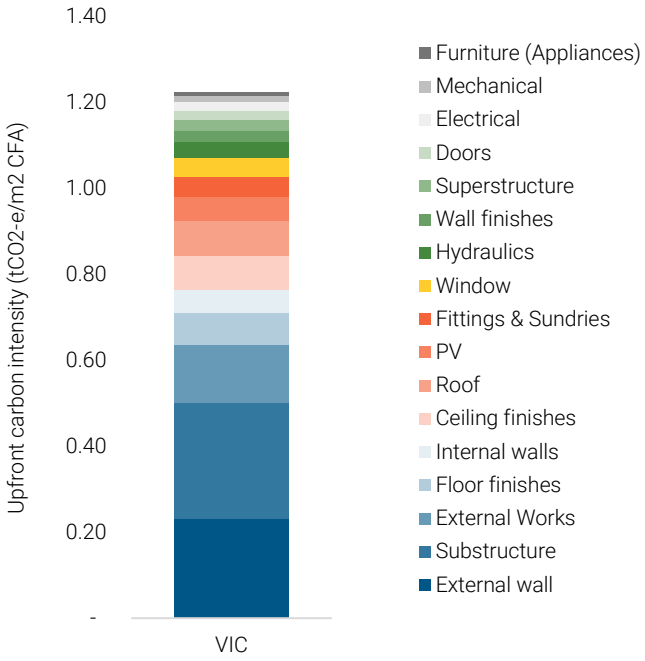
# Appendix A – Reference home results

This section covers the upfront carbon results for the Class 1a reference home. The reference home (home design provided by Henley Homes and selected by the GBCA) is constructed in Victoria, meaning the total upfront carbon of the VIC variant is the same as the reference home. The reference home has been utilised to develop the nominated models for each state/ territory across Australia.

The total upfront carbon in the reference home is about ~196 $tCO_2$-e absolute (A1-A5) or 1.23 $tCO_2$-e/$m^2$ CFA. The total carbon intensity in gross floor area terms of the reference home is 0.84 $tCO_2$-e/$m^2$ GFA. The building element breakdown and total building element percentage contribution of the reference home is presented in Figure 9.

*Figure 9: Total upfront carbon in $tCO_2$-e/$m^2$ CFA for the reference home*




Please note: The following building elements have no upfront carbon contribution: Vertical transport (not applicable for a single storey home), site preparation (no cost breakdown provided), fire services (excluded from BOQ) and preliminaries (no cost breakdown provided).

# Appendix B – Assessment methodology

This section presents the upfront carbon assessment methodology table, reflecting the outcomes of stakeholder consultations and incorporating the changes discussed in Appendix C.

| No. | Assessment Element | Proposed Methodology |
|---|---|---|
| 1. | Life Cycle Stage Coverage | Stage A1-A5 inclusive. |
| 2 | Reference Standards | ISO 14044<br>RiCS / ICMS-3 |
| 3 | Goals | Quantify upfront carbon intensity: Provide an accurate assessment of the upfront carbon associated with common single dwelling (Class 1a) construction practices, using a range of typical building materials from each Australian state and territories.<br>Understand regional variability: Examine how regional material preferences, construction methods, supply chain constraints, and climate conditions influence the carbon footprint of residential construction and identify the most effective approaches for localised carbon reduction.<br>National level overview: Forecast the results at the national level over the next few years and express the potential outcomes both in terms of the construction sector alone and in the context of the National greenhouse reduction goals.<br>Identify mitigation potential: Investigate alternative low-carbon materials and construction methods, analysing their potential to reduce upfront carbon emissions without compromising on performance, affordability, or regulatory compliance.<br>Inform policy strategy: Develop insights that can help shape policy measures and industry strategies to reduce upfront carbon in single dwellings, supporting efforts such as the Green Star Homes standard and the work of the MECLA Homes working group. |
| 4 | Scope of building elements included | The prevailing Standard Method of Measurement as outlined by ICMS-3 / RiCS is utilised for the building element selection. These are also covered in detail in Table 13 in section 8.4.<br>• Site Preparation<br>• Substructure<br>• Superstructure<br>• Roof<br>• PV<br>• External Walls<br>• Windows<br>• Doors<br>• Internal Walls<br>• Internal Finishes – floor, wall and ceiling finishes for base build<br>• Doors – main door and internal doors<br>• Fittings & sundries<br>• Mechanical Services – base building only<br>• Electrical Services – base build only<br>• Hydraulics Services – base build only<br>• Fire Services and Systems<br>• External Works<br>• Furniture (appliances only) |
| 5 | Items excluded | The following building elements / items are excluded from the assessment:<br>• Demolition |

| | | |
|---|---|---|
| | | • Fire services<br>• Loose furniture<br>• Equipment not installed as part of base building<br>• Vertical transport (not applicable for a single storey home) |
| 6 | Target completeness | RiCS / ICMS-3: 95% of the project (including all building elements) by utilising quantities and costs where a quantity is not available (excluding contingencies, escalation, land cost and builder's margins).<br><br>The assessment is based on the reference home's bill of quantities, cost information and drawings. We followed the data hierarchy outlined in the Upfront Carbon Emissions calculation guide – interim, version 1 from GBCA to the best extent as stated below:<br>• The use of NABERS' National Emission Factors Database that covers an extensive list of EPDs released by NABERS and other EPDs; subject to EPDs being suitable & valid for specified products.<br>• Industry generic values for other materials are drawn from a range of sources, including, but not limited to, NABERS' National Emission Factors Database default values / AusLCI / EPiC / ICE 3.0 / IELab or ABS EEIO rates / industry generic information. All industry generic data will be assessed and utilised based on country / location of manufacture relevance / product relevance / data quality.<br>• IO data has been used to fill the gaps when quantities are not available. |
| 7 | Functional unit for reporting | The following functional units are utilised for the purpose of reporting of the total upfront embodied carbon of the class 1a reference home and its states and territories variants:<br>• Total upfront carbon in tCO2-e absolute (A1-A5)<br>• Upfront carbon intensity in tCO2-e/m2 GFA<br>• Upfront carbon intensity in tCO2-e/m2 CFA<br>• Upfront carbon intensity in tCO2-e/m2 NFA |
| 8 | Project metadata reference | Building classification: Class 1a single residential dwelling<br><br>Floor area definition: This is highlighted in Table 1 in section 3.1 in detail and is as follows:<br>• Gross floor area in $m^2$<br>• Conditioned floor area in $m^2$<br>• Net floor area in $m^2$ |
| 9 | Calculator Method and Systems | Excel modelling tools as well as The FootprintCalculator™ is utilised for the upfront carbon assessment. It is consistent and aligned to the prevailing RiCS / ICMS / ISO14044 measurement standards.<br><br>To achieve the goal of 95% completeness a "combined" impact assessment calculation methodology will be applied. This includes:<br>a) Multiply a physical quantity of specified material by its related carbon coefficient and<br>b) Where a quantity cannot be determined, the dollar cost of that item is multiplied by the relevant Input-Output (IO) sector coefficient.<br>The measurement of physical quantity of material and its related carbon coefficient applied to calculate total upfront carbon. |
| 10 | Carbon LCI sources and data hierarchy | The following data hierarchy outlined in the Upfront Carbon Emissions calculation guide – interim, version 1 from GBCA is followed to the best extent as stated below:<br>• The use of NABERS' National Emission Factors Database that covers an extensive list of EPDs released by NABERS and other EPDs; subject to EPDs being suitable & valid for specified products. |

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| | | • Industry generic values for other materials are drawn from a range of sources, including, but not limited to, NABERS' National Emission Factors Database default values / AusLCI / EPiC / ICE 3.0 / IELab or ABS EEIO rates / industry generic information. All industry generic data will be assessed and utilised based on country / location of manufacture relevance / product relevance / data quality.<br>• IO data has been used to fill the gaps when quantities are not available. |
| 11 | Sources of quantities | Bill of quantities prepared by the contractor (including costs)<br>Documentation set (including architectural, structural, detailed drawings and landscape drawings) |
| 12 | Acceptable Measurement Rules | Prevailing Australian Standard Method of Measurement<br>Prevailing International Cost Management Standard (ICMS)<br>Prevailing RiCS Standard Method of Measurement<br>NABERS Upfront Carbon Calculation method<br>GBCA Upfront Carbon calculation method |
| 13 | Outputs | A full calculated estimate (excel summary) of emissions consistent with ICMS-3 / RiCS<br>Visual graphs co-relating to the excel summary tables |

# Appendix C – Variation in construction materials across states

The following tables summaries the material / assemblies used for each regional variation.

| States / Regions | Building elements | | | | | |
|---|---|---|---|---|---|---|
| | **Substructure** | **Roof** | **External walls** | **External Windows** | **Internal walls** | **Internal finishes** |
| VIC | Concrete waffle pod slab:<br>Waffle slab complete including 20MPa concrete, SL92 reinforcement, polystyrene formwork, waterproofing membrane and sand bed<br><br>Edge beams:<br>Strip footing complete Insulation with R value <R1.0 or more must be installed around vertical edge of perimeter<br><br>Footings:<br>Pad footing complete | Framing:<br>Timber truss included all fixings & connections<br><br>Roof Insulation:<br>R2.0 glass wool with sarking<br><br>Cladding:<br>Roof tiles (concrete / terracotta) (min 20 degree incline is required)<br><br>Ceiling insulation:<br>R4.5 glass wool insulation | External skin:<br>110 mm brick veneer with min 25mm cavity & moisture barrier (plastic sheeting)<br><br>Insulation:<br>R2.5 glass fibre batts / bulk insulation<br><br>Framing:<br>(90mm x 45mm) Timber framing<br><br>Internal cladding:<br>13mm plasterboard with paint | Aluminium framed double-glazed windows complete with powder coated finish, awning windows and hardware (high SHGC & low U value | Framing:<br>(90mm x 45mm) Timber framing<br><br>Insulation:<br>R2.0 glass wool batts / bulk insulation<br><br>Cladding:<br>12 mm plasterboard with paint | Wall finishes:<br>Paint for all walls<br>Ceramic tiling for wet area walls<br><br>Floor finishes:<br>Polished concrete tiles for alfresco, porch and outdoor seating<br>Ceramic tiling for wet areas<br>Carpet tiles for bedrooms<br>Engineered timber boards for common spaces<br>Concrete sealer for garage<br><br>Ceiling finish:<br>Set plasterboard with paint finish |

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|---|---|---|---|---|---|---|
| NSW | **Concrete waffle pod slab:**<br>Waffle slab complete including 20MPa concrete, SL92 reinforcement, polystyrene formwork, waterproofing membrane and sand bed<br><br>**Edge beams:**<br>Strip footing complete<br>Insulation with R value <R1.0 or more must be installed around vertical edge of perimeter<br><br>**Footings:**<br>Pad footing complete | **Framing:**<br>Timber truss included all fixings & connections<br><br>**Roof Insulation:**<br>R2.0 glass wool with sarking<br><br>**Cladding:**<br>0.48mm corrugated steel roof sheeting (with 2-5 degree incline<br><br>**Ceiling insulation:**<br>R4.5 glass wool insulation | **External skin:**<br>110 mm brick veneer with min 25mm cavity & moisture barrier (plastic sheeting)<br><br>**Insulation:**<br>R2.5 glass fibre batts / bulk insulation<br><br>**Framing:**<br>(90mm x 45mm) Timber framing<br><br>**Internal cladding:**<br>13mm plasterboard with paint | Aluminium framed double glazed windows complete with powder coated finish, awning windows and hardware (high SHGC & low U value | **Framing:**<br>(90mm x 45mm) Timber framing<br><br>**Insulation:**<br>R2.0 glass wool batts / bulk insulation<br><br>**Cladding:**<br>10 mm plasterboard with paint | **Wall finishes:**<br>Paint for all walls<br>Ceramic tiling for wet area walls<br><br>**Floor finishes:**<br>Polished concrete tiles for alfresco, porch and outdoor seating<br>Ceramic tiling for wet areas<br>Carpet tiles for bedrooms<br>Engineered timber boards for common spaces<br>Concrete sealer for garage<br><br>**Ceiling finish:**<br>Set plasterboard with paint finish |
| ACT & TAS | **Concrete waffle pod slab:**<br>Waffle slab complete including 20MPa concrete, SL92 reinforcement, polystyrene formwork, waterproofing membrane and sand bed<br><br>**Edge beams:**<br>Strip footing complete<br>Insulation with R value <R1.0 or more must be installed around vertical edge of perimeter<br><br>**Footings:**<br>Pad footing complete | **Framing:**<br>Timber truss included all fixings & connections<br><br>**Roof Insulation:**<br>R2.0 glass wool with sarking<br><br>**Cladding:**<br>0.48mm corrugated steel roof sheeting (with 2-5 degree incline<br><br>**Ceiling insulation:**<br>R4.5 glass wool insulation | **External skin:**<br>110 mm brick veneer with min 25mm cavity & moisture barrier (plastic sheeting)<br><br>**Insulation:**<br>R3.0 glass fibre batts / bulk insulation<br><br>**Framing:**<br>(90mm x 45mm) Timber framing<br><br>**Internal cladding:**<br>13mm plasterboard with paint | Aluminium framed double glazed windows complete with powder coated finish, awning windows and hardware (high SHGC & low U value | **Framing:**<br>(90mm x 45mm) Timber framing<br><br>**Insulation:**<br>R2.0 glass wool batts / bulk insulation<br><br>**Cladding:**<br>10 mm plasterboard with paint | **Wall finishes:**<br>Paint for all walls<br>Ceramic tiling for wet area walls<br><br>**Floor finishes:**<br>Polished concrete tiles for alfresco, porch and outdoor seating<br>Ceramic tiling for wet areas<br>Carpet tiles for bedrooms<br>Engineered timber boards for common spaces<br>Concrete sealer for garage<br><br>**Ceiling finish:**<br>Set plasterboard with paint finish |

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|---|---|---|---|---|---|---|
| NT & FNQ | **Concrete slab on ground:**<br>Concrete slab on grade with 20MPa concrete, SL92 reinforcement, plastic membrane and sand bed<br><br>**Edge beams:**<br>Strip footing complete including excavation, concrete reinforcement, formwork and backfilling | **Framing:**<br>Timber truss included all fixings & connections<br><br>**Roof Insulation:**<br><R1.0 foil faced insulation<br><br>**Cladding:**<br>0.64mm corrugated steel roof sheeting (with 2-5 degree incline<br><br>**Ceiling insulation:**<br>R3.0 glass wool insulation | **External skin:**<br>150mm concrete blocks with stud wall, reflective foil membrane (vapour permeable if appropriate)<br><br>**Insulation:**<br><R1.0 foil faced insulation<br><br>**Framing:**<br>(90mm x 45mm) Timber framing<br><br>**Internal Cladding:**<br>13mm plasterboard with paint | Single glazed, low emissivity glass, aluminium frame (low SHGC & high U value) | **Framing:**<br>(90mm x 45mm) Timber framing<br><br>**Insulation:**<br>R2.0 glass wool batts / bulk insulation<br><br>**Cladding:**<br>10 mm plasterboard with paint | **Wall finishes:**<br>Paint for all walls<br>Ceramic tiling for wet area walls<br><br>**Floor finishes:**<br>Polished concrete tiles for alfresco, porch and outdoor seating<br>Ceramic tiling for wet areas<br>Carpet tiles for bedrooms<br>Concrete sealer for garage<br><br>**Ceiling finish:**<br>Set plasterboard with paint finish |
| QLD | **Concrete slab on ground:**<br>Concrete slab on grade with 20MPa concrete, SL92 reinforcement, plastic membrane and sand bed<br><br>**Edge beams:**<br>Strip footing complete including excavation, concrete reinforcement, formwork and backfilling | **Framing:**<br>Timber truss included all fixings & connections<br><br>**Roof Insulation:**<br>R2.0 glass wool with sarking<br><br>**Cladding:**<br>0.48mm corrugated steel roof sheeting (with 2-5 degree incline<br><br>**Ceiling insulation:**<br>R3.5 glass wool insulation | **External skin:**<br>110 mm brick veneer with min 25mm cavity & moisture barrier (plastic sheeting)<br><br>**Insulation:**<br>R2.5 glass fibre batts / bulk insulation<br><br>**Framing:**<br>(90mm x 45mm) Timber framing<br><br>**Internal cladding:**<br>13mm plasterboard with paint | Single glazed, low emissivity glass, aluminium frame (low SHGC & high U value) | **Framing:**<br>(90mm x 45mm) Timber framing<br><br>**Insulation:**<br>R2.0 glass wool batts / bulk insulation<br><br>**Cladding:**<br>10 mm plasterboard with paint | **Wall finishes:**<br>Paint for all walls<br>Ceramic tiling for wet area walls<br><br>**Floor finishes:**<br>Polished concrete tiles for alfresco, porch and outdoor seating<br>Ceramic tiling for wet areas<br>Carpet tiles for bedrooms<br>Engineered timber boards for common spaces<br>Concrete sealer for garage<br><br>**Ceiling finish:**<br>Set plasterboard with paint finish |

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|---|---|---|---|---|---|---|
| SA | **Concrete slab on ground:**<br>Concrete slab on grade with 20MPa concrete, SL92 reinforcement, plastic membrane and sand bed<br><br>**Edge beams:**<br>Strip footing complete including excavation, concrete reinforcement, formwork and backfilling | **Framing:**<br>Timber truss included all fixings & connections<br><br>**Roof Insulation:**<br>R2.0 glass wool with sarking<br><br>**Cladding:**<br>0.48mm corrugated steel roof sheeting (with 2-5 degree incline<br><br>**Ceiling insulation:**<br>R4.5 glass wool insulation | **External skin:**<br>110 mm brick veneer with min 25mm cavity & moisture barrier (plastic sheeting)<br><br>**Insulation:**<br>R2.5 bulk insulation<br><br>**Framing:**<br>(90mm x 45mm) Timber framing<br><br>**Internal cladding:**<br>13mm plasterboard with paint | Aluminium framed double glazed windows complete with powder coated finish, awning windows and hardware (high SHGC & low U value | **Framing:**<br>(90mm x 45mm) Timber framing<br><br>**Insulation:**<br>R2.0 glass wool batts / bulk insulation<br><br>**Cladding:**<br>10 mm plasterboard with paint | **Wall finishes:**<br>Paint for all walls<br>Ceramic tiling for wet area walls<br><br>**Floor finishes:**<br>Polished concrete tiles for alfresco, porch and outdoor seating<br>Ceramic tiling for wet areas<br>Carpet tiles for bedrooms<br>Engineered timber boards for common spaces<br>Concrete sealer for garage<br><br>**Ceiling finish:**<br>Set plasterboard with paint finish |
| WA | **Concrete slab on ground:**<br>Concrete slab on grade with 20MPa concrete, SL92 reinforcement, plastic membrane and sand bed<br><br>**Edge beams:**<br>Strip footing complete including excavation, concrete reinforcement, formwork and backfilling | **Framing:**<br>Timber truss included all fixings & connections<br><br>**Roof Insulation:**<br>No insulation<br><br>**Cladding:**<br>0.48mm corrugated steel roof sheeting (with 2-5 degree incline<br><br>**Ceiling insulation:**<br>R3.5 glass wool insulation | **Framing:**<br>Timber truss included all fixings & connections<br><br>**Roof Insulation:**<br>No insulation<br><br>**Cladding:**<br>0.42 / 0.48 mm Colorbond (std) or 0.48mm Zinclume (for 2-5 degrees incline)<br><br>**Ceiling insulation:**<br>R4.3 glass wool insulation | Aluminium framed double glazed windows complete with powder coated finish, awning windows and hardware (high SHGC & low U value | **Framing:**<br>90mm single brick skin<br><br>**Insulation:**<br>No insulation<br><br>**Cladding:**<br>Sand finish plaster | **Wall finishes:**<br>Paint for all walls<br>Ceramic tiling for wet area walls<br><br>**Floor finishes:**<br>Polished concrete tiles for alfresco, porch and outdoor seating<br>Ceramic tiling for wet areas<br>Carpet tiles for bedrooms<br>Engineered timber boards for common spaces<br>Concrete sealer for garage<br><br>**Ceiling finish:**<br>Set plasterboard with paint finish |

# Appendix D – Calculation inputs

This section provides the quantity and emission factors used for the assessment for each regional variation.

*Table 14: Calculation inputs for VIC regional variation*

| Building element | Sub element | Emission factor source | Emission factor description | Quantity | Unit | Emission factor (kgCO2-e/unit) | Total emissions (tCO2-e) |
|---|---|---|---|---|---|---|---|
| Site prep | Excavation | The GreenBook | Bulk Excavation (In M3) - Bulk Excavation and Removal | 3.50 | m3 | 20.00 | 0.07 |
| Site prep | Excavation cost | The GreenBook | Bulk Excavation and Removal | Quantities based on cost redacted for confidentiality purposes | | | 0.05 |
| Substructure | Concrete | NABERS | Default - Generic concrete mix with a strength of 20MPa | 56.00 | m3 | 426.65 | 23.89 |
| Substructure | Steel mesh | NABERS | EPD - Steel, Reinforcing mesh, Steel, Reinforcing Mesh - SL53 to SL81, RL718 to RL1218 (mm) (InfraBuild, Australia), Australia | 1.12 | T | 2369.00 | 2.66 |
| Substructure | Steel mesh | NABERS | Default - Bar & mesh reinforcing steel | 2.60 | T | 4197.50 | 10.91 |
| Substructure | Bar reinforcement | NABERS | EPD - Steel, Reinforcing bar, Steel, Reinforcing bar, 10 mm to 50 mm, (InfraBuild, Australia), Australia | 0.20 | T | 1920.50 | 0.38 |
| Substructure | Aggregates | NABERS | Default - Aggregate fill - Various aggregates used as fill including quarry products, road base and ballast of differing size distributions | 32.76 | T | 11.73 | 0.38 |
| Substructure | Waterproofing | The GreenBook | Waterproof Membrane PVC 25 Microns - With laps in place | 47.00 | m3 | 0.43 | 0.02 |
| Substructure | Other | The GreenBook | Polystyrene - waffle pod slab - rigid insulation medium | 53.00 | m3 | 96.00 | 5.09 |
| Superstructure walls | Structural steel | NABERS | Default - Galvanised Structural sections steel (welded beam, columns, angles, plates etc) (hot rolled) | 0.05 | T | 4703.50 | 0.24 |
| Superstructure walls | Timber | NABERS | EPD - Hardwood, rough sawn, kiln-dried H3 ACQ, Australia | 4.30 | m3 | 401.66 | 1.73 |

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|---|---|---|---|---|---|---|---|
| Superstructure walls | Timber | NABERS | EPD - Softwood (Radiata pine), roughsawn, kiln-dried, H3 CCA treated, e.g. framing [majority from sustainable forest management practices] (FWPA) | 7.70 | m3 | 238.74 | 1.84 |
| Roof | Colorbond steel | The GreenBook | Colourbond Steel Am100 - 0.42mm - Added 30% waste and laps | 2.50 | m2 | 20.00 | 0.05 |
| Roof | Timber | NABERS | EPD - Softwood (Radiata pine), roughsawn, kiln-dried, H3 CCA treated, e.g. framing [majority from sustainable forest management practices] (FWPA) | 6.05 | m3 | 238.74 | 1.44 |
| Roof | Flashing | NABERS | Default - Steel cladding that has been painted, including all base metal thicknesses (BMT) from 0.42 mm to 1.0 mm | 25.62 | m2 | 13.80 | 0.35 |
| Roof | Roof covering | NABERS | Default - Concrete roof tiles | 19.00 | T | 303.60 | 5.77 |
| Roof | Fibre cement | The GreenBook | Fibre Cement, Hardieflex, Soffits And Eaves - Aus EPD (A1-A5) - Eaves and Soffits - 4.5mm thick | 40.00 | m2 | 6.25 | 0.25 |
| Roof | Soffit / Eaves | The GreenBook | Hardwood Timber Soffit / Eaves Lining 18mm - Virgin | 52.00 | m2 | 16.92 | 0.88 |
| PV | PV | The GreenBook | Polycrystalline Photovoltaic Solar Panels On Aluminium Frame - Virgin | 30.00 | m2 | 300.00 | 9.00 |
| Roof | Sarking | The GreenBook | Aluminium Faced Foil Sarking - Virgin | 243.00 | m2 | 5.02 | 1.22 |
| Roof | Insulation | The GreenBook | Glasswool Blanket Or Batt, Foil-Faced R2.0 (90mm) - 65% Recycled Content | 243.00 | m2 | 9.01 | 2.19 |
| Roof | Roof plank | The GreenBook | Hardwood | Quantities based on cost redacted for confidentiality purposes | | | 0.05 |
| Roof | Downpipes | The GreenBook | Residential Roof Construction | Quantities based on cost redacted for confidentiality purposes | | | 0.46 |
| Roof | PV cell mounting kit | The GreenBook | Sheet Metal Products | Quantities based on cost redacted for confidentiality purposes | | | 0.28 |
| Roof | Fascia, gutter | The GreenBook | Purlins, Girts and other light framing | Quantities based on cost redacted for confidentiality purposes | | | 0.04 |
| External walls | Timber framing | NABERS | EPD - Softwood (Radiata pine), surfaced, kiln-dried, H2 LOSP treated, [majority from sustainable forest management practices] (FWPA) | 7.92 | m3 | 194.01 | 1.54 |

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|---|---|---|---|---|---|---|---|
| External walls | Plasterboard lining | NABERS | Default - Plasterboard | 165.00 | m2 | 9.37 | 1.55 |
| External walls | Sarking | The GreenBook | Aluminium Faced Foil Sarking - Virgin | 165.00 | m2 | 5.03 | 0.83 |
| External walls | Insulation | The GreenBook | Glasswool Blanket or Batt, Foil-Faced R2.5 (100mm) - 65% Recycled Content | 165.00 | m2 | 10.00 | 1.65 |
| External walls | Waterproofing | The GreenBook | 2mm PVC / Bitumen Membrane - 2mm PVC / bitumen membrane | 165.00 | m2 | 28.00 | 4.62 |
| External wall components | Brick | NABERS | Default - Masonry bricks made from clay inc fired, perforated and used in masonry | 32.67 | T | 516.35 | 16.87 |
| External wall components | Mortar | The GreenBook | Mortar | 8.90 | T | 350.00 | 3.12 |
| External wall components | Sundries | NABERS | Default - Steel (light framing) - galvanised | 0.25 | T | 4657.50 | 1.16 |
| External walls | Sand | The GreenBook | Sand - Virgin - land sources | 8.00 | m3 | 7.50 | 0.06 |
| External walls | Steel sections | NABERS | Default - Galvanised Structural sections steel (welded beam, columns, angles, plates etc) (hot rolled) | 0.72 | T | 4703.50 | 3.39 |
| External walls | Stainless steel | NABERS | Default - Stainless steel (general) | 0.20 | T | 6888.50 | 1.38 |
| External walls | Plywood Board | The GreenBook | Plywood Board - 18mm | 10.00 | m2 | 32.00 | 0.32 |
| External walls | Timber | NABERS | Default - Laminated veneer timber (LVL) including treated & untreated | 0.70 | m3 | 508.30 | 0.36 |
| External walls | Timber | NABERS | EPD - Softwood (Radiata pine), surfaced, kiln-dried, H2 LOSP treated, [majority from sustainable forest management practices] (FWPA) | 0.15 | m3 | 194.01 | 0.03 |
| External walls | Expansion joints | The GreenBook | Residential building construction | Quantities based on cost redacted for confidentiality purposes | | | 0.04 |
| External walls | Brick cleaner | The GreenBook | Non-residential General External Wall (repair and maintenance) | Quantities based on cost redacted for confidentiality purposes | | | 0.08 |
| External walls | Hardware | The GreenBook | Non-residential General External Wall Construction | Quantities based on cost redacted for confidentiality purposes | | | 0.04 |

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|---|---|---|---|---|---|---|---|
| External windows | Windows | The GreenBook | Double Glazed Aluminium Framed Windows - 4/12/4mm toughened glass units | 23.00 | m2 | 317.83 | 7.31 |
| Internal walls | Timber framing | NABERS | EPD - Softwood (Radiata pine), surfaced, kiln-dried, H2 LOSP treated, [majority from sustainable forest management practices] (FWPA) | 6.70 | m3 | 194.01 | 1.30 |
| Internal walls | Plasterboard lining | NABERS | Default - Plasterboard - Board made from plaster typically coated in paper. Thickness from 4mm to 22mm. | 278.00 | m2 | 9.37 | 2.61 |
| Internal walls | Waterproofing | The GreenBook | 2mm PVC / Bitumen Membrane - 2mm PVC / bitumen membrane | 139.00 | m2 | 27.99 | 3.89 |
| Internal walls | Insulation | The GreenBook | Glasswool Blanket Or Batt, Foil-Faced R2.5 (90mm) - 65% Recycled Content | 100.50 | m2 | 10.00 | 1.01 |
| Wall finishes components | Ceramic Tile | NABERS | Default - Ceramic tiles (wall & floor) - excludes mortar, base, etc | 680.00 | kg | 1.13 | 0.77 |
| Wall finishes components | Epoxy glue | The GreenBook | 10mm epoxy glue | 34.00 | m2 | 41.00 | 1.39 |
| Wall finishes components | Grout | The GreenBook | Grout | 34.00 | m2 | 2.60 | 0.09 |
| Wall finishes | Timber skirting | NABERS | Timber Skirting Fixed With Glue (A1-A5) (In M) - 150mm high by 10mm thick | 7.00 | m2 | 6.54 | 0.05 |
| Wall finishes | Paint | The GreenBook | Paint Finish (In M2) - Acrylic and lime based paint | 244.00 | m2 | 2.99 | 0.73 |
| Wall finishes | Waterproofing | The GreenBook | 2mm PVC / Bitumen Membrane - 2mm PVC / bitumen membrane | 34.00 | m2 | 27.94 | 0.95 |
| Wall finishes | Painting service | The GreenBook | Paints | Quantities based on cost redacted for confidentiality purposes | | | 0.09 |
| Wall finishes | Wall wrap | The GreenBook | Residential Wall Finishes and Cladding | Quantities based on cost redacted for confidentiality purposes | | | 0.05 |
| Ceiling finishes | Plasterboard lining | NABERS | Default - Plasterboard - Board made from plaster typically coated in paper. Thickness from 4mm to 22mm. | 255.00 | m2 | 9.37 | 2.39 |
| Ceiling finishes | Paint | The GreenBook | Paint Finish (In M2) - Acrylic and lime based paint | 255.00 | m2 | 3.02 | 0.77 |
| Ceiling finishes | Insulation | The GreenBook | Glasswool Blanket Or Batt, Foil-Faced R2.5 (100mm) - 65% Recycled Content | 30.00 | m2 | 10.00 | 0.30 |

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|---|---|---|---|---|---|---|---|
| Ceiling finishes | Insulation | The GreenBook | Glasswool Blanket Or Batt, Foil-Faced R3 (130mm) - 65% Recycled Content | 570.00 | m2 | 16.00 | 9.12 |
| Floor finishes components | Ceramic Tile | NABERS | Default - Ceramic tiles (wall & floor) - excludes mortar, base, etc. | 420.00 | kg | 1.13 | 0.48 |
| Floor finishes components | Epoxy glue | The GreenBook | 10mm epoxy glue | 21.00 | m2 | 41.00 | 0.86 |
| Floor finishes components | Grout | The GreenBook | Grout | 21.00 | m2 | 2.60 | 0.05 |
| Floor finishes components | Concrete tile | The GreenBook | 20mm concrete tile | 42.00 | m2 | 17.00 | 0.71 |
| Floor finishes components | Polishing | The GreenBook | Polishing allowance | 42.00 | m2 | 17.00 | 0.71 |
| Floor finishes components | Mortar | The GreenBook | 30mm cement mortar bedding | 42.00 | m2 | 31.00 | 1.30 |
| Floor finishes components | Fixing | The GreenBook | Allow for fix in to site @ $50/m2 & 0.6kgCO2/$ | 42.00 | m2 | 30.00 | 1.26 |
| Floor finishes | Carpet | NABERS | Default - Carpet flooring | 55.00 | m2 | 39.33 | 2.16 |
| Floor finishes | Timber Boards | The GreenBook | Engineered Timber Boards - 12mm | 102.00 | m2 | 33.04 | 3.37 |
| Floor finishes | Sealer | The GreenBook | Concrete Sealer - Applied to floor | 36.00 | m2 | 1.94 | 0.07 |
| Floor finishes | Waterproofing | The GreenBook | 2mm PVC / Bitumen Membrane - 2mm PVC / bitumen membrane | 21.00 | m2 | 27.98 | 0.59 |
| Doors | Solid door | The GreenBook | Solid Timber Door And Frame, 35mm Thick Leaf - Single leaf, virgin | 10.00 | No | 105.00 | 1.05 |
| Doors | Roller Shutter | NABERS | EPD - Roller doors sectional door 601 (Europe) | 11.00 | m2 | 126.50 | 1.39 |
| Doors | Glazed door | NABERS | Default - Door - glazed - Aluminium frame - Generic | 1.67 | m2 | 359.95 | 0.60 |
| Doors | Hardware | The GreenBook | Residential Doors/Frames and Hardware | Quantities based on cost redacted for confidentiality purposes | | | 0.52 |

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|---|---|---|---|---|---|---|---|
| Fittings & sundries | Stainless steel | The GreenBook | Kitchen Sink - Stainless steel | 2.00 | No. | 445.00 | 0.89 |
| Fittings & sundries | Laminated HDR | The GreenBook | Base Unit for Kitchen Sink/ Hand Basin - Laminated HMR | 12.16 | Lm | 380.76 | 4.63 |
| Fittings & sundries | Benchtop stone | The GreenBook | Benchtop - Reconstituted stone | 0.14 | m3 | 1071.43 | 0.15 |
| Fittings & sundries | Kitchen cabinets and vanity | The GreenBook | Built-in Cabinetry | Quantities based on cost redacted for confidentiality purposes | | | 0.98 |
| Fittings & sundries | Shelving | The GreenBook | Residential Fittings and Sundries | Quantities based on cost redacted for confidentiality purposes | | | 0.34 |
| Fittings & sundries | Mirror | The GreenBook | Residential Fittings and Sundries | Quantities based on cost redacted for confidentiality purposes | | | 0.29 |
| Mechanical services | AC ducted heating | The GreenBook | Air Conditioning | Quantities based on cost redacted for confidentiality purposes | | | 2.53 |
| Electrical services | Meter panel, 3 Phase power | The GreenBook | General Electrical Services | Quantities based on cost redacted for confidentiality purposes | | | 0.41 |
| Electrical services | Cabling works | The GreenBook | General Electrical Services | Quantities based on cost redacted for confidentiality purposes | | | 1.65 |
| Electrical services | PV Cell installation | The GreenBook | Solar PV array | Quantities based on cost redacted for confidentiality purposes | | | 1.01 |
| Electrical services | Telecommunication lines | The GreenBook | Cable and conduit | Quantities based on cost redacted for confidentiality purposes | | | 0.18 |
| Hydraulic services | Basins | The GreenBook | Porcelain - Virgin porcelain - all types (pans, basins, cisterns, etc.) | 125.00 | kg | 7.04 | 0.88 |
| Hydraulic services | Stormwater, sewer and PVC pipes | The GreenBook | General Hydraulic Services | Quantities based on cost redacted for confidentiality purposes | | | 1.03 |
| Hydraulic services | Hot water system | The GreenBook | General Hydraulic Services | Quantities based on cost redacted for confidentiality purposes | | | 4.05 |
| External works component | Concrete | NABERS | Default - Generic concrete mix with a strength of 20MPa | 12.32 | m3 | 426.65 | 5.26 |
| External works component | Steel | NABERS | Default - Reinforcing steel bar & mesh | 0.32 | T | 4197.50 | 1.34 |

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|---|---|---|---|---|---|---|---|
| External works component | Waterproofing | The GreenBook | 40mic plastic membrane | 77.00 | m2 | 2.00 | 0.15 |
| External works component | Sand bed | The GreenBook | 50mm sand bed | 77.00 | m2 | 1.00 | 0.08 |
| External works component | Sealer | The GreenBook | Sealer | 77.00 | m2 | 6.00 | 0.46 |
| External works | Fence | The GreenBook | Fence - Timber paling 1800mm high | 128.00 | m2 | 71.02 | 9.09 |
| External works | Steel Balustrade | The GreenBook | Stainless Steel Balustrade - 1200mm high | 14.00 | Lm | 325.71 | 4.56 |
| External works | Stormwater drains | The GreenBook | Water Supplies and Equipment | Quantities based on cost redacted for confidentiality purposes | | | 0.83 |
| Furniture | Appliances | The GreenBook | Household Appliances | Quantities based on cost redacted for confidentiality purposes | | | 0.37 |
| Furniture | Cooktop, rangehood | The GreenBook | Induction Cooktop - Bosch - Serie 8 90cm PIV975DC1E | Quantities based on cost redacted for confidentiality purposes | | | 0.86 |
| Total | | | | | | | 196.23 |

*Table 15: Calculation inputs for ACT & TAS regional variation*

| Building element | Sub element | Emission factor source | Emission factor description | Quantity | Unit | Emission factor (kgCO2-e/unit) | Total emissions (tCO2-e) |
|---|---|---|---|---|---|---|---|
| Site prep | Excavation | The GreenBook | Bulk Excavation (In M3) - Bulk Excavation and Removal | 3.50 | m3 | 20.00 | 0.07 |
| Site prep | Excavation cost | The GreenBook | Bulk Excavation and Removal | Quantities based on cost redacted for confidentiality purposes | | | 0.05 |
| Substructure | Concrete | NABERS | Default - Generic concrete mix with a strength of 20MPa | 56.00 | m3 | 426.65 | 23.89 |
| Substructure | Steel mesh | NABERS | EPD - Steel, Reinforcing mesh, Steel, Reinforcing Mesh - SL53 to SL81, RL718 to RL1218 (mm) (InfraBuild, Australia), Australia | 1.12 | T | 2369.00 | 2.66 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Substructure | Steel mesh | NABERS | Default - Bar & mesh reinforcing steel | 2.60 | T | 4197.50 | 10.91 |
| Substructure | Bar reinforcement | NABERS | EPD - Steel, Reinforcing bar, Steel, Reinforcing bar, 10 mm to 50 mm, (InfraBuild, Australia), Australia | 0.20 | T | 1920.50 | 0.38 |
| Substructure | Aggregates | NABERS | Default - Aggregate fill - Various aggregates used as fill including quarry products, road base and ballast of differing size distributions | 32.76 | T | 11.73 | 0.38 |
| Substructure | Waterproofing | The GreenBook | Waterproof Membrane PVC 25 Microns - With laps in place | 47.00 | m3 | 0.43 | 0.02 |
| Substructure | Other | The GreenBook | Polystyrene - waffle pod slab - rigid insulation medium | 53.00 | m3 | 96.00 | 5.09 |
| Superstructure walls | Structural steel | NABERS | Default - Galvanised Structural sections steel (welded beam, columns, angles, plates etc) (hot rolled) | 0.05 | T | 4703.50 | 0.24 |
| Superstructure walls | Timber | NABERS | EPD - Hardwood, rough sawn, kiln-dried H3 ACQ, Australia | 4.30 | m3 | 401.66 | 1.73 |
| Superstructure walls | Timber | NABERS | EPD - Softwood (Radiata pine), roughsawn, kiln-dried, H3 CCA treated, e.g. framing [majority from sustainable forest management practices] (FWPA) | 7.70 | m3 | 238.74 | 1.84 |
| Roof | Colorbond steel | The GreenBook | Colourbond Steel Am100 - 0.42mm - Added 30% waste and laps | 2.50 | m2 | 20.00 | 0.05 |
| Roof | Timber | NABERS | EPD - Softwood (Radiata pine), roughsawn, kiln-dried, H3 CCA treated, e.g. framing [majority from sustainable forest management practices] (FWPA) | 0.30 | m3 | 238.74 | 0.07 |
| Roof | Timber | NABERS | EPD - Softwood (Radiata pine), roughsawn, kiln-dried, H3 CCA treated, e.g. framing [majority from sustainable forest management practices] (FWPA) | 4.80 | m3 | 238.74 | 1.15 |
| Roof | Flashing | NABERS | Default - Steel cladding that has been painted, including all base metal thicknesses (BMT) from 0.42 mm to 1.0 mm | 25.62 | m2 | 13.80 | 0.35 |
| Roof | Roof covering | NABERS | Default - Steel cladding with a metallic coating including all base metal thicknesses (BMT) from 0.3 mm to 2.9mm | 348.00 | m2 | 9.60 | 3.34 |
| Roof | Fibre cement | The GreenBook | Fibre Cement, Hardieflex, Soffits And Eaves - Aus EPD (A1-A5) - Eaves and Soffits - 4.5mm thick | 40.00 | m2 | 6.25 | 0.25 |
| Roof | Soffit / Eaves | The GreenBook | Hardwood Timber Soffit / Eaves Lining 18mm - Virgin | 52.00 | m2 | 16.92 | 0.88 |

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|---|---|---|---|---|---|---|---|
| PV | PV | The GreenBook | Polycrystalline Photovoltaic Solar Panels On Aluminium Frame - Virgin | 30.00 | m2 | 300.00 | 9.00 |
| Roof | Sarking | The GreenBook | Aluminium Faced Foil Sarking - Virgin | 243.00 | m2 | 5.02 | 1.22 |
| Roof | Insulation | The GreenBook | Glasswool Blanket Or Batt, Foil-Faced R2.0 (90mm) - 65% Recycled Content | 243.00 | m2 | 9.01 | 2.19 |
| Roof | Roof plank | The GreenBook | Hardwood | Quantities based on cost redacted for confidentiality purposes | | | 0.05 |
| Roof | Downpipes | The GreenBook | Residential Roof Construction | Quantities based on cost redacted for confidentiality purposes | | | 0.46 |
| Roof | PV cell mounting kit | The GreenBook | Sheet Metal Products | Quantities based on cost redacted for confidentiality purposes | | | 0.28 |
| Roof | Fascia, gutter | The GreenBook | Purlins, Girts and other light framing | Quantities based on cost redacted for confidentiality purposes | | | 0.04 |
| External walls | Timber framing | NABERS | EPD - Softwood (Radiata pine), surfaced, kiln-dried, H2 LOSP treated, [majority from sustainable forest management practices] (FWPA) | 7.92 | m3 | 194.01 | 1.54 |
| External walls | Plasterboard lining | NABERS | Default - Plasterboard | 165.00 | m2 | 9.37 | 1.55 |
| External walls | Sarking | The GreenBook | Aluminium Faced Foil Sarking - Virgin | 165.00 | m2 | 5.03 | 0.83 |
| External walls | Insulation | The GreenBook | Glasswool Blanket Or Batt, Foil-Faced R3 (130mm) - 65% Recycled Content | 165.00 | m2 | 12.00 | 1.98 |
| External walls | Waterproofing | The GreenBook | 2mm PVC / Bitumen Membrane - 2mm PVC / bitumen membrane | 165.00 | m2 | 28.00 | 4.62 |
| External wall components | Brick | NABERS | Default - Masonry bricks made from clay inc fired, perforated and used in masonry | 32.67 | T | 516.35 | 16.87 |
| External wall components | Mortar | The GreenBook | Mortar | 8.90 | T | 350.00 | 3.12 |
| External wall components | Sundries | NABERS | Default - Steel (light framing) - galvanised | 0.25 | T | 4657.50 | 1.16 |
| External walls | Sand | The GreenBook | Sand - Virgin - land sources | 8.00 | m3 | 7.50 | 0.06 |

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|---|---|---|---|---|---|---|---|
| External walls | Steel sections | NABERS | Default - Galvanised Structural sections steel (welded beam, columns, angles, plates etc) (hot rolled) | 0.72 | T | 4703.50 | 3.39 |
| External walls | Stainless steel | NABERS | Default - Stainless steel (general) | 0.20 | T | 6888.50 | 1.38 |
| External walls | Plywood Board | The GreenBook | Plywood Board - 18mm | 10.00 | m2 | 32.00 | 0.32 |
| External walls | Timber | NABERS | Default - Laminated veneer timber (LVL) including treated & untreated | 0.70 | m3 | 508.30 | 0.36 |
| External walls | Timber | NABERS | EPD - Softwood (Radiata pine), surfaced, kiln-dried, H2 LOSP treated, [majority from sustainable forest management practices] (FWPA) | 0.15 | m3 | 194.01 | 0.03 |
| External walls | Expansion joints | The GreenBook | Residential building construction | Quantities based on cost redacted for confidentiality purposes | | | 0.04 |
| External walls | Brick cleaner | The GreenBook | Non-residential General External Wall (repair and maintenance) | Quantities based on cost redacted for confidentiality purposes | | | 0.08 |
| External walls | Hardware | The GreenBook | Non-residential General External Wall Construction | Quantities based on cost redacted for confidentiality purposes | | | 0.04 |
| External windows | Windows | The GreenBook | Double Glazed Aluminium Framed Windows - 4/12/4mm toughened glass units | 23.00 | m2 | 317.83 | 7.31 |
| Internal walls | Timber framing | NABERS | EPD - Softwood (Radiata pine), surfaced, kiln-dried, H2 LOSP treated, [majority from sustainable forest management practices] (FWPA) | 6.70 | m3 | 194.01 | 1.30 |
| Internal walls | Plasterboard lining | NABERS | Default - Plasterboard - Board made from plaster typically coated in paper. Thickness from 4mm to 22mm. | 278.00 | m2 | 9.37 | 2.61 |
| Internal walls | Waterproofing | The GreenBook | 2mm PVC / Bitumen Membrane - 2mm PVC / bitumen membrane | 139.00 | m2 | 27.99 | 3.89 |
| Internal walls | Insulation | The GreenBook | Glasswool Blanket Or Batt, Foil-Faced R2.5 (90mm) - 65% Recycled Content | 100.50 | m2 | 10.00 | 1.01 |
| Wall finishes components | Ceramic Tile | NABERS | Default - Ceramic tiles (wall & floor) - excludes mortar, base, etc | 680.00 | kg | 1.13 | 0.77 |
| Wall finishes components | Epoxy glue | The GreenBook | 10mm epoxy glue | 34.00 | m2 | 41.00 | 1.39 |

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|---|---|---|---|---|---|---|---|
| Wall finishes components | Grout | The GreenBook | Grout | 34.00 | m2 | 2.60 | 0.09 |
| Wall finishes | Timber skirting | NABERS | Timber Skirting Fixed With Glue (A1-A5) (In M) - 150mm high by 10mm thick | 7.00 | m2 | 6.54 | 0.05 |
| Wall finishes | Paint | The GreenBook | Paint Finish (In M2) - Acrylic and lime based paint | 244.00 | m2 | 2.99 | 0.73 |
| Wall finishes | Waterproofing | The GreenBook | 2mm PVC / Bitumen Membrane - 2mm PVC / bitumen membrane | 34.00 | m2 | 27.94 | 0.95 |
| Wall finishes | Painting service | The GreenBook | Paints | Quantities based on cost redacted for confidentiality purposes | | | 0.09 |
| Wall finishes | Wall wrap | The GreenBook | Residential Wall Finishes and Cladding | Quantities based on cost redacted for confidentiality purposes | | | 0.05 |
| Ceiling finishes | Plasterboard lining | NABERS | Default - Plasterboard - Board made from plaster typically coated in paper. Thickness from 4mm to 22mm. | 255.00 | m2 | 9.37 | 2.39 |
| Ceiling finishes | Paint | The GreenBook | Paint Finish (In M2) - Acrylic and lime based paint | 255.00 | m2 | 3.02 | 0.77 |
| Ceiling finishes | Insulation | The GreenBook | Glasswool Blanket Or Batt, Foil-Faced R2.5 (100mm) - 65% Recycled Content | 30.00 | m2 | 10.00 | 0.30 |
| Ceiling finishes | Insulation | The GreenBook | Glasswool Blanket Or Batt, Foil-Faced R3 (130mm) - 65% Recycled Content | 570.00 | m2 | 16.00 | 9.12 |
| Floor finishes components | Ceramic Tile | NABERS | Default - Ceramic tiles (wall & floor) - excludes mortar, base, etc | 420.00 | kg | 1.13 | 0.48 |
| Floor finishes components | Epoxy glue | The GreenBook | 10mm epoxy glue | 21.00 | m2 | 41.00 | 0.86 |
| Floor finishes components | Grout | The GreenBook | Grout | 21.00 | m2 | 2.60 | 0.05 |
| Floor finishes components | Concrete tile | The GreenBook | 20mm concrete tile | 42.00 | m2 | 17.00 | 0.71 |
| Floor finishes components | Polishing | The GreenBook | Polishing allowance | 42.00 | m2 | 17.00 | 0.71 |
| Floor finishes components | Mortar | The GreenBook | 30mm cement mortar bedding | 42.00 | m2 | 31.00 | 1.30 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Floor finishes components | Fixing | The GreenBook | Allow for fix in to site @ $50/m2 & 0.6kgCO2/$ | 42.00 | m2 | 30.00 | 1.26 |
| Floor finishes | Carpet | NABERS | Default - Carpet flooring | 55.00 | m2 | 39.33 | 2.16 |
| Floor finishes | Timber Boards | The GreenBook | Engineered Timber Boards - 12mm | 102.00 | m2 | 33.04 | 3.37 |
| Floor finishes | Sealer | The GreenBook | Concrete Sealer - Applied to floor | 36.00 | m2 | 1.94 | 0.07 |
| Floor finishes | Waterproofing | The GreenBook | 2mm PVC / Bitumen Membrane - 2mm PVC / bitumen membrane | 21.00 | m2 | 27.98 | 0.59 |
| Doors | Solid door | The GreenBook | Solid Timber Door And Frame, 35mm Thick Leaf - Single leaf, virgin | 10.00 | No | 105.00 | 1.05 |
| Doors | Roller Shutter | NABERS | EPD - Roller doors sectional door 601 (Europe) | 11.00 | m2 | 126.50 | 1.39 |
| Doors | Glazed door | NABERS | Default - Door - glazed - Aluminium frame - Generic | 1.67 | m2 | 359.95 | 0.60 |
| Doors | Hardware | The GreenBook | Residential Doors/Frames and Hardware | Quantities based on cost redacted for confidentiality purposes | | | 0.52 |
| Fittings & sundries | Stainless steel | The GreenBook | Kitchen Sink - Stainless steel | 2.00 | No. | 445.00 | 0.89 |
| Fittings & sundries | Laminated HDR | The GreenBook | Base Unit for Kitchen Sink/ Hand Basin - Laminated HMR | 12.16 | Lm | 380.76 | 4.63 |
| Fittings & sundries | Benchtop stone | The GreenBook | Benchtop - Reconstituted stone | 0.14 | m3 | 1071.43 | 0.15 |
| Fittings & sundries | Kitchen cabinets and vanity | The GreenBook | Built-in Cabinetry | Quantities based on cost redacted for confidentiality purposes | | | 0.98 |
| Fittings & sundries | Shelving | The GreenBook | Residential Fittings and Sundries | Quantities based on cost redacted for confidentiality purposes | | | 0.34 |
| Fittings & sundries | Mirror | The GreenBook | Residential Fittings and Sundries | Quantities based on cost redacted for confidentiality purposes | | | 0.29 |
| Mechanical services | AC ducted heating | The GreenBook | Air Conditioning | Quantities based on cost redacted for confidentiality purposes | | | 2.53 |

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|---|---|---|---|---|---|---|---|
| Electrical services | Meter panel, 3 Phase power | The GreenBook | General Electrical Services | Quantities based on cost redacted for confidentiality purposes | | | 0.41 |
| Electrical services | Cabling works | The GreenBook | General Electrical Services | Quantities based on cost redacted for confidentiality purposes | | | 1.65 |
| Electrical services | PV Cell installation | The GreenBook | Solar PV array | Quantities based on cost redacted for confidentiality purposes | | | 1.01 |
| Electrical services | Telecommunication lines | The GreenBook | Cable and conduit | Quantities based on cost redacted for confidentiality purposes | | | 0.18 |
| Hydraulic services | Basins | The GreenBook | Porcelain - Virgin porcelain - all types (pans, basins, cisterns, etc.) | 125.00 | kg | 7.04 | 0.88 |
| Hydraulic services | Stormwater, sewer and PVC pipes | The GreenBook | General Hydraulic Services | Quantities based on cost redacted for confidentiality purposes | | | 1.03 |
| Hydraulic services | Hot water system | The GreenBook | General Hydraulic Services | Quantities based on cost redacted for confidentiality purposes | | | 4.05 |
| External works component | Concrete | NABERS | Default - Generic concrete mix with a strength of 20MPa | 12.32 | m3 | 426.65 | 5.26 |
| External works component | Steel | NABERS | Default - Reinforcing steel bar & mesh | 0.32 | T | 4197.50 | 1.34 |
| External works component | Waterproofing | The GreenBook | 40mic plastic membrane | 77.00 | m2 | 2.00 | 0.15 |
| External works component | Sand bed | The GreenBook | 50mm sand bed | 77.00 | m2 | 1.00 | 0.08 |
| External works component | Sealer | The GreenBook | Sealer | 77.00 | m2 | 6.00 | 0.46 |
| External works | Fence | The GreenBook | Fence - Timber paling 1800mm high | 128.00 | m2 | 71.02 | 9.09 |
| External works | Steel Balustrade | The GreenBook | Stainless Steel Balustrade - 1200mm high | 14.00 | Lm | 325.71 | 4.56 |
| External works | Stormwater drains | The GreenBook | Water Supplies and Equipment | Quantities based on cost redacted for confidentiality purposes | | | 0.83 |
| Furniture | Appliances | The GreenBook | Household Appliances | Quantities based on cost redacted for confidentiality purposes | | | 0.37 |

| | | | | | |
|---|---|---|---|---|---|
| Furniture | Cooktop, rangehood | The GreenBook | Induction Cooktop - Bosch - Serie 8 90cm PIV975DC1E | Quantities based on cost redacted for confidentiality purposes | 0.86 |
| Total | | | | | 193.91 |

*Table 16: Calculation inputs for NSW regional variation*

| Building element | Sub element | Emission factor source | Emission factor description | Quantity | Unit | Emission factor (kgCO2-e/unit) | Total emissions (tCO2-e) |
|---|---|---|---|---|---|---|---|
| Site prep | Excavation | The GreenBook | Bulk Excavation (In M3) - Bulk Excavation and Removal | 3.50 | m3 | 20.00 | 0.07 |
| Site prep | Excavation cost | The GreenBook | Bulk Excavation and Removal | Quantities based on cost redacted for confidentiality purposes | | | 0.05 |
| Substructure | Concrete | NABERS | Default - Generic concrete mix with a strength of 20MPa | 56.00 | m3 | 426.65 | 23.89 |
| Substructure | Steel mesh | NABERS | EPD - Steel, Reinforcing mesh, Steel, Reinforcing Mesh - SL53 to SL81, RL718 to RL1218 (mm) (InfraBuild, Australia), Australia | 1.12 | T | 2369.00 | 2.66 |
| Substructure | Steel mesh | NABERS | Default - Bar & mesh reinforcing steel | 2.60 | T | 4197.50 | 10.91 |
| Substructure | Bar reinforcement | NABERS | EPD - Steel, Reinforcing bar, Steel, Reinforcing bar, 10 mm to 50 mm, (InfraBuild, Australia), Australia | 0.20 | T | 1920.50 | 0.38 |
| Substructure | Aggregates | NABERS | Default - Aggregate fill - Various aggregates used as fill including quarry products, road base and ballast of differing size distributions | 32.76 | T | 11.73 | 0.38 |
| Substructure | Waterproofing | The GreenBook | Waterproof Membrane PVC 25 Microns - With laps in place | 47.00 | m3 | 0.43 | 0.02 |
| Substructure | Other | The GreenBook | Polystyrene - waffle pod slab - rigid insulation medium | 53.00 | m3 | 96.00 | 5.09 |
| Superstructure walls | Structural steel | NABERS | Default - Galvanised Structural sections steel (welded beam, columns, angles, plates etc) (hot rolled) | 0.05 | T | 4703.50 | 0.24 |
| Superstructure walls | Timber | NABERS | EPD - Hardwood, rough sawn, kiln-dried H3 ACQ, Australia | 4.30 | m3 | 401.66 | 1.73 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Superstructure walls | Timber | NABERS | EPD - Softwood (Radiata pine), roughsawn, kiln-dried, H3 CCA treated, e.g. framing [majority from sustainable forest management practices] (FWPA) | 7.70 | m3 | 238.74 | 1.84 |
| Roof | Colorbond steel | The GreenBook | Colourbond Steel Am100 - 0.42mm - Added 30% waste and laps | 2.50 | m2 | 20.00 | 0.05 |
| Roof | Timber | NABERS | EPD - Softwood (Radiata pine), roughsawn, kiln-dried, H3 CCA treated, e.g. framing [majority from sustainable forest management practices] (FWPA) | 5.1 | m3 | 238.74 | 1.22 |
| Roof | Flashing | NABERS | Default - Steel cladding that has been painted, including all base metal thicknesses (BMT) from 0.42 mm to 1.0 mm | 25.62 | m2 | 13.80 | 0.35 |
| Roof | Roof covering | NABERS | Default - Steel cladding with a metallic coating including all base metal thicknesses (BMT) from 0.3 mm to 2.9mm | 348.00 | m2 | 9.60 | 3.34 |
| Roof | Fibre cement | The GreenBook | Fibre Cement, Hardieflex, Soffits And Eaves - Aus EPD (A1-A5) - Eaves and Soffits - 4.5mm thick | 40.00 | m2 | 6.25 | 0.25 |
| Roof | Soffit / Eaves | The GreenBook | Hardwood Timber Soffit / Eaves Lining 18mm - Virgin | 52.00 | m2 | 16.92 | 0.88 |
| PV | PV | The GreenBook | Polycrystalline Photovoltaic Solar Panels On Aluminium Frame - Virgin | 30.00 | m2 | 300.00 | 9.00 |
| Roof | Sarking | The GreenBook | Aluminium Faced Foil Sarking - Virgin | 243.00 | m2 | 5.02 | 1.22 |
| Roof | Insulation | The GreenBook | Glasswool Blanket Or Batt, Foil-Faced R2.0 (90mm) - 65% Recycled Content | 243.00 | m2 | 9.01 | 2.19 |
| Roof | Roof plank | The GreenBook | Hardwood | Quantities based on cost redacted for confidentiality purposes | | | 0.05 |
| Roof | Downpipes | The GreenBook | Residential Roof Construction | Quantities based on cost redacted for confidentiality purposes | | | 0.46 |
| Roof | PV cell mounting kit | The GreenBook | Sheet Metal Products | Quantities based on cost redacted for confidentiality purposes | | | 0.28 |
| Roof | Fascia, gutter | The GreenBook | Purlins, Girts and other light framing | Quantities based on cost redacted for confidentiality purposes | | | 0.04 |
| External walls | Timber framing | NABERS | EPD - Softwood (Radiata pine), surfaced, kiln-dried, H2 LOSP treated, [majority from sustainable forest management practices] (FWPA) | 7.92 | m3 | 194.01 | 1.54 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| External walls | Plasterboard lining | NABERS | Default - Plasterboard | 165.00 | m2 | 9.37 | 1.55 |
| External walls | Sarking | The GreenBook | Aluminium Faced Foil Sarking - Virgin | 165.00 | m2 | 5.03 | 0.83 |
| External walls | Insulation | The GreenBook | Glasswool Blanket or Batt, Foil-Faced R2.5 (100mm) - 65% Recycled Content | 165.00 | m2 | 10.00 | 1.65 |
| External walls | Waterproofing | The GreenBook | 2mm PVC / Bitumen Membrane - 2mm PVC / bitumen membrane | 165.00 | m2 | 28.00 | 4.62 |
| External wall components | Brick | NABERS | Default - Masonry bricks made from clay inc fired, perforared and used in masonry | 32.67 | T | 516.35 | 16.87 |
| External wall components | Mortar | The GreenBook | Mortar | 8.90 | T | 350.00 | 3.12 |
| External wall components | Sundries | NABERS | Default - Steel (light framing) - galvanised | 0.25 | T | 4657.50 | 1.16 |
| External walls | Sand | The GreenBook | Sand - Virgin - land sources | 8.00 | m3 | 7.50 | 0.06 |
| External walls | Steel sections | NABERS | Default - Galvanised Structural sections steel (welded beam, columns, angles, plates etc) (hot rolled) | 0.72 | T | 4703.50 | 3.39 |
| External walls | Stainless steel | NABERS | Default - Stainless steel (general) | 0.20 | T | 6888.50 | 1.38 |
| External walls | Plywood Board | The GreenBook | Plywood Board - 18mm | 10.00 | m2 | 32.00 | 0.32 |
| External walls | Timber | NABERS | Default - Laminated veneer timber (LVL) including treated & untreated | 0.70 | m3 | 508.30 | 0.36 |
| External walls | Timber | NABERS | EPD - Softwood (Radiata pine), surfaced, kiln-dried, H2 LOSP treated, [majority from sustainable forest management practices] (FWPA) | 0.15 | m3 | 194.01 | 0.03 |
| External walls | Expansion joints | The GreenBook | Residential building construction | Quantities based on cost redacted for confidentiality purposes | | | 0.04 |
| External walls | Brick cleaner | The GreenBook | Non-residential General External Wall (repair and maintenance) | Quantities based on cost redacted for confidentiality purposes | | | 0.08 |
| External walls | Hardware | The GreenBook | Non-residential General External Wall Construction | Quantities based on cost redacted for confidentiality purposes | | | 0.04 |

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|---|---|---|---|---|---|---|---|
| External windows | Windows | The GreenBook | Double Glazed Aluminium Framed Windows - 4/12/4mm toughened glass units | 23.00 | m2 | 317.83 | 7.31 |
| Internal walls | Timber framing | NABERS | EPD - Softwood (Radiata pine), surfaced, kiln-dried, H2 LOSP treated, [majority from sustainable forest management practices] (FWPA) | 6.70 | m3 | 194.01 | 1.30 |
| Internal walls | Plasterboard lining | NABERS | Default - Plasterboard - Board made from plaster typically coated in paper. Thickness from 4mm to 22mm. | 278.00 | m2 | 9.37 | 2.61 |
| Internal walls | Waterproofing | The GreenBook | 2mm PVC / Bitumen Membrane - 2mm PVC / bitumen membrane | 139.00 | m2 | 27.99 | 3.89 |
| Internal walls | Insulation | The GreenBook | Glasswool Blanket Or Batt, Foil-Faced R2.5 (90mm) - 65% Recycled Content | 100.50 | m2 | 10.00 | 1.01 |
| Wall finishes components | Ceramic Tile | NABERS | Default - Ceramic tiles (wall & floor) - excludes mortar, base, etc | 680.00 | kg | 1.13 | 0.77 |
| Wall finishes components | Epoxy glue | The GreenBook | 10mm epoxy glue | 34.00 | m2 | 41.00 | 1.39 |
| Wall finishes components | Grout | The GreenBook | Grout | 34.00 | m2 | 2.60 | 0.09 |
| Wall finishes | Timber skirting | NABERS | Timber Skirting Fixed With Glue (A1-A5) (In M) - 150mm high by 10mm thick | 7.00 | m2 | 6.54 | 0.05 |
| Wall finishes | Paint | The GreenBook | Paint Finish (In M2) - Acrylic and lime based paint | 244.00 | m2 | 2.99 | 0.73 |
| Wall finishes | Waterproofing | The GreenBook | 2mm PVC / Bitumen Membrane - 2mm PVC / bitumen membrane | 34.00 | m2 | 27.94 | 0.95 |
| Wall finishes | Painting service | The GreenBook | Paints | Quantities based on cost redacted for confidentiality purposes | | | 0.09 |
| Wall finishes | Wall wrap | The GreenBook | Residential Wall Finishes and Cladding | Quantities based on cost redacted for confidentiality purposes | | | 0.05 |
| Ceiling finishes | Plasterboard lining | NABERS | Default - Plasterboard - Board made from plaster typically coated in paper. Thickness from 4mm to 22mm. | 255.00 | m2 | 9.37 | 2.39 |
| Ceiling finishes | Paint | The GreenBook | Paint Finish (In M2) - Acrylic and lime based paint | 255.00 | m2 | 3.02 | 0.77 |
| Ceiling finishes | Insulation | The GreenBook | Glasswool Blanket Or Batt, Foil-Faced R2.5 (100mm) - 65% Recycled Content | 30.00 | m2 | 10.00 | 0.30 |

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|---|---|---|---|---|---|---|---|
| Ceiling finishes | Insulation | The GreenBook | Glasswool Blanket Or Batt, Foil-Faced R3 (130mm) - 65% Recycled Content | 570.00 | m2 | 16.00 | 9.12 |
| Floor finishes components | Ceramic Tile | NABERS | Default - Ceramic tiles (wall & floor) - excludes mortar, base, etc. | 420.00 | kg | 1.13 | 0.48 |
| Floor finishes components | Epoxy glue | The GreenBook | 10mm epoxy glue | 21.00 | m2 | 41.00 | 0.86 |
| Floor finishes components | Grout | The GreenBook | Grout | 21.00 | m2 | 2.60 | 0.05 |
| Floor finishes components | Concrete tile | The GreenBook | 20mm concrete tile | 42.00 | m2 | 17.00 | 0.71 |
| Floor finishes components | Polishing | The GreenBook | Polishing allowance | 42.00 | m2 | 17.00 | 0.71 |
| Floor finishes components | Mortar | The GreenBook | 30mm cement mortar bedding | 42.00 | m2 | 31.00 | 1.30 |
| Floor finishes components | Fixing | The GreenBook | Allow for fix in to site @ $50/m2 & 0.6kgCO2/$ | 42.00 | m2 | 30.00 | 1.26 |
| Floor finishes | Carpet | NABERS | Default - Carpet flooring | 55.00 | m2 | 39.33 | 2.16 |
| Floor finishes | Timber Boards | The GreenBook | Engineered Timber Boards - 12mm | 102.00 | m2 | 33.04 | 3.37 |
| Floor finishes | Sealer | The GreenBook | Concrete Sealer - Applied to floor | 36.00 | m2 | 1.94 | 0.07 |
| Floor finishes | Waterproofing | The GreenBook | 2mm PVC / Bitumen Membrane - 2mm PVC / bitumen membrane | 21.00 | m2 | 27.98 | 0.59 |
| Doors | Solid door | The GreenBook | Solid Timber Door And Frame, 35mm Thick Leaf - Single leaf, virgin | 10.00 | No | 105.00 | 1.05 |
| Doors | Roller Shutter | NABERS | EPD - Roller doors sectional door 601 (Europe) | 11.00 | m2 | 126.50 | 1.39 |
| Doors | Glazed door | NABERS | Default - Door - glazed - Aluminium frame - Generic | 1.67 | m2 | 359.95 | 0.60 |
| Doors | Hardware | The GreenBook | Residential Doors/Frames and Hardware | Quantities based on cost redacted for confidentiality purposes | | | 0.52 |

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|---|---|---|---|---|---|---|---|
| Fittings & sundries | Stainless steel | The GreenBook | Kitchen Sink - Stainless steel | 2.00 | No. | 445.00 | 0.89 |
| Fittings & sundries | Laminated HDR | The GreenBook | Base Unit for Kitchen Sink/ Hand Basin - Laminated HMR | 12.16 | Lm | 380.76 | 4.63 |
| Fittings & sundries | Benchtop stone | The GreenBook | Benchtop - Reconstituted stone | 0.14 | m3 | 1071.43 | 0.15 |
| Fittings & sundries | Kitchen cabinets and vanity | The GreenBook | Built-in Cabinetry | Quantities based on cost redacted for confidentiality purposes | | | 0.98 |
| Fittings & sundries | Shelving | The GreenBook | Residential Fittings and Sundries | Quantities based on cost redacted for confidentiality purposes | | | 0.34 |
| Fittings & sundries | Mirror | The GreenBook | Residential Fittings and Sundries | Quantities based on cost redacted for confidentiality purposes | | | 0.29 |
| Mechanical services | AC ducted heating | The GreenBook | Air Conditioning | Quantities based on cost redacted for confidentiality purposes | | | 2.53 |
| Electrical services | Meter panel, 3 Phase power | The GreenBook | General Electrical Services | Quantities based on cost redacted for confidentiality purposes | | | 0.41 |
| Electrical services | Cabling works | The GreenBook | General Electrical Services | Quantities based on cost redacted for confidentiality purposes | | | 1.65 |
| Electrical services | PV Cell installation | The GreenBook | Solar PV array | Quantities based on cost redacted for confidentiality purposes | | | 1.01 |
| Electrical services | Telecommunication lines | The GreenBook | Cable and conduit | Quantities based on cost redacted for confidentiality purposes | | | 0.18 |
| Hydraulic services | Basins | The GreenBook | Porcelain - Virgin porcelain - all types (pans, basins, cisterns, etc.) | 125.00 | kg | 7.04 | 0.88 |
| Hydraulic services | Stormwater, sewer and PVC pipes | The GreenBook | General Hydraulic Services | Quantities based on cost redacted for confidentiality purposes | | | 1.03 |
| Hydraulic services | Hot water system | The GreenBook | General Hydraulic Services | Quantities based on cost redacted for confidentiality purposes | | | 4.05 |
| External works component | Concrete | NABERS | Default - Generic concrete mix with a strength of 20MPa | 12.32 | m3 | 426.65 | 5.26 |
| External works component | Steel | NABERS | Default - Reinforcing steel bar & mesh | 0.32 | T | 4197.50 | 1.34 |

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|---|---|---|---|---|---|---|---|
| External works component | Waterproofing | The GreenBook | 40mic plastic membrane | 77.00 | m2 | 2.00 | 0.15 |
| External works component | Sand bed | The GreenBook | 50mm sand bed | 77.00 | m2 | 1.00 | 0.08 |
| External works component | Sealer | The GreenBook | Sealer | 77.00 | m2 | 6.00 | 0.46 |
| External works | Fence | The GreenBook | Fence - Timber paling 1800mm high | 128.00 | m2 | 71.02 | 9.09 |
| External works | Steel Balustrade | The GreenBook | Stainless Steel Balustrade - 1200mm high | 14.00 | Lm | 325.71 | 4.56 |
| External works | Stormwater drains | The GreenBook | Water Supplies and Equipment | Quantities based on cost redacted for confidentiality purposes | | | 0.83 |
| Furniture | Appliances | The GreenBook | Household Appliances | Quantities based on cost redacted for confidentiality purposes | | | 0.37 |
| Furniture | Cooktop, rangehood | The GreenBook | Induction Cooktop - Bosch - Serie 8 90cm PIV975DC1E | Quantities based on cost redacted for confidentiality purposes | | | 0.86 |
| Total | | | | | | | 193.58 |

*Table 17: Calculation inputs for NT & FNQ regional variation*

| Building element | Sub element | Emission factor source | Emission factor description | Quantity | Unit | Emission factor (kgCO2-e/unit) | Total emissions (tCO2-e) |
|---|---|---|---|---|---|---|---|
| Site prep | Excavation | The GreenBook | Bulk Excavation (In M3) - Bulk Excavation and Removal | 3.50 | m3 | 20.00 | 0.07 |
| Site prep | Excavation cost | The GreenBook | Bulk Excavation and Removal | Quantities based on cost redacted for confidentiality purposes | | | 0.05 |
| Substructure | Concrete | NABERS | Default - Generic concrete mix with a strength of 20MPa | 41.00 | m3 | 426.65 | 17.49 |
| Substructure | Steel mesh | NABERS | EPD - Steel, Reinforcing mesh, Steel, Reinforcing Mesh - SL53 to SL81, RL718 to RL1218 (mm) (InfraBuild, Australia), Australia | 1.12 | T | 2369.00 | 2.66 |

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|---|---|---|---|---|---|---|---|
| Substructure | Steel mesh | NABERS | Default - Bar & mesh reinforcing steel | 1.20 | T | 4197.50 | 5.04 |
| Substructure | Aggregates | NABERS | Default - Aggregate fill - Various aggregates used as fill including quarry products, road base and ballast of differing size distributions | 32.76 | T | 11.73 | 0.38 |
| Substructure | Waterproofing | The GreenBook | Waterproof Membrane PVC 25 Microns - With laps in place | 47.00 | m3 | 0.43 | 0.02 |
| Superstructure walls | Structural steel | NABERS | Default - Galvanised Structural sections steel (welded beam, columns, angles, plates etc) (hot rolled) | 0.05 | T | 4703.50 | 0.24 |
| Superstructure walls | Timber | NABERS | EPD - Hardwood, rough sawn, kiln-dried H3 ACQ, Australia | 4.30 | m3 | 401.66 | 1.73 |
| Superstructure walls | Timber | NABERS | EPD - Softwood (Radiata pine), roughsawn, kiln-dried, H3 CCA treated, e.g. framing [majority from sustainable forest management practices] (FWPA) | 7.70 | m3 | 238.74 | 1.84 |
| Roof | Colorbond steel | The GreenBook | Colourbond Steel Am100 - 0.42mm - Added 30% waste and laps | 2.50 | m2 | 20.00 | 0.05 |
| Roof | Timber | NABERS | EPD - Softwood (Radiata pine), roughsawn, kiln-dried, H3 CCA treated, e.g. framing [majority from sustainable forest management practices] (FWPA) | 5.1 | m3 | 238.74 | 1.22 |
| Roof | Flashing | NABERS | Default - Steel cladding that has been painted, including all base metal thicknesses (BMT) from 0.42 mm to 1.0 mm | 25.62 | m2 | 13.80 | 0.35 |
| Roof | Roof covering | NABERS | Default - Steel cladding with a metallic coating including all base metal thicknesses (BMT) from 0.3 mm to 2.9mm | 348.00 | m2 | 9.60 | 3.34 |
| Roof | Fibre cement | The GreenBook | Fibre Cement, Hardieflex, Soffits And Eaves - Aus EPD (A1-A5) - Eaves and Soffits - 4.5mm thick | 40.00 | m2 | 6.25 | 0.25 |
| Roof | Soffit / Eaves | The GreenBook | Hardwood Timber Soffit / Eaves Lining 18mm - Virgin | 52.00 | m2 | 16.92 | 0.88 |
| PV | PV | The GreenBook | Polycrystalline Photovoltaic Solar Panels On Aluminium Frame - Virgin | 30.00 | m2 | 300.00 | 9.00 |
| Roof | Sarking | The GreenBook | Aluminium Faced Foil Sarking - Virgin | 243.00 | m2 | 6.17 | 1.50 |
| Roof | Roof plank | The GreenBook | Hardwood | Quantities based on cost redacted for confidentiality purposes | | | 0.05 |

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|---|---|---|---|---|---|---|---|
| Roof | Downpipes | The GreenBook | Residential Roof Construction | Quantities based on cost redacted for confidentiality purposes | | | 0.46 |
| Roof | PV cell mounting kit | The GreenBook | Sheet Metal Products | Quantities based on cost redacted for confidentiality purposes | | | 0.28 |
| Roof | Fascia, gutter | The GreenBook | Purlins, Girts and other light framing | Quantities based on cost redacted for confidentiality purposes | | | 0.04 |
| External walls | Blockwork | NABERS | General - Concrete brick or block i.e. cinder block or concrete finishing brick used in masonry. Not including any core fill material or reinforcing. | 39.60 | T | 303.60 | 12.02 |
| External walls | Mortar | The GreenBook | Mortar | 8.90 | T | 350.00 | 3.12 |
| External walls | Reinforcement | NABERS | Default - Steel (light framing) - galvanised | 0.25 | T | 4657.50 | 1.16 |
| External walls | Timber framing | NABERS | EPD - Softwood (Radiata pine), surfaced, kiln-dried, H2 LOSP treated, [majority from sustainable forest management practices] (FWPA) | 7.92 | m3 | 194.01 | 1.54 |
| External walls | Plasterboard lining | NABERS | Default - Plasterboard | 165.00 | m2 | 9.37 | 1.55 |
| External walls | Sarking | The GreenBook | Aluminium Faced Foil Sarking - Virgin | 165.00 | m2 | 5.03 | 0.83 |
| External walls | Sand | The GreenBook | Sand - Virgin - land sources | 8.00 | m3 | 7.50 | 0.06 |
| External walls | Steel sections | NABERS | Default - Galvanised Structural sections steel (welded beam, columns, angles, plates etc) (hot rolled) | 0.72 | T | 4703.50 | 3.39 |
| External walls | Stainless steel | NABERS | Default - Stainless steel (general) | 0.20 | T | 6888.50 | 1.38 |
| External walls | Plywood Board | The GreenBook | Plywood Board - 18mm | 10.00 | m2 | 32.00 | 0.32 |
| External walls | Timber | NABERS | Default - Laminated veneer timber (LVL) including treated & untreated | 0.70 | m3 | 508.30 | 0.36 |
| External walls | Timber | NABERS | EPD - Softwood (Radiata pine), surfaced, kiln-dried, H2 LOSP treated, [majority from sustainable forest management practices] (FWPA) | 0.15 | m3 | 194.01 | 0.03 |
| External walls | Expansion joints | The GreenBook | Residential building construction | Quantities based on cost redacted for confidentiality purposes | | | 0.04 |

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|---|---|---|---|---|---|---|---|
| External walls | Brick cleaner | The GreenBook | Non-residential General External Wall (repair and maintenance) | Quantities based on cost redacted for confidentiality purposes | | | 0.08 |
| External walls | Hardware | The GreenBook | Non-residential General External Wall Construction | Quantities based on cost redacted for confidentiality purposes | | | 0.04 |
| External windows | Windows | The GreenBook | Laminated Low-E Aluminium Framed Window - Single 6.38mm glass | 23.00 | m2 | 259.13 | 5.96 |
| Internal walls | Timber framing | NABERS | EPD - Softwood (Radiata pine), surfaced, kiln-dried, H2 LOSP treated, [majority from sustainable forest management practices] (FWPA) | 6.70 | m3 | 194.01 | 1.30 |
| Internal walls | Plasterboard lining | NABERS | Default - Plasterboard - Board made from plaster typically coated in paper. Thickness from 4mm to 22mm. | 278.00 | m2 | 9.37 | 2.61 |
| Internal walls | Waterproofing | The GreenBook | 2mm PVC / Bitumen Membrane - 2mm PVC / bitumen membrane | 139.00 | m2 | 27.99 | 3.89 |
| Internal walls | Insulation | The GreenBook | Glasswool Blanket Or Batt, Foil-Faced R2.5 (90mm) - 65% Recycled Content | 100.50 | m2 | 10.00 | 1.01 |
| Wall finishes components | Ceramic Tile | NABERS | Default - Ceramic tiles (wall & floor) - excludes mortar, base, etc | 680.00 | kg | 1.13 | 0.77 |
| Wall finishes components | Epoxy glue | The GreenBook | 10mm epoxy glue | 34.00 | m2 | 41.00 | 1.39 |
| Wall finishes components | Grout | The GreenBook | Grout | 34.00 | m2 | 2.60 | 0.09 |
| Wall finishes | Timber skirting | NABERS | Timber Skirting Fixed With Glue (A1-A5) (In M) - 150mm high by 10mm thick | 7.00 | m2 | 6.54 | 0.05 |
| Wall finishes | Paint | The GreenBook | Paint Finish (In M2) - Acrylic and lime based paint | 244.00 | m2 | 2.99 | 0.73 |
| Wall finishes | Waterproofing | The GreenBook | 2mm PVC / Bitumen Membrane - 2mm PVC / bitumen membrane | 34.00 | m2 | 27.94 | 0.95 |
| Wall finishes | Painting service | The GreenBook | Paints | Quantities based on cost redacted for confidentiality purposes | | | 0.09 |
| Wall finishes | Wall wrap | The GreenBook | Residential Wall Finishes and Cladding | Quantities based on cost redacted for confidentiality purposes | | | 0.05 |
| Ceiling finishes | Plasterboard lining | NABERS | Default - Plasterboard - Board made from plaster typically coated in paper. Thickness from 4mm to 22mm. | 255.00 | m2 | 9.37 | 2.39 |

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|---|---|---|---|---|---|---|---|
| Ceiling finishes | Paint | The GreenBook | Paint Finish (In M2) - Acrylic and lime based paint | 255.00 | m2 | 3.02 | 0.77 |
| Ceiling finishes | Insulation | The GreenBook | Glasswool Blanket Or Batt, Foil-Faced R2.5 (100mm) - 65% Recycled Content | 30.00 | m2 | 10.00 | 0.30 |
| Ceiling finishes | Insulation | The GreenBook | Glasswool Blanket Or Batt, Foil-Faced R3 (130mm) - 65% Recycled Content | 380.00 | m2 | 12.00 | 4.56 |
| Floor finishes components | Ceramic Tile | NABERS | Default - Ceramic tiles (wall & floor) - excludes mortar, base, etc. | 2460.00 | kg | 1.13 | 2.78 |
| Floor finishes components | Epoxy glue | The GreenBook | 10mm epoxy glue | 123.00 | m2 | 41.00 | 5.04 |
| Floor finishes components | Grout | The GreenBook | Grout | 123.00 | m2 | 2.60 | 0.32 |
| Floor finishes components | Concrete tile | The GreenBook | 20mm concrete tile | 42.00 | m2 | 17.00 | 0.71 |
| Floor finishes components | Polishing | The GreenBook | Polishing allowance | 42.00 | m2 | 17.00 | 0.71 |
| Floor finishes components | Mortar | The GreenBook | 30mm cement mortar bedding | 42.00 | m2 | 31.00 | 1.30 |
| Floor finishes components | Fixing | The GreenBook | Allow for fix in to site @ $50/m2 & 0.6kgCO2/$ | 42.00 | m2 | 30.00 | 1.26 |
| Floor finishes | Carpet | NABERS | Default - Carpet flooring | 55.00 | m2 | 39.33 | 2.16 |
| Floor finishes | Sealer | The GreenBook | Concrete Sealer - Applied to floor | 36.00 | m2 | 1.94 | 0.07 |
| Floor finishes | Waterproofing | The GreenBook | 2mm PVC / Bitumen Membrane - 2mm PVC / bitumen membrane | 21.00 | m2 | 27.98 | 0.59 |
| Doors | Solid door | The GreenBook | Solid Timber Door And Frame, 35mm Thick Leaf - Single leaf, virgin | 10.00 | No | 105.00 | 1.05 |
| Doors | Roller Shutter | NABERS | EPD - Roller doors sectional door 601 (Europe) | 11.00 | m2 | 126.50 | 1.39 |
| Doors | Glazed door | NABERS | Default - Door - glazed - Aluminium frame - Generic | 1.67 | m2 | 359.95 | 0.60 |

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|---|---|---|---|---|---|---|---|
| Doors | Hardware | The GreenBook | Residential Doors/Frames and Hardware | Quantities based on cost redacted for confidentiality purposes | | | 0.52 |
| Fittings & sundries | Stainless steel | The GreenBook | Kitchen Sink - Stainless steel | 2.00 | No. | 445.00 | 0.89 |
| Fittings & sundries | Laminated HDR | The GreenBook | Base Unit for Kitchen Sink/ Hand Basin - Laminated HMR | 12.16 | Lm | 380.76 | 4.63 |
| Fittings & sundries | Benchtop stone | The GreenBook | Benchtop - Reconstituted stone | 0.14 | m3 | 1071.43 | 0.15 |
| Fittings & sundries | Kitchen cabinets and vanity | The GreenBook | Built-in Cabinetry | Quantities based on cost redacted for confidentiality purposes | | | 0.98 |
| Fittings & sundries | Shelving | The GreenBook | Residential Fittings and Sundries | Quantities based on cost redacted for confidentiality purposes | | | 0.34 |
| Fittings & sundries | Mirror | The GreenBook | Residential Fittings and Sundries | Quantities based on cost redacted for confidentiality purposes | | | 0.29 |
| Mechanical services | AC ducted heating | The GreenBook | Air Conditioning | Quantities based on cost redacted for confidentiality purposes | | | 2.53 |
| Electrical services | Meter panel, 3 Phase power | The GreenBook | General Electrical Services | Quantities based on cost redacted for confidentiality purposes | | | 0.41 |
| Electrical services | Cabling works | The GreenBook | General Electrical Services | Quantities based on cost redacted for confidentiality purposes | | | 1.65 |
| Electrical services | PV Cell installation | The GreenBook | Solar PV array | Quantities based on cost redacted for confidentiality purposes | | | 1.01 |
| Electrical services | Telecommunication lines | The GreenBook | Cable and conduit | Quantities based on cost redacted for confidentiality purposes | | | 0.18 |
| Hydraulic services | Basins | The GreenBook | Porcelain - Virgin porcelain - all types (pans, basins, cisterns, etc.) | 125.00 | kg | 7.04 | 0.88 |
| Hydraulic services | Stormwater, sewer and PVC pipes | The GreenBook | General Hydraulic Services | Quantities based on cost redacted for confidentiality purposes | | | 1.03 |
| Hydraulic services | Hot water system | The GreenBook | General Hydraulic Services | Quantities based on cost redacted for confidentiality purposes | | | 4.05 |
| External works component | Concrete | NABERS | Default - Generic concrete mix with a strength of 20MPa | 12.32 | m3 | 426.65 | 5.26 |

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|---|---|---|---|---|---|---|---|
| External works component | Steel | NABERS | Default - Reinforcing steel bar & mesh | 0.32 | T | 4197.50 | 1.34 |
| External works component | Waterproofing | The GreenBook | 40mic plastic membrane | 77.00 | m2 | 2.00 | 0.15 |
| External works component | Sand bed | The GreenBook | 50mm sand bed | 77.00 | m2 | 1.00 | 0.08 |
| External works component | Sealer | The GreenBook | Sealer | 77.00 | m2 | 6.00 | 0.46 |
| External works | Fence | The GreenBook | Fence - Timber paling 1800mm high | 128.00 | m2 | 71.02 | 9.09 |
| External works | Steel Balustrade | The GreenBook | Stainless Steel Balustrade - 1200mm high | 14.00 | Lm | 325.71 | 4.56 |
| External works | Stormwater drains | The GreenBook | Water Supplies and Equipment | Quantities based on cost redacted for confidentiality purposes | | | 0.83 |
| Furniture | Appliances | The GreenBook | Household Appliances | Quantities based on cost redacted for confidentiality purposes | | | 0.37 |
| Furniture | Cooktop, rangehood | The GreenBook | Induction Cooktop - Bosch - Serie 8 90cm PIV975DC1E | Quantities based on cost redacted for confidentiality purposes | | | 0.86 |
| Total | | | | | | | 160.28 |

*Table 18: Calculation inputs for QLD regional variation*

| Building element | Sub element | Emission factor source | Emission factor description | Quantity | Unit | Emission factor (kgCO2-e/unit) | Total emissions (tCO2-e) |
|---|---|---|---|---|---|---|---|
| Site prep | Excavation | The GreenBook | Bulk Excavation (In M3) - Bulk Excavation and Removal | 3.50 | m3 | 20.00 | 0.07 |
| Site prep | Excavation cost | The GreenBook | Bulk Excavation and Removal | Quantities based on cost redacted for confidentiality purposes | | | 0.05 |
| Substructure | Concrete | NABERS | Default - Generic concrete mix with a strength of 20MPa | 41.00 | m3 | 426.65 | 17.49 |

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|---|---|---|---|---|---|---|---|
| Substructure | Steel mesh | NABERS | EPD - Steel, Reinforcing mesh, Steel, Reinforcing Mesh - SL53 to SL81, RL718 to RL1218 (mm) (InfraBuild, Australia), Australia | 1.12 | T | 2369.00 | 2.66 |
| Substructure | Steel mesh | NABERS | Default - Bar & mesh reinforcing steel | 1.20 | T | 4197.50 | 5.04 |
| Substructure | Aggregates | NABERS | Default - Aggregate fill - Various aggregates used as fill including quarry products, road base and ballast of differing size distributions | 32.76 | T | 11.73 | 0.38 |
| Substructure | Waterproofing | The GreenBook | Waterproof Membrane PVC 25 Microns - With laps in place | 47.00 | m3 | 0.43 | 0.02 |
| Superstructure walls | Structural steel | NABERS | Default - Galvanised Structural sections steel (welded beam, columns, angles, plates etc) (hot rolled) | 0.05 | T | 4703.50 | 0.24 |
| Superstructure walls | Timber | NABERS | EPD - Hardwood, rough sawn, kiln-dried H3 ACQ, Australia | 4.30 | m3 | 401.66 | 1.73 |
| Superstructure walls | Timber | NABERS | EPD - Softwood (Radiata pine), roughsawn, kiln-dried, H3 CCA treated, e.g. framing [majority from sustainable forest management practices] (FWPA) | 7.70 | m3 | 238.74 | 1.84 |
| Roof | Colorbond steel | The GreenBook | Colourbond Steel Am100 - 0.42mm - Added 30% waste and laps | 2.50 | m2 | 20.00 | 0.05 |
| Roof | Timber | NABERS | EPD - Softwood (Radiata pine), roughsawn, kiln-dried, H3 CCA treated, e.g. framing [majority from sustainable forest management practices] (FWPA) | 5.1 | m3 | 238.74 | 1.22 |
| Roof | Flashing | NABERS | Default - Steel cladding that has been painted, including all base metal thicknesses (BMT) from 0.42 mm to 1.0 mm | 25.62 | m2 | 13.80 | 0.35 |
| Roof | Roof covering | NABERS | Default - Steel cladding with a metallic coating including all base metal thicknesses (BMT) from 0.3 mm to 2.9mm | 348.00 | m2 | 9.60 | 3.34 |
| Roof | Fibre cement | The GreenBook | Fibre Cement, Hardieflex, Soffits And Eaves - Aus EPD (A1-A5) - Eaves and Soffits - 4.5mm thick | 40.00 | m2 | 6.25 | 0.25 |
| Roof | Soffit / Eaves | The GreenBook | Hardwood Timber Soffit / Eaves Lining 18mm - Virgin | 52.00 | m2 | 16.92 | 0.88 |
| PV | PV | The GreenBook | Polycrystalline Photovoltaic Solar Panels On Aluminium Frame - Virgin | 30.00 | m2 | 300.00 | 9.00 |
| Roof | Sarking | The GreenBook | Aluminium Faced Foil Sarking - Virgin | 243.00 | m2 | 5.02 | 1.22 |

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|---|---|---|---|---|---|---|---|
| Roof | Insulation | The GreenBook | Glasswool Blanket Or Batt, Foil-Faced R2.0 (90mm) - 65% Recycled Content | 243.00 | m2 | 9.01 | 2.19 |
| Roof | Roof plank | The GreenBook | Hardwood | Quantities based on cost redacted for confidentiality purposes | | | 0.05 |
| Roof | Downpipes | The GreenBook | Residential Roof Construction | Quantities based on cost redacted for confidentiality purposes | | | 0.46 |
| Roof | PV cell mounting kit | The GreenBook | Sheet Metal Products | Quantities based on cost redacted for confidentiality purposes | | | 0.28 |
| Roof | Fascia, gutter | The GreenBook | Purlins, Girts and other light framing | Quantities based on cost redacted for confidentiality purposes | | | 0.04 |
| External walls | Timber framing | NABERS | EPD - Softwood (Radiata pine), surfaced, kiln-dried, H2 LOSP treated, [majority from sustainable forest management practices] (FWPA) | 7.92 | m3 | 194.01 | 1.54 |
| External walls | Plasterboard lining | NABERS | Default - Plasterboard | 165.00 | m2 | 9.37 | 1.55 |
| External walls | Sarking | The GreenBook | Aluminium Faced Foil Sarking - Virgin | 165.00 | m2 | 5.03 | 0.83 |
| External walls | Insulation | The GreenBook | Glasswool Blanket or Batt, Foil-Faced R2.5 (100mm) - 65% Recycled Content | 165.00 | m2 | 10.00 | 1.65 |
| External walls | Waterproofing | The GreenBook | 2mm PVC / Bitumen Membrane - 2mm PVC / bitumen membrane | 165.00 | m2 | 28.00 | 4.62 |
| External wall components | Brick | NABERS | Default - Masonry bricks made from clay inc fired, perforated and used in masonry | 32.67 | T | 516.35 | 16.87 |
| External wall components | Mortar | The GreenBook | Mortar | 8.90 | T | 350.00 | 3.12 |
| External wall components | Sundries | NABERS | Default - Steel (light framing) - galvanised | 0.25 | T | 4657.50 | 1.16 |
| External walls | Sand | The GreenBook | Sand - Virgin - land sources | 8.00 | m3 | 7.50 | 0.06 |
| External walls | Steel sections | NABERS | Default - Galvanised Structural sections steel (welded beam, columns, angles, plates etc) (hot rolled) | 0.72 | T | 4703.50 | 3.39 |
| External walls | Stainless steel | NABERS | Default - Stainless steel (general) | 0.20 | T | 6888.50 | 1.38 |

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|---|---|---|---|---|---|---|---|
| External walls | Plywood Board | The GreenBook | Plywood Board - 18mm | 10.00 | m2 | 32.00 | 0.32 |
| External walls | Timber | NABERS | Default - Laminated veneer timber (LVL) including treated & untreated | 0.70 | m3 | 508.30 | 0.36 |
| External walls | Timber | NABERS | EPD - Softwood (Radiata pine), surfaced, kiln-dried, H2 LOSP treated, [majority from sustainable forest management practices] (FWPA) | 0.15 | m3 | 194.01 | 0.03 |
| External walls | Expansion joints | The GreenBook | Residential building construction | Quantities based on cost redacted for confidentiality purposes | | | 0.04 |
| External walls | Brick cleaner | The GreenBook | Non-residential General External Wall (repair and maintenance) | Quantities based on cost redacted for confidentiality purposes | | | 0.08 |
| External walls | Hardware | The GreenBook | Non-residential General External Wall Construction | Quantities based on cost redacted for confidentiality purposes | | | 0.04 |
| External windows | Windows | The GreenBook | Laminated Low-E Aluminium Framed Window - Single 6.38mm glass | 23.00 | m2 | 259.13 | 5.96 |
| Internal walls | Timber framing | NABERS | EPD - Softwood (Radiata pine), surfaced, kiln-dried, H2 LOSP treated, [majority from sustainable forest management practices] (FWPA) | 6.70 | m3 | 194.01 | 1.30 |
| Internal walls | Plasterboard lining | NABERS | Default - Plasterboard - Board made from plaster typically coated in paper. Thickness from 4mm to 22mm. | 278.00 | m2 | 9.37 | 2.61 |
| Internal walls | Waterproofing | The GreenBook | 2mm PVC / Bitumen Membrane - 2mm PVC / bitumen membrane | 139.00 | m2 | 27.99 | 3.89 |
| Internal walls | Insulation | The GreenBook | Glasswool Blanket Or Batt, Foil-Faced R2.5 (90mm) - 65% Recycled Content | 100.50 | m2 | 10.00 | 1.01 |
| Wall finishes components | Ceramic Tile | NABERS | Default - Ceramic tiles (wall & floor) - excludes mortar, base, etc | 680.00 | kg | 1.13 | 0.77 |
| Wall finishes components | Epoxy glue | The GreenBook | 10mm epoxy glue | 34.00 | m2 | 41.00 | 1.39 |
| Wall finishes components | Grout | The GreenBook | Grout | 34.00 | m2 | 2.60 | 0.09 |
| Wall finishes | Timber skirting | NABERS | Timber Skirting Fixed With Glue (A1-A5) (In M) - 150mm high by 10mm thick | 7.00 | m2 | 6.54 | 0.05 |

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|---|---|---|---|---|---|---|---|
| Wall finishes | Paint | The GreenBook | Paint Finish (In M2) - Acrylic and lime based paint | 244.00 | m2 | 2.99 | 0.73 |
| Wall finishes | Waterproofing | The GreenBook | 2mm PVC / Bitumen Membrane - 2mm PVC / bitumen membrane | 34.00 | m2 | 27.94 | 0.95 |
| Wall finishes | Painting service | The GreenBook | Paints | Quantities based on cost redacted for confidentiality purposes | | | 0.09 |
| Wall finishes | Wall wrap | The GreenBook | Residential Wall Finishes and Cladding | Quantities based on cost redacted for confidentiality purposes | | | 0.05 |
| Ceiling finishes | Plasterboard lining | NABERS | Default - Plasterboard - Board made from plaster typically coated in paper. Thickness from 4mm to 22mm. | 255.00 | m2 | 9.37 | 2.39 |
| Ceiling finishes | Paint | The GreenBook | Paint Finish (In M2) - Acrylic and lime based paint | 255.00 | m2 | 3.02 | 0.77 |
| Ceiling finishes | Insulation | The GreenBook | Glasswool Blanket Or Batt, Foil-Faced R2.5 (100mm) - 65% Recycled Content | 30.00 | m2 | 10.00 | 0.30 |
| Ceiling finishes | Insulation | The GreenBook | Glasswool Blanket Or Batt, Foil-Faced R3 (130mm) - 65% Recycled Content | 380.00 | m2 | 12.00 | 4.56 |
| Floor finishes components | Ceramic Tile | NABERS | Default - Ceramic tiles (wall & floor) - excludes mortar, base, etc. | 420.00 | kg | 1.13 | 0.48 |
| Floor finishes components | Epoxy glue | The GreenBook | 10mm epoxy glue | 21.00 | m2 | 41.00 | 0.86 |
| Floor finishes components | Grout | The GreenBook | Grout | 21.00 | m2 | 2.60 | 0.05 |
| Floor finishes components | Concrete tile | The GreenBook | 20mm concrete tile | 42.00 | m2 | 17.00 | 0.71 |
| Floor finishes components | Polishing | The GreenBook | Polishing allowance | 42.00 | m2 | 17.00 | 0.71 |
| Floor finishes components | Mortar | The GreenBook | 30mm cement mortar bedding | 42.00 | m2 | 31.00 | 1.30 |
| Floor finishes components | Fixing | The GreenBook | Allow for fix in to site @ $50/m2 & 0.6kgCO2/$ | 42.00 | m2 | 30.00 | 1.26 |
| Floor finishes | Carpet | NABERS | Default - Carpet flooring | 55.00 | m2 | 39.33 | 2.16 |

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|---|---|---|---|---|---|---|---|
| Floor finishes | Timber Boards | The GreenBook | Engineered Timber Boards - 12mm | 102.00 | m2 | 33.04 | 3.37 |
| Floor finishes | Sealer | The GreenBook | Concrete Sealer - Applied to floor | 36.00 | m2 | 1.94 | 0.07 |
| Floor finishes | Waterproofing | The GreenBook | 2mm PVC / Bitumen Membrane - 2mm PVC / bitumen membrane | 21.00 | m2 | 27.98 | 0.59 |
| Doors | Solid door | The GreenBook | Solid Timber Door And Frame, 35mm Thick Leaf - Single leaf, virgin | 10.00 | No | 105.00 | 1.05 |
| Doors | Roller Shutter | NABERS | EPD - Roller doors sectional door 601 (Europe) | 11.00 | m2 | 126.50 | 1.39 |
| Doors | Glazed door | NABERS | Default - Door - glazed - Aluminium frame - Generic | 1.67 | m2 | 359.95 | 0.60 |
| Doors | Hardware | The GreenBook | Residential Doors/Frames and Hardware | Quantities based on cost redacted for confidentiality purposes | | | 0.52 |
| Fittings & sundries | Stainless steel | The GreenBook | Kitchen Sink - Stainless steel | 2.00 | No. | 445.00 | 0.89 |
| Fittings & sundries | Laminated HDR | The GreenBook | Base Unit for Kitchen Sink/ Hand Basin - Laminated HMR | 12.16 | Lm | 380.76 | 4.63 |
| Fittings & sundries | Benchtop stone | The GreenBook | Benchtop - Reconstituted stone | 0.14 | m3 | 1071.43 | 0.15 |
| Fittings & sundries | Kitchen cabinets and vanity | The GreenBook | Built-in Cabinetry | Quantities based on cost redacted for confidentiality purposes | | | 0.98 |
| Fittings & sundries | Shelving | The GreenBook | Residential Fittings and Sundries | Quantities based on cost redacted for confidentiality purposes | | | 0.34 |
| Fittings & sundries | Mirror | The GreenBook | Residential Fittings and Sundries | Quantities based on cost redacted for confidentiality purposes | | | 0.29 |
| Mechanical services | AC ducted heating | The GreenBook | Air Conditioning | Quantities based on cost redacted for confidentiality purposes | | | 2.53 |
| Electrical services | Meter panel, 3 Phase power | The GreenBook | General Electrical Services | Quantities based on cost redacted for confidentiality purposes | | | 0.41 |
| Electrical services | Cabling works | The GreenBook | General Electrical Services | Quantities based on cost redacted for confidentiality purposes | | | 1.65 |

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|---|---|---|---|---|---|---|---|
| Electrical services | PV Cell installation | The GreenBook | Solar PV array | Quantities based on cost redacted for confidentiality purposes | | | 1.01 |
| Electrical services | Telecommunication lines | The GreenBook | Cable and conduit | Quantities based on cost redacted for confidentiality purposes | | | 0.18 |
| Hydraulic services | Basins | The GreenBook | Porcelain - Virgin porcelain - all types (pans, basins, cisterns, etc.) | 125.00 | kg | 7.04 | 0.88 |
| Hydraulic services | Stormwater, sewer and PVC pipes | The GreenBook | General Hydraulic Services | Quantities based on cost redacted for confidentiality purposes | | | 1.03 |
| Hydraulic services | Hot water system | The GreenBook | General Hydraulic Services | Quantities based on cost redacted for confidentiality purposes | | | 4.05 |
| External works component | Concrete | NABERS | Default - Generic concrete mix with a strength of 20MPa | 12.32 | m3 | 426.65 | 5.26 |
| External works component | Steel | NABERS | Default - Reinforcing steel bar & mesh | 0.32 | T | 4197.50 | 1.34 |
| External works component | Waterproofing | The GreenBook | 40mic plastic membrane | 77.00 | m2 | 2.00 | 0.15 |
| External works component | Sand bed | The GreenBook | 50mm sand bed | 77.00 | m2 | 1.00 | 0.08 |
| External works component | Sealer | The GreenBook | Sealer | 77.00 | m2 | 6.00 | 0.46 |
| External works | Fence | The GreenBook | Fence - Timber paling 1800mm high | 128.00 | m2 | 71.02 | 9.09 |
| External works | Steel Balustrade | The GreenBook | Stainless Steel Balustrade - 1200mm high | 14.00 | Lm | 325.71 | 4.56 |
| External works | Stormwater drains | The GreenBook | Water Supplies and Equipment | Quantities based on cost redacted for confidentiality purposes | | | 0.83 |
| Furniture | Appliances | The GreenBook | Household Appliances | Quantities based on cost redacted for confidentiality purposes | | | 0.37 |
| Furniture | Cooktop, rangehood | The GreenBook | Induction Cooktop - Bosch - Serie 8 90cm PIV975DC1E | Quantities based on cost redacted for confidentiality purposes | | | 0.86 |
| **Total** | | | | | | | **169.92** |

*Table 19: Calculation inputs for WA regional variation*

| Building element | Sub element | Emission factor source | Emission factor description | Quantity | Unit | Emission factor (kgCO2-e/unit) | Total emissions (tCO2-e) |
|---|---|---|---|---|---|---|---|
| Site prep | Excavation | The GreenBook | Bulk Excavation (In M3) - Bulk Excavation and Removal | 3.50 | m3 | 20.00 | 0.07 |
| Site prep | Excavation cost | The GreenBook | Bulk Excavation and Removal | Quantities based on cost redacted for confidentiality purposes | | | 0.05 |
| Substructure | Concrete | NABERS | Default - Generic concrete mix with a strength of 20MPa | 41.00 | m3 | 426.65 | 17.49 |
| Substructure | Steel mesh | NABERS | EPD - Steel, Reinforcing mesh, Steel, Reinforcing Mesh - SL53 to SL81, RL718 to RL1218 (mm) (InfraBuild, Australia), Australia | 1.12 | T | 2369.00 | 2.66 |
| Substructure | Steel mesh | NABERS | Default - Bar & mesh reinforcing steel | 1.20 | T | 4197.50 | 5.04 |
| Substructure | Aggregates | NABERS | Default - Aggregate fill - Various aggregates used as fill including quarry products, road base and ballast of differing size distributions | 30.38 | T | 11.73 | 0.36 |
| Substructure | Waterproofing | The GreenBook | Waterproof Membrane PVC 25 Microns - With laps in place | 47.00 | m3 | 0.43 | 0.02 |
| Superstructure walls | Structural steel | NABERS | Default - Galvanised Structural sections steel (welded beam, columns, angles, plates etc) (hot rolled) | 0.05 | T | 4703.50 | 0.24 |
| Superstructure walls | Timber | NABERS | EPD - Hardwood, rough sawn, kiln-dried H3 ACQ, Australia | 4.30 | m3 | 401.66 | 1.73 |
| Superstructure walls | Timber | NABERS | EPD - Softwood (Radiata pine), roughsawn, kiln-dried, H3 CCA treated, e.g. framing [majority from sustainable forest management practices] (FWPA) | 7.70 | m3 | 238.74 | 1.84 |
| Roof | Colorbond steel | The GreenBook | Colourbond Steel Am100 - 0.42mm - Added 30% waste and laps | 2.50 | m2 | 20.00 | 0.05 |
| Roof | Timber | NABERS | EPD - Softwood (Radiata pine), roughsawn, kiln-dried, H3 CCA treated, e.g. framing [majority from sustainable forest management practices] (FWPA) | 5.1 | m3 | 238.74 | 1.22 |
| Roof | Flashing | NABERS | Default - Steel cladding that has been painted, including all base metal thicknesses (BMT) from 0.42 mm to 1.0 mm | 25.62 | m2 | 13.80 | 0.35 |

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|---|---|---|---|---|---|---|---|
| Roof | Roof covering | NABERS | Default - Steel cladding with a metallic coating including all base metal thicknesses (BMT) from 0.3 mm to 2.9mm | 348.00 | m2 | 9.60 | 3.34 |
| Roof | Fibre cement | The GreenBook | Fibre Cement, Hardieflex, Soffits And Eaves - Aus EPD (A1-A5) - Eaves and Soffits - 4.5mm thick | 40.00 | m2 | 6.25 | 0.25 |
| Roof | Soffit / Eaves | The GreenBook | Hardwood Timber Soffit / Eaves Lining 18mm - Virgin | 52.00 | m2 | 16.92 | 0.88 |
| PV | PV | The GreenBook | Polycrystalline Photovoltaic Solar Panels On Aluminium Frame - Virgin | 30.00 | m2 | 300.00 | 9.00 |
| Roof | Sarking | The GreenBook | Aluminium Faced Foil Sarking - Virgin | 243.00 | m2 | 5.02 | 1.22 |
| Roof | Roof plank | The GreenBook | Hardwood | Quantities based on cost redacted for confidentiality purposes | | | 0.05 |
| Roof | Downpipes | The GreenBook | Residential Roof Construction | Quantities based on cost redacted for confidentiality purposes | | | 0.46 |
| Roof | PV cell mounting kit | The GreenBook | Sheet Metal Products | Quantities based on cost redacted for confidentiality purposes | | | 0.28 |
| Roof | Fascia, gutter | The GreenBook | Purlins, Girts and other light framing | Quantities based on cost redacted for confidentiality purposes | | | 0.04 |
| External walls | Clay brick wall | NABERS | Default - Clay bricks | 65.34 | T | 516.35 | 33.74 |
| External walls | Mortar | The GreenBook | 10mm mortar to bricks | 17.80 | T | 350.00 | 6.23 |
| External walls | Sundries | NABERS | Default - Steel (light framing) - galvanised | 0.25 | T | 4657.50 | 1.16 |
| External walls | Cement render | The GreenBook | Cement Render (Plaster) - 12mm | 165.00 | m2 | 4.00 | 0.66 |
| External walls | Sarking | The GreenBook | Aluminium Faced Foil Sarking - Virgin | 165.00 | m2 | 5.03 | 0.83 |
| External walls | Sand | The GreenBook | Fine Aggregates (In Tonnes) - Virgin - Sand - Generic (A1-A5) | 10.00 | T | 24.00 | 0.24 |
| External walls | Waterproofing | The GreenBook | 3 Micron Plastic Roll Membrane Or Similar - Virgin | 165.00 | m2 | 40.00 | 6.60 |
| External walls | Steel sections | NABERS | Default - Galvanised Structural sections steel (welded beam, columns, angles, plates etc) (hot rolled) | 0.72 | T | 4703.50 | 3.39 |

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|---|---|---|---|---|---|---|---|
| External walls | Stainless steel | NABERS | Default - Stainless steel (general) | 0.20 | T | 6888.50 | 1.38 |
| External walls | Plywood Board | The GreenBook | Plywood Board - 18mm | 10.00 | m2 | 32.00 | 0.32 |
| External walls | Timber | NABERS | Default - Laminated veneer timber (LVL) including treated & untreated | 0.70 | m3 | 508.30 | 0.36 |
| External walls | Timber | NABERS | EPD - Softwood (Radiata pine), surfaced, kiln-dried, H2 LOSP treated, [majority from sustainable forest management practices] (FWPA) | 0.15 | m3 | 194.01 | 0.03 |
| External walls | Expansion joints | The GreenBook | Residential building construction | Quantities based on cost redacted for confidentiality purposes | | | 0.04 |
| External walls | Brick cleaner | The GreenBook | Non-residential General External Wall (repair and maintenance) | Quantities based on cost redacted for confidentiality purposes | | | 0.08 |
| External walls | Hardware | The GreenBook | Non-residential General External Wall Construction | Quantities based on cost redacted for confidentiality purposes | | | 0.04 |
| External windows | Windows | The GreenBook | Double Glazed Aluminium Framed Windows - 4/12/4mm toughened glass units | 23.00 | m2 | 317.83 | 7.31 |
| Internal walls | Bricks | NABERS | Default - Clay bricks | 27.52 | T | 516.35 | 14.21 |
| Internal walls | Mortar | The GreenBook | Mortar | 7.50 | T | 350.00 | 2.62 |
| Internal walls | Sundries | NABERS | Default - Steel (light framing) - galvanised | 0.25 | T | 4657.50 | 1.16 |
| Internal walls | Cement render | The GreenBook | 10mm render | 1.39 | m3 | 10.00 | 0.01 |
| Internal walls | Plasterboard lining | NABERS | Default - Plasterboard - Board made from plaster typically coated in paper. Thickness from 4mm to 22mm. | 278.00 | m2 | 9.37 | 2.61 |
| Internal walls | Waterproofing | The GreenBook | 2mm PVC / Bitumen Membrane - 2mm PVC / bitumen membrane | 139.00 | m2 | 27.99 | 3.89 |
| Wall finishes components | Ceramic Tile | NABERS | Default - Ceramic tiles (wall & floor) - excludes mortar, base, etc | 680.00 | kg | 1.13 | 0.77 |
| Wall finishes components | Epoxy glue | The GreenBook | 10mm epoxy glue | 34.00 | m2 | 41.00 | 1.39 |

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|---|---|---|---|---|---|---|---|
| Wall finishes components | Grout | The GreenBook | Grout | 34.00 | m2 | 2.60 | 0.09 |
| Wall finishes | Timber skirting | NABERS | Timber Skirting Fixed With Glue (A1-A5) (In M) - 150mm high by 10mm thick | 7.00 | m2 | 6.54 | 0.05 |
| Wall finishes | Paint | The GreenBook | Paint Finish (In M2) - Acrylic and lime based paint | 244.00 | m2 | 2.99 | 0.73 |
| Wall finishes | Waterproofing | The GreenBook | 2mm PVC / Bitumen Membrane - 2mm PVC / bitumen membrane | 34.00 | m2 | 27.94 | 0.95 |
| Wall finishes | Painting service | The GreenBook | Paints | Quantities based on cost redacted for confidentiality purposes | | | 0.09 |
| Wall finishes | Wall wrap | The GreenBook | Residential Wall Finishes and Cladding | Quantities based on cost redacted for confidentiality purposes | | | 0.05 |
| Ceiling finishes | Plasterboard lining | NABERS | Default - Plasterboard - Board made from plaster typically coated in paper. Thickness from 4mm to 22mm. | 255.00 | m2 | 9.37 | 2.39 |
| Ceiling finishes | Paint | The GreenBook | Paint Finish (In M2) - Acrylic and lime based paint | 255.00 | m2 | 3.02 | 0.77 |
| Ceiling finishes | Insulation | The GreenBook | Glasswool Blanket Or Batt, Foil-Faced R2.5 (100mm) - 65% Recycled Content | 30.00 | m2 | 10.00 | 0.30 |
| Ceiling finishes | Insulation | The GreenBook | Glasswool Blanket Or Batt, Foil-Faced R3 (130mm) - 65% Recycled Content | 380.00 | m2 | 12.00 | 4.56 |
| Floor finishes components | Ceramic Tile | NABERS | Default - Ceramic tiles (wall & floor) - excludes mortar, base, etc. | 420.00 | kg | 1.13 | 0.48 |
| Floor finishes components | Epoxy glue | The GreenBook | 10mm epoxy glue | 21.00 | m2 | 41.00 | 0.86 |
| Floor finishes components | Grout | The GreenBook | Grout | 21.00 | m2 | 2.60 | 0.05 |
| Floor finishes components | Concrete tile | The GreenBook | 20mm concrete tile | 42.00 | m2 | 17.00 | 0.71 |
| Floor finishes components | Polishing | The GreenBook | Polishing allowance | 42.00 | m2 | 17.00 | 0.71 |
| Floor finishes components | Mortar | The GreenBook | 30mm cement mortar bedding | 42.00 | m2 | 31.00 | 1.30 |

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|---|---|---|---|---|---|---|---|
| Floor finishes components | Fixing | The GreenBook | Allow for fix in to site @ $50/m2 & 0.6kgCO2/$ | 42.00 | m2 | 30.00 | 1.26 |
| Floor finishes | Carpet | NABERS | Default - Carpet flooring | 55.00 | m2 | 39.33 | 2.16 |
| Floor finishes | Timber Boards | The GreenBook | Engineered Timber Boards - 12mm | 102.00 | m2 | 33.04 | 3.37 |
| Floor finishes | Sealer | The GreenBook | Concrete Sealer - Applied to floor | 36.00 | m2 | 1.94 | 0.07 |
| Floor finishes | Waterproofing | The GreenBook | 2mm PVC / Bitumen Membrane - 2mm PVC / bitumen membrane | 21.00 | m2 | 27.98 | 0.59 |
| Doors | Solid door | The GreenBook | Solid Timber Door And Frame, 35mm Thick Leaf - Single leaf, virgin | 10.00 | No | 105.00 | 1.05 |
| Doors | Roller Shutter | NABERS | EPD - Roller doors sectional door 601 (Europe) | 11.00 | m2 | 126.50 | 1.39 |
| Doors | Glazed door | NABERS | Default - Door - glazed - Aluminium frame - Generic | 1.67 | m2 | 359.95 | 0.60 |
| Doors | Hardware | The GreenBook | Residential Doors/Frames and Hardware | Quantities based on cost redacted for confidentiality purposes | | | 0.52 |
| Fittings & sundries | Stainless steel | The GreenBook | Kitchen Sink - Stainless steel | 2.00 | No. | 445.00 | 0.89 |
| Fittings & sundries | Laminated HDR | The GreenBook | Base Unit for Kitchen Sink/ Hand Basin - Laminated HMR | 12.16 | Lm | 380.76 | 4.63 |
| Fittings & sundries | Benchtop stone | The GreenBook | Benchtop - Reconstituted stone | 0.14 | m3 | 1071.43 | 0.15 |
| Fittings & sundries | Kitchen cabinets and vanity | The GreenBook | Built-in Cabinetry | Quantities based on cost redacted for confidentiality purposes | | | 0.98 |
| Fittings & sundries | Shelving | The GreenBook | Residential Fittings and Sundries | Quantities based on cost redacted for confidentiality purposes | | | 0.34 |
| Fittings & sundries | Mirror | The GreenBook | Residential Fittings and Sundries | Quantities based on cost redacted for confidentiality purposes | | | 0.29 |
| Mechanical services | AC ducted heating | The GreenBook | Air Conditioning | Quantities based on cost redacted for confidentiality purposes | | | 2.53 |

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|---|---|---|---|---|---|---|---|
| Electrical services | Meter panel, 3 Phase power | The GreenBook | General Electrical Services | Quantities based on cost redacted for confidentiality purposes | | | 0.41 |
| Electrical services | Cabling works | The GreenBook | General Electrical Services | Quantities based on cost redacted for confidentiality purposes | | | 1.65 |
| Electrical services | PV Cell installation | The GreenBook | Solar PV array | Quantities based on cost redacted for confidentiality purposes | | | 1.01 |
| Electrical services | Telecommunication lines | The GreenBook | Cable and conduit | Quantities based on cost redacted for confidentiality purposes | | | 0.18 |
| Hydraulic services | Basins | The GreenBook | Porcelain - Virgin porcelain - all types (pans, basins, cisterns, etc.) | 125.00 | kg | 7.04 | 0.88 |
| Hydraulic services | Stormwater, sewer and PVC pipes | The GreenBook | General Hydraulic Services | Quantities based on cost redacted for confidentiality purposes | | | 1.03 |
| Hydraulic services | Hot water system | The GreenBook | General Hydraulic Services | Quantities based on cost redacted for confidentiality purposes | | | 4.05 |
| External works component | Concrete | NABERS | Default - Generic concrete mix with a strength of 20MPa | 12.32 | m3 | 426.65 | 5.26 |
| External works component | Steel | NABERS | Default - Reinforcing steel bar & mesh | 0.32 | T | 4197.50 | 1.34 |
| External works component | Waterproofing | The GreenBook | 40mic plastic membrane | 77.00 | m2 | 2.00 | 0.15 |
| External works component | Sand bed | The GreenBook | 50mm sand bed | 77.00 | m2 | 1.00 | 0.08 |
| External works component | Sealer | The GreenBook | Sealer | 77.00 | m2 | 6.00 | 0.46 |
| External works | Fence | The GreenBook | Fence - Timber paling 1800mm high | 128.00 | m2 | 71.02 | 9.09 |
| External works | Steel Balustrade | The GreenBook | Stainless Steel Balustrade - 1200mm high | 14.00 | Lm | 325.71 | 4.56 |
| External works | Stormwater drains | The GreenBook | Water Supplies and Equipment | Quantities based on cost redacted for confidentiality purposes | | | 0.83 |
| Furniture | Appliances | The GreenBook | Household Appliances | Quantities based on cost redacted for confidentiality purposes | | | 0.37 |

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|---|---|---|---|---|---|
| Furniture | Cooktop, rangehood | The GreenBook | Induction Cooktop - Bosch - Serie 8 90cm PIV975DC1E | Quantities based on cost redacted for confidentiality purposes | 0.86 |
| Total | | | | | 206.44 |

*Table 20: Calculation inputs for SA regional variation*

| Building element | Sub element | Emission factor source | Emission factor description | Quantity | Unit | Emission factor (kgCO2-e/unit) | Total emissions (tCO2-e) |
|---|---|---|---|---|---|---|---|
| Site prep | Excavation | The GreenBook | Bulk Excavation (In M3) - Bulk Excavation and Removal | 3.50 | m3 | 20.00 | 0.07 |
| Site prep | Excavation cost | The GreenBook | Bulk Excavation and Removal | Quantities based on cost redacted for confidentiality purposes | | | 0.05 |
| Substructure | Concrete | NABERS | Default - Generic concrete mix with a strength of 20MPa | 41.00 | m3 | 426.65 | 17.49 |
| Substructure | Steel mesh | NABERS | EPD - Steel, Reinforcing mesh, Steel, Reinforcing Mesh - SL53 to SL81, RL718 to RL1218 (mm) (InfraBuild, Australia), Australia | 1.12 | T | 2369.00 | 2.66 |
| Substructure | Steel mesh | NABERS | Default - Bar & mesh reinforcing steel | 1.20 | T | 4197.50 | 5.04 |
| Substructure | Aggregates | NABERS | Default - Aggregate fill - Various aggregates used as fill including quarry products, road base and ballast of differing size distributions | 32.76 | T | 11.73 | 0.38 |
| Substructure | Waterproofing | The GreenBook | Waterproof Membrane PVC 25 Microns - With laps in place | 47.00 | m3 | 0.43 | 0.02 |
| Superstructure walls | Structural steel | NABERS | Default - Galvanised Structural sections steel (welded beam, columns, angles, plates etc) (hot rolled) | 0.05 | T | 4703.50 | 0.24 |
| Superstructure walls | Timber | NABERS | EPD - Hardwood, rough sawn, kiln-dried H3 ACQ, Australia | 4.30 | m3 | 401.66 | 1.73 |
| Superstructure walls | Timber | NABERS | EPD - Softwood (Radiata pine), roughsawn, kiln-dried, H3 CCA treated, e.g. framing [majority from sustainable forest management practices] (FWPA) | 7.70 | m3 | 238.74 | 1.84 |

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|---|---|---|---|---|---|---|---|
| Roof | Colorbond steel | The GreenBook | Colourbond Steel Am100 - 0.42mm - Added 30% waste and laps | 2.50 | m2 | 20.00 | 0.05 |
| Roof | Timber | NABERS | EPD - Softwood (Radiata pine), roughsawn, kiln-dried, H3 CCA treated, e.g. framing [majority from sustainable forest management practices] (FWPA) | 5.1 | m3 | 238.74 | 1.22 |
| Roof | Flashing | NABERS | Default - Steel cladding that has been painted, including all base metal thicknesses (BMT) from 0.42 mm to 1.0 mm | 25.62 | m2 | 13.80 | 0.35 |
| Roof | Roof covering | NABERS | Default - Steel cladding with a metallic coating including all base metal thicknesses (BMT) from 0.3 mm to 2.9mm | 348.00 | T | 9.60 | 3.34 |
| Roof | Fibre cement | The GreenBook | Fibre Cement, Hardieflex, Soffits And Eaves - Aus EPD (A1-A5) - Eaves and Soffits - 4.5mm thick | 40.00 | m2 | 6.25 | 0.25 |
| Roof | Soffit / Eaves | The GreenBook | Hardwood Timber Soffit / Eaves Lining 18mm - Virgin | 52.00 | m2 | 16.92 | 0.88 |
| PV | PV | The GreenBook | Polycrystalline Photovoltaic Solar Panels On Aluminium Frame - Virgin | 30.00 | m2 | 300.00 | 9.00 |
| Roof | Sarking | The GreenBook | Aluminium Faced Foil Sarking - Virgin | 243.00 | m2 | 5.02 | 1.22 |
| Roof | Insulation | The GreenBook | Glasswool Blanket Or Batt, Foil-Faced R2.0 (90mm) - 65% Recycled Content | 243.00 | m2 | 9.01 | 2.19 |
| Roof | Roof plank | The GreenBook | Hardwood | Quantities based on cost redacted for confidentiality purposes | | | 0.05 |
| Roof | Downpipes | The GreenBook | Residential Roof Construction | Quantities based on cost redacted for confidentiality purposes | | | 0.46 |
| Roof | PV cell mounting kit | The GreenBook | Sheet Metal Products | Quantities based on cost redacted for confidentiality purposes | | | 0.28 |
| Roof | Fascia, gutter | The GreenBook | Purlins, Girts and other light framing | Quantities based on cost redacted for confidentiality purposes | | | 0.04 |
| External walls | Timber framing | NABERS | EPD - Softwood (Radiata pine), surfaced, kiln-dried, H2 LOSP treated, [majority from sustainable forest management practices] (FWPA) | 7.92 | m3 | 194.01 | 1.54 |
| External walls | Plasterboard lining | NABERS | Default - Plasterboard | 165.00 | m2 | 9.37 | 1.55 |
| External walls | Sarking | The GreenBook | Aluminium Faced Foil Sarking - Virgin | 165.00 | m2 | 5.03 | 0.83 |

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|---|---|---|---|---|---|---|---|
| External walls | Insulation | The GreenBook | Glasswool Blanket Or Batt, Foil-Faced R2.0 (90mm) - 65% Recycled Content | 165.00 | m2 | 8.97 | 1.48 |
| External walls | Waterproofing | The GreenBook | 2mm PVC / Bitumen Membrane - 2mm PVC / bitumen membrane | 165.00 | m2 | 28.00 | 4.62 |
| External wall components | Brick | NABERS | Default - Masonry bricks made from clay inc fired, perforared and used in masonry | 32.67 | T | 516.35 | 16.87 |
| External wall components | Mortar | The GreenBook | Mortar | 8.90 | T | 350.00 | 3.12 |
| External wall components | Sundries | NABERS | Default - Steel (light framing) - galvanised | 0.25 | T | 4657.50 | 1.16 |
| External walls | Sand | The GreenBook | Sand - Virgin - land sources | 8.00 | m3 | 7.50 | 0.06 |
| External walls | Steel sections | NABERS | Default - Galvanised Structural sections steel (welded beam, columns, angles, plates etc) (hot rolled) | 0.72 | T | 4703.50 | 3.39 |
| External walls | Stainless steel | NABERS | Default - Stainless steel (general) | 0.20 | T | 6888.50 | 1.38 |
| External walls | Plywood Board | The GreenBook | Plywood Board - 18mm | 10.00 | m2 | 32.00 | 0.32 |
| External walls | Timber | NABERS | Default - Laminated veneer timber (LVL) including treated & untreated | 0.70 | m3 | 508.30 | 0.36 |
| External walls | Timber | NABERS | EPD - Softwood (Radiata pine), surfaced, kiln-dried, H2 LOSP treated, [majority from sustainable forest management practices] (FWPA) | 0.15 | m3 | 194.01 | 0.03 |
| External walls | Expansion joints | The GreenBook | Residential building construction | Quantities based on cost redacted for confidentiality purposes | | | 0.04 |
| External walls | Brick cleaner | The GreenBook | Non-residential General External Wall (repair and maintenance) | Quantities based on cost redacted for confidentiality purposes | | | 0.08 |
| External walls | Hardware | The GreenBook | Non-residential General External Wall Construction | Quantities based on cost redacted for confidentiality purposes | | | 0.04 |
| External windows | Windows | The GreenBook | Double Glazed Aluminium Framed Windows - 4/12/4mm toughened glass units | 23.00 | m2 | 317.83 | 7.31 |

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|---|---|---|---|---|---|---|---|
| Internal walls | Timber framing | NABERS | EPD - Softwood (Radiata pine), surfaced, kiln-dried, H2 LOSP treated, [majority from sustainable forest management practices] (FWPA) | 6.70 | m3 | 194.01 | 1.30 |
| Internal walls | Plasterboard lining | NABERS | Default - Plasterboard - Board made from plaster typically coated in paper. Thickness from 4mm to 22mm. | 278.00 | m2 | 9.37 | 2.61 |
| Internal walls | Waterproofing | The GreenBook | 2mm PVC / Bitumen Membrane - 2mm PVC / bitumen membrane | 139.00 | m2 | 27.99 | 3.89 |
| Internal walls | Insulation | The GreenBook | Glasswool Blanket Or Batt, Foil-Faced R2.5 (90mm) - 65% Recycled Content | 100.50 | m2 | 10.00 | 1.01 |
| Wall finishes components | Ceramic Tile | NABERS | Default - Ceramic tiles (wall & floor) - excludes mortar, base, etc | 680.00 | kg | 1.13 | 0.77 |
| Wall finishes components | Epoxy glue | The GreenBook | 10mm epoxy glue | 34.00 | m2 | 41.00 | 1.39 |
| Wall finishes components | Grout | The GreenBook | Grout | 34.00 | m2 | 2.60 | 0.09 |
| Wall finishes | Timber skirting | NABERS | Timber Skirting Fixed With Glue (A1-A5) (In M) - 150mm high by 10mm thick | 7.00 | m2 | 6.54 | 0.05 |
| Wall finishes | Paint | The GreenBook | Paint Finish (In M2) - Acrylic and lime based paint | 244.00 | m2 | 2.99 | 0.73 |
| Wall finishes | Waterproofing | The GreenBook | 2mm PVC / Bitumen Membrane - 2mm PVC / bitumen membrane | 34.00 | m2 | 27.94 | 0.95 |
| Wall finishes | Painting service | The GreenBook | Paints | Quantities based on cost redacted for confidentiality purposes | | | 0.09 |
| Wall finishes | Wall wrap | The GreenBook | Residential Wall Finishes and Cladding | Quantities based on cost redacted for confidentiality purposes | | | 0.05 |
| Ceiling finishes | Plasterboard lining | NABERS | Default - Plasterboard - Board made from plaster typically coated in paper. Thickness from 4mm to 22mm. | 255.00 | m2 | 9.37 | 2.39 |
| Ceiling finishes | Paint | The GreenBook | Paint Finish (In M2) - Acrylic and lime based paint | 255.00 | m2 | 3.02 | 0.77 |
| Ceiling finishes | Insulation | The GreenBook | Glasswool Blanket Or Batt, Foil-Faced R2.5 (100mm) - 65% Recycled Content | 30.00 | m2 | 10.00 | 0.30 |
| Ceiling finishes | Insulation | The GreenBook | Glasswool Blanket Or Batt, Foil-Faced R3 (130mm) - 65% Recycled Content | 570.00 | m2 | 16.00 | 9.12 |

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| Floor finishes components | Ceramic Tile | NABERS | Default - Ceramic tiles (wall & floor) - excludes mortar, base, etc. | 420.00 | kg | 1.13 | 0.48 |
| Floor finishes components | Epoxy glue | The GreenBook | 10mm epoxy glue | 21.00 | m2 | 41.00 | 0.86 |
| Floor finishes components | Grout | The GreenBook | Grout | 21.00 | m2 | 2.60 | 0.05 |
| Floor finishes components | Concrete tile | The GreenBook | 20mm concrete tile | 42.00 | m2 | 17.00 | 0.71 |
| Floor finishes components | Polishing | The GreenBook | Polishing allowance | 42.00 | m2 | 17.00 | 0.71 |
| Floor finishes components | Mortar | The GreenBook | 30mm cement mortar bedding | 42.00 | m2 | 31.00 | 1.30 |
| Floor finishes components | Fixing | The GreenBook | Allow for fix in to site @ $50/m2 & 0.6kgCO2/$ | 42.00 | m2 | 30.00 | 1.26 |
| Floor finishes | Carpet | NABERS | Default - Carpet flooring | 55.00 | m2 | 39.33 | 2.16 |
| Floor finishes | Timber Boards | The GreenBook | Engineered Timber Boards - 12mm | 102.00 | m2 | 33.04 | 3.37 |
| Floor finishes | Sealer | The GreenBook | Concrete Sealer - Applied to floor | 36.00 | m2 | 1.94 | 0.07 |
| Floor finishes | Waterproofing | The GreenBook | 2mm PVC / Bitumen Membrane - 2mm PVC / bitumen membrane | 21.00 | m2 | 27.98 | 0.59 |
| Doors | Solid door | The GreenBook | Solid Timber Door And Frame, 35mm Thick Leaf - Single leaf, virgin | 10.00 | No | 105.00 | 1.05 |
| Doors | Roller Shutter | NABERS | EPD - Roller doors sectional door 601 (Europe) | 11.00 | m2 | 126.50 | 1.39 |
| Doors | Glazed door | NABERS | Default - Door - glazed - Aluminium frame - Generic | 1.67 | m2 | 359.95 | 0.60 |
| Doors | Hardware | The GreenBook | Residential Doors/Frames and Hardware | Quantities based on cost redacted for confidentiality purposes | | | 0.52 |
| Fittings & sundries | Stainless steel | The GreenBook | Kitchen Sink - Stainless steel | 2.00 | No. | 445.00 | 0.89 |

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| Fittings & sundries | Laminated HDR | The GreenBook | Base Unit for Kitchen Sink/ Hand Basin - Laminated HMR | 12.16 | Lm | 380.76 | 4.63 |
| Fittings & sundries | Benchtop stone | The GreenBook | Benchtop - Reconstituted stone | 0.14 | m3 | 1071.43 | 0.15 |
| Fittings & sundries | Kitchen cabinets and vanity | The GreenBook | Built-in Cabinetry | Quantities based on cost redacted for confidentiality purposes | | | 0.98 |
| Fittings & sundries | Shelving | The GreenBook | Residential Fittings and Sundries | Quantities based on cost redacted for confidentiality purposes | | | 0.34 |
| Fittings & sundries | Mirror | The GreenBook | Residential Fittings and Sundries | Quantities based on cost redacted for confidentiality purposes | | | 0.29 |
| Mechanical services | AC ducted heating | The GreenBook | Air Conditioning | Quantities based on cost redacted for confidentiality purposes | | | 2.53 |
| Electrical services | Meter panel, 3 Phase power | The GreenBook | General Electrical Services | Quantities based on cost redacted for confidentiality purposes | | | 0.41 |
| Electrical services | Cabling works | The GreenBook | General Electrical Services | Quantities based on cost redacted for confidentiality purposes | | | 1.65 |
| Electrical services | PV Cell installation | The GreenBook | Solar PV array | Quantities based on cost redacted for confidentiality purposes | | | 1.01 |
| Electrical services | Telecommunication lines | The GreenBook | Cable and conduit | Quantities based on cost redacted for confidentiality purposes | | | 0.18 |
| Hydraulic services | Basins | The GreenBook | Porcelain - Virgin porcelain - all types (pans, basins, cisterns, etc.) | 125.00 | kg | 7.04 | 0.88 |
| Hydraulic services | Stormwater, sewer and PVC pipes | The GreenBook | General Hydraulic Services | Quantities based on cost redacted for confidentiality purposes | | | 1.03 |
| Hydraulic services | Hot water system | The GreenBook | General Hydraulic Services | Quantities based on cost redacted for confidentiality purposes | | | 4.05 |
| External works component | Concrete | NABERS | Default - Generic concrete mix with a strength of 20MPa | 12.32 | m3 | 426.65 | 5.26 |
| External works component | Steel | NABERS | Default - Reinforcing steel bar & mesh | 0.32 | T | 4197.50 | 1.34 |
| External works component | Waterproofing | The GreenBook | 40mic plastic membrane | 77.00 | m2 | 2.00 | 0.15 |

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|---|---|---|---|---|---|---|---|
| External works component | Sand bed | The GreenBook | 50mm sand bed | 77.00 | m2 | 1.00 | 0.08 |
| External works component | Sealer | The GreenBook | Sealer | 77.00 | m2 | 6.00 | 0.46 |
| External works | Fence | The GreenBook | Fence - Timber paling 1800mm high | 128.00 | m2 | 71.02 | 9.09 |
| External works | Steel Balustrade | The GreenBook | Stainless Steel Balustrade - 1200mm high | 14.00 | Lm | 325.71 | 4.56 |
| External works | Stormwater drains | The GreenBook | Water Supplies and Equipment | Quantities based on cost redacted for confidentiality purposes | | | 0.83 |
| Furniture | Appliances | The GreenBook | Household Appliances | Quantities based on cost redacted for confidentiality purposes | | | 0.37 |
| Furniture | Cooktop, rangehood | The GreenBook | Induction Cooktop - Bosch - Serie 8 90cm PIV975DC1E | Quantities based on cost redacted for confidentiality purposes | | | 0.86 |
| **Total** | | | | | | | **175.66** |

Green Building Council Australia