Our homes weigh a tonne*

*(of carbon per square metre)

A call to action

20 May 2025

Acknowledgment of Country

We at the Green Building Council of Australia recognise the Traditional Custodians of Country throughout Australia. We pay our respects to Elders past and present, and recognise their continuous connection to lands, skies and waters.

Australia's First People are the world's oldest continuous living culture, and Australia's first practitioners of sustainability. They have shaped the built environment for millennia with purpose-built architecture that responds to the unique character and challenges of the landscape. The Green Building Council of Australia recognises the power of the built environment to shape a future that cares for both people and planet. The choices we make today matter for the future of tomorrow.

FUNDING PARTNERS

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 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 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.

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.

Jorge Chapa – Chief Impact Officer
Jeff Oatman – Head of Collaborations & Membership
Katherine Featherstone – Senior Manager Products & Materials
Emily Chung – Manager – Future Focus

TECHNICAL PARTNER

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.

Dr Caroline Noller – Founder of The Footprint Company
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Tanvi Patel – Senior Sustainability Consultant

Content

Change log

Versions	Date	Description
1	20 May 2025	Initial release

01

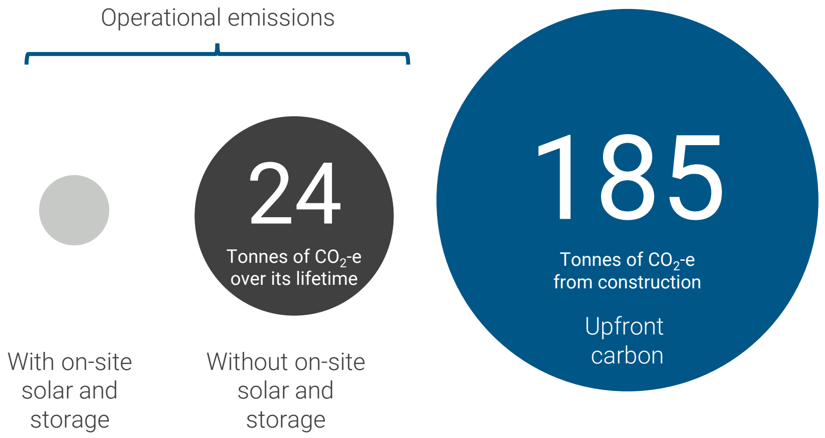
A call to action

Ignoring upfront carbon of our homes threatens Australia's net zero target by 2050.

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

The upfront carbon from construction materials and activities are around a tonne of CO_2 equivalent (tCO2-e) per m^2 of conditioned floor area (CFA). This is equivalent to an average total upfront carbon of 185 tCO_2-e[1]. Meanwhile, as the grid decarbonises, the operational emissions of a house built today will be approximately 24 tCO_2-e over its lifetime[2]. **Upfront carbon is over seven times more significant—and it's locked in at construction.**

If the home has on-site solar and battery storage, the upfront carbon of the home will make up more.



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.

Approximately 119,000[3] new detached houses are expected to be built annually over the next five years, representing 45% of all construction activity.

The numbers speak for themselves – assuming the upfront carbon of our homes does not change, the construction of new homes could use between 7 to 11% of Australia's total carbon budget between now and 2050.

We aren't suggesting houses aren't built – we just want them built better.

1. Our technical report specified a range of 1.00 to 1.29 tonnes of CO_2 equivalent per m^2 of conditioned floor area. This is equivalent to an average total of 185 tonnes of CO_2 equivalent for a house.
2. An average lifetime of a house of approximately 60 years is assumed. The grid intensity is assumed to reduce in line with the Step Change scenario from AEMO's 2024 Integrated System Plan.
3. Based on industry forecasts, our technical report calculates that an average of approximately 119,000 new detached homes will be built annually between 2024 and 2029.

02

The facts and figures in a nutshell

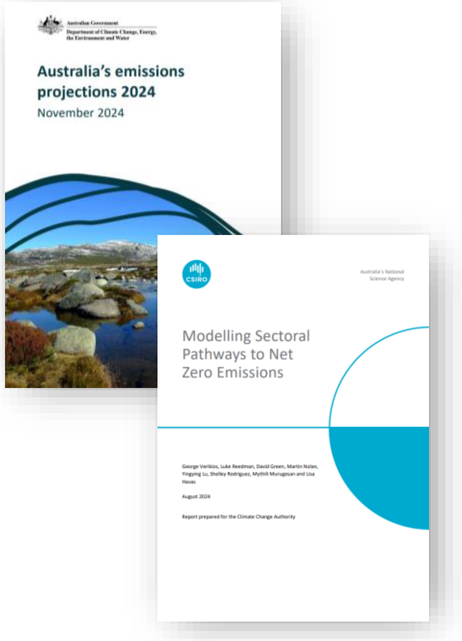
The built environment will need to decarbonise rapidly over the next 10–15 years to stay within our country's remaining carbon budget.

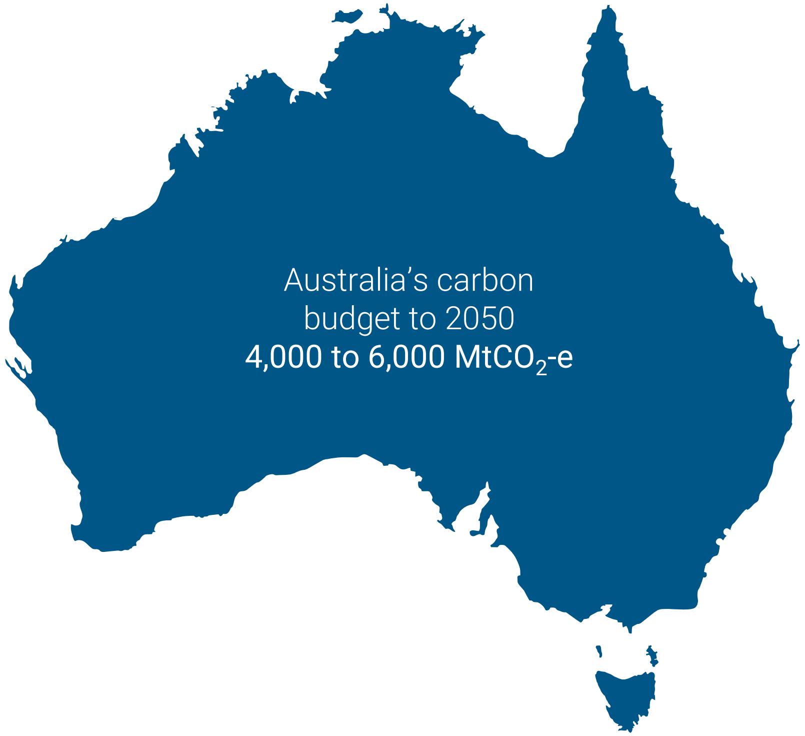
Australia operates within a carbon budget framework to meet its legally binding emissions reduction targets under the Paris Agreement. The nation has committed to reducing emissions by 43% below 2005 levels by 2030 and achieving net zero by 2050.

There are two national numbers to consider when it comes to carbon budgets for Australia between now and 2050:

2030
The Department of Climate Change, Energy, the Environment and Water advises a carbon budget of 4,377 $MtCO_2$-e for the period from 2021 to 2030[1]. This budget was calculated based on the legislated 43% target.

2050
CSIRO[2] estimated the remaining budget to be between 4,000 to 6,000 $MtCO_2$-e. The budget varies based on the speed of action, and whether we follow a 2 degree or 1.5 degree scenario.





1. This is similar to a budget of 4,377 Mt CO_2-e published by the Department of Climate Change, Energy, the Environment and Water in their report, Australia's emissions projections 2024.
2. Table 17, "Modelling Sectoral Pathways to Net Zero Emissions", CSIRO, 2024.

The residential sector in Australia

The residential sector in Australia is critical. It continues to grow to meet Australia's need to house its growing population.

As of September 2024, there are around **11.25 million homes**[1] in Australia, of which:

- 70% are single family dwellings (~7.88 million homes)
- 16% are apartments (~1.8 million units)
- 13% are townhouses, semi-detached, or terrace houses (~1.46 million units)

The average floor area[2] between 2008 to 2023:

- a new home is 235.4 m^2.
- apartments is 114.9 m^2.

Annual housing commencements

On any given year, there are between 150,000 to 230,000 residential homes that commence construction in Australia. While the number of homes vary per year, over the past 15 years, about 40% are apartments and 60% are single family dwellings[3].

Between financial year (FY) 2025 to FY 2029, it is forecasted that 600,000 new single family dwellings will be commence construction[4].

1. Table 1, Total Value of Dwellings, All series, ABS, 2024
2. Building Activity, Australia, ABS, 2024
3. Building Activity, Australia, ABS, 2025
4. As forecasted by the Master Builders Association based on ABS data. Our technical report provides a further details.

Australian new housing construction

FY	New single family dwellings		New apartments and other		Total
2010-11	100,549	62%	60,782	38%	161,331
2011-12	89,837	62%	54,376	38%	144,213
2012-13	95,633	58%	67,876	42%	163,509
2013-14	107,618	59%	75,653	41%	183,271
2014-15	117,124	54%	100,064	46%	217,188
2015-16	116,381	50%	114,779	50%	231,160
2016-17	115,557	53%	104,157	47%	219,714
2017-18	121,621	53%	106,247	47%	227,868
2018-19	112,341	57%	83,362	43%	195,703
2019-20	102,354	59%	69,680	41%	172,034
2020-21	140,506	66%	71,948	34%	212,454
2021-22	131,507	64%	73,853	36%	205,360
2022-23	110,264	64%	62,565	36%	172,829
2023-24	99,656	63%	59,282	37%	158,938
2024-25	109,660	61%	70,593	39%	180,253
2025-26	116,134	59%	80,922	41%	197,056
2026-27	123,277	58%	89,378	42%	212,655
2027-28	125,317	56%	98,119	44%	223,436
2028-29	120,224	55%	100,339	45%	220,563
Average	**113,451**	**59%**	**81,262**	**41%**	**194,712**

As forecasted by the Master Builders Association based on ABS data. Our technical report provides a further details.

Assuming the built environment continues to grow at the same pace, between now and 2050, we will build around 2.8 million new homes and almost 2 million new apartments.

03

The emissions profile of a single-family dwelling

1. Refer to *Appendix A* for further definitions for these terms.
2. Homes in Australia can be, and should be, built to be all electric, as there's no viable emissions-free solution to the use of natural gas or LPG. Meanwhile, electricity can be emissions-free today.

A new home's carbon emissions profile consists of upfront carbon, in-use and end-of-life emissions, as well as operational emissions[1].

Upfront carbon

Upfront carbon refers to the emissions generated from the materials and processes used to construct a home. This includes:

- Building material production
- Transportation of materials to site
- Construction activity emissions from fuels and electricity

Operational emissions

Once occupied, a home continues to produce carbon emissions through energy consumption. Homes in Australia typically use energy from electricity (either from on-site solar or from the grid) and from fuels, mostly natural gas or LPG[2].

In-use and end-of-life emissions

While not as significant as those above, there are other emissions from materials that occur during maintenance, renovations, and demolition of the home in the future. For purposes of this paper, they are excluded, though we note any savings in upfront carbon tend to also result in equivalent savings in the maintenance, replacement, and end-of-life emissions.

Our methodology to calculate the emissions of a home

To calculate the emissions profile of a home, we partnered with TSA Riley to help us define an average home in Australia, following the model defined as part of the National Construction Code (NCC)'s Regulatory Impact Statement Analysis relating to upgrading minimum energy performance standards to 7-Star NatHERS.

We chose a typical home, based on national trends. It's a single-story, 4-bedroom house with 2 bathrooms, a garage, porch, and alfresco area. The house measures around 234m^2. The study calculates carbon emissions for both internal spaces and external landscaping.

We assumed an all-electric home and performed relevant regional variations on foundations, roofing, walls, and insulation. All homes were compliant with NCC 2022 requirements.

For operational emissions, we used the average home power consumption for Australia. As it is an all-electric home, we did not calculate any emissions from fossil fuels like gas.

We assumed a grid decarbonisation scenario based on AEMO's Step Change scenario, as defined in their 2024 Integrated System Plan report. This scenario points to the grid decarbonising rapidly over the next decade, with an expectation of the grid mostly being powered by renewables by 2035.

For upfront carbon, we calculated the different material variations to come up with a bill of quantities. We then selected emission factors for those materials using the NABERS' National Emission Factors database and industry averages. When precise data is unavailable, Input-Output (IO) data fills in the gaps. NABERS data is prioritised as it will become the basis of any future policy, and the preferred dataset for Australia.

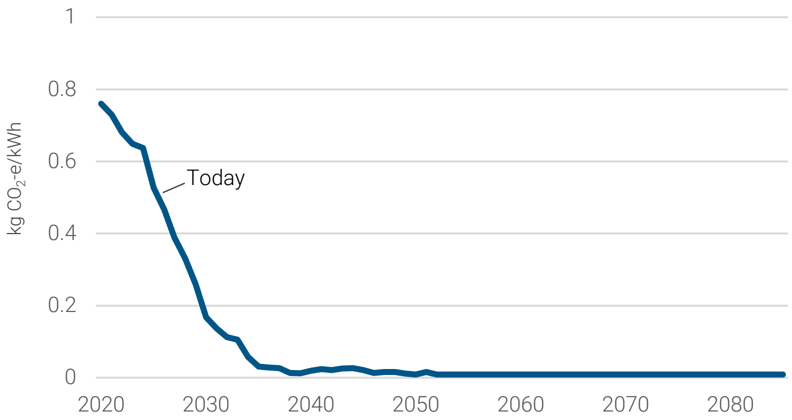
We also aim to be transparent about our assumptions – Appendix B of this paper outlines our calculations, and the same is done in our technical report.

The operational emissions of a home

All-electric homes have a pathway to decarbonisation while those that use natural gas do not. As the grid decarbonises, an all-electric home benefits from the reduced emissions. When combined with on-site solar and storage, the home could achieve near zero emissions.

The operational emissions of our model home come from electricity consumption. To determine what these are, we had to first calculate the grid emissions profile over the next 60 years.

According to AEMO's Step Change scenario[1], the grid[2] is expected to decarbonise between now and 2050, with a likely extrapolation to 2085 as follows:



1. Step Change scenario, Integrated System Plan, AEMO, 2024
2. While AEMO's Step Change scenario applies to the National Electricity Market (NEM), the Wholesale Electricity Market (for Western Australia) shows a similar trajectory.
3. Simple electricity and gas benchmarks, AER, 2021
4. The emissions intensity of the grid is based on the predicted scope 2 in AEMO's Step Change scenario with a 10% increase to account for scope 3 electricity losses.

The average energy consumption of a house

The energy consumption for a home in Australia varies based on where it is located, the type of house construction and the number of people living there.

The Australian Energy Regulator published electricity consumption benchmarks[4]across different climate zones and household sizes, which we have been used to calculate an average number for Australia. We assumed a family of four, in Sydney, as a good average for the country, noting that colder climates tend to use more electricity and warmer climates use less.

For a family of four, we assumed a daily rate of 20kWh, or approximately 7300 kWh a year. In 2025, this house will emit around 3.9 tCO_2-e[5]. In 2035, assuming no changes to the energy consumption of the house and the grid continues to decarbonise, it would emit approximately 0.23 tCO_2-e[5] and in 2050, the home would emit barely any emissions.

Over its 60-year lifetime, an average all-electric house built in 2025 will emit around 24 tonnes of CO_2-e from its operational emissions. If powered mostly by on-site solar with storage? That number would be much lower.

The upfront carbon of a home

Upfront carbon matters, as it is spent once the home has been built. Unlike operational emissions, once built, there is no way to reduce these emissions.

Our study began with a single-storey, 4-bedroom detached house chosen to represent an average Australian home.

Its design reflects common features found across Australia, including a concrete floor slab, a timber-framed roof, and standard finishes inside. The regional differences in construction techniques and material choices were accounted for when determining the upfront carbon of an average home in Australia. For instance, in Western Australia, double brick external walls are used while in the Northern Territory and Far North Queensland, blockwork is more typical compared to the rest of Australia which commonly uses brick veneer construction.

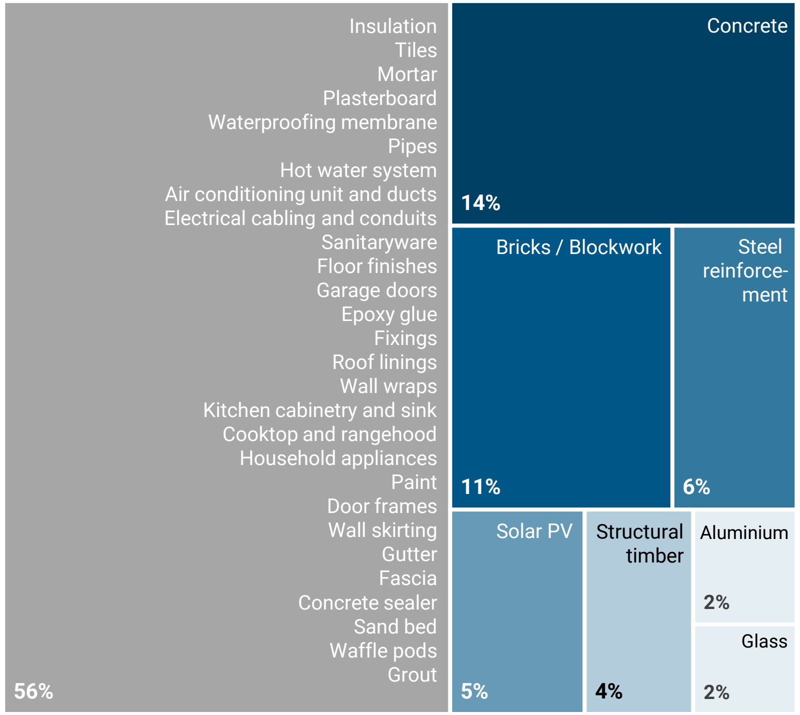
To ensure our analysis was comprehensive, we included the major structural elements (like the slab, walls, and roof), the internal finishes (such as flooring and ceilings), external works (driveways and fencing), and essential fittings and fixtures (windows, doors, and basic services). While the landscaped areas and soft scaping aren't part of the main floor area calculation, they were still considered in the overall carbon totals. Unlike other studies, we decided to include everything, to get a true number for the upfront carbon of a home[1].

The results showed that total upfront carbon varies by state and territory, reflecting regional differences in construction typology however despite these differences, the national average hovered between **1 to 1.16 tCO_2-e per m^2 on a conditioned floor area** basis (that is, the area where we live in a house).

1. Various studies have assessed the upfront carbon footprint of homes. While they all consider the building structure and internal walls, they often have limited coverage of internal finishes and building services, excluding external works. The findings generally correlate with others based on the percentage of building elements examined, though some discrepancies arise from differences in methodology, scope, and carbon factors.

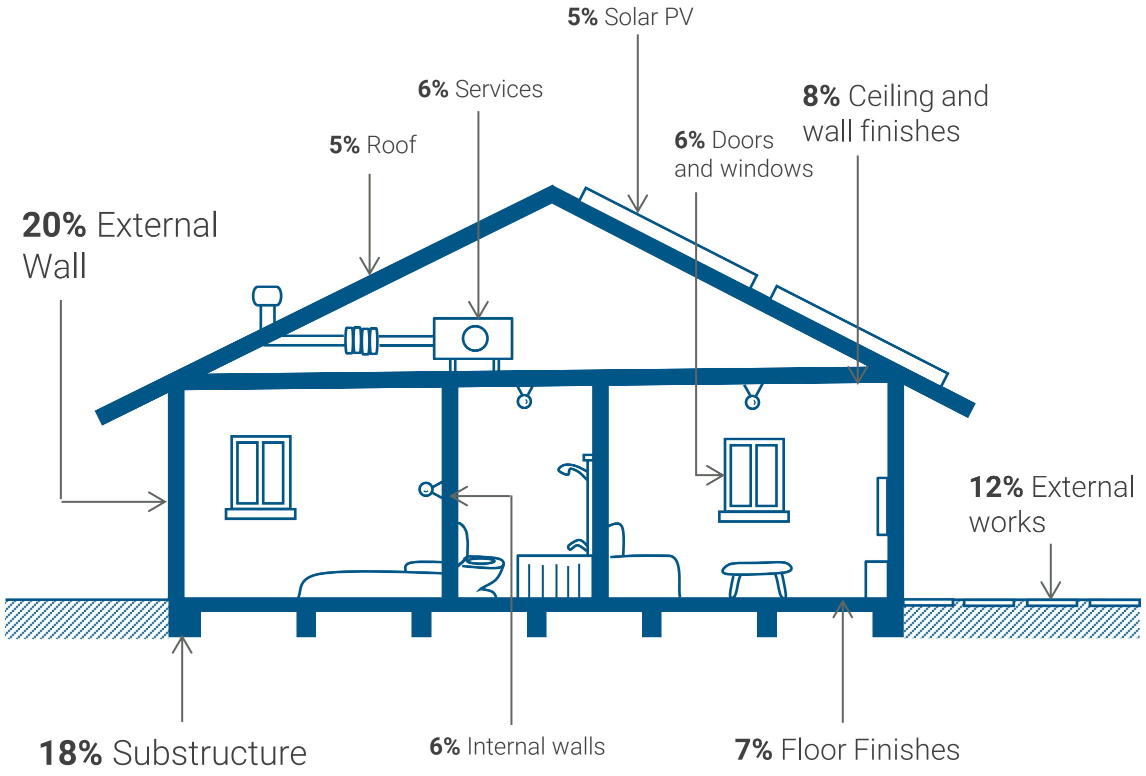
What materials do we find upfront carbon in a home?

In every location, materials like concrete, bricks/blockwork and steel reinforcement tend to dominate the overall carbon footprint.



Where do we find upfront carbon in a home?

There were certain building elements that consistently stood out as the largest contributors to upfront carbon in every region. These includes the substructure (ie. ground slab and footings), external walls, and external works.



On average, a typical single family dwelling is responsible for **185 tCO_2-e** before anyone moves in.

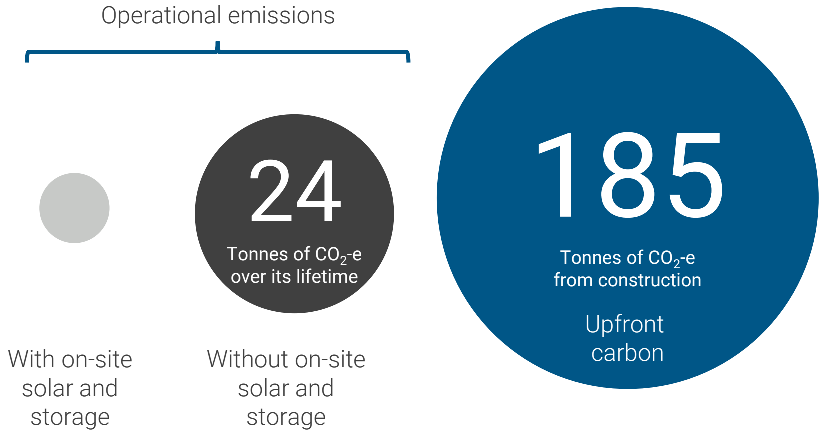
04

What does this mean for Australia's carbon budget?

1. From the study we did with thinkstep-anz, [Embodied carbon & embodied energy in Australia's buildings](), approximately 24% of the emissions associated with manufacture of building materials in 2019 is from electricity. The emissions associated with the electricity and therefore the overall upfront carbon of new houses were projected to decrease in alignment with the decarbonisation rate of the grid predicted in AEMO's Step Change Scenario (refer to page 9 for further details). Emissions reductions associated with materials innovation have not been assumed.

The results are inescapable – upfront carbon is the largest source of emissions in new homes in Australia. But are they the largest source over the lifetime of the asset?

The previous section highlights this. The operational emissions of a home over 60 years are 24 tonnes. The emissions to build and furnish that same house are 185 tonnes, over seven times as much.



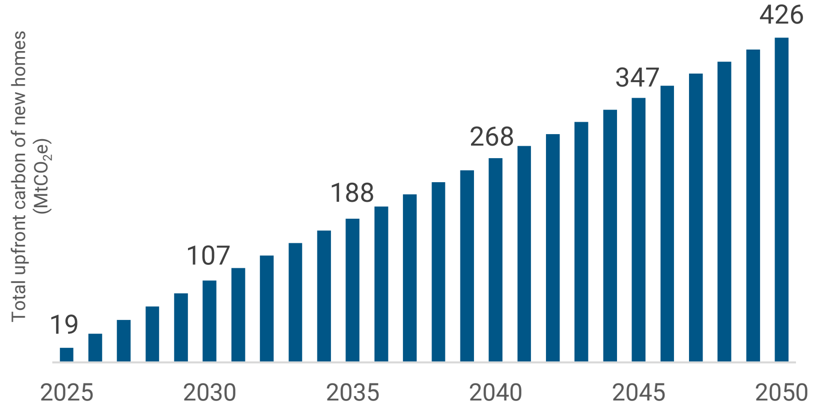
Even assuming the grid were to decarbonise much slower, the upfront carbon would still be much larger. In fact, if we assumed the grid stopped decarbonising tomorrow, it would still take more than 48 years for the operational emissions to catch-up to the upfront carbon.

The fact is, upfront carbon is the single largest source of emissions in a typical new home in Australia.

So, what happens to our carbon budget?

Looking at the numbers in section 2, we can estimate the amount of carbon that would be taken up by building single family dwellings at the same rate as today between now and 2050.

Since 2010, Australia built on average around 111,496 homes a year. Over 25 years, that is around 2.79 million homes. Assuming that reductions in upfront carbon between now and then are only attributed to the decarbonisation of the grid[1], the construction of homes in Australia would emit 426 $MtCO_2$-e.



If nothing changes, the construction of new single-family dwellings could use up anywhere between 7 to 11% of Australia's carbon budget.

If we build anything else, we'll exhaust our carbon budget faster.

05

What must we do about it?

1. Our Upfront Opportunity, ASBEC, 2025
2. The information to calculate embodied carbon is already mostly entered as part of the NatHERS assessment. A builder already adds type of materials, and the software can calculate material amounts based on some simple extrapolation of information.
3. The reduction targets proposed are on 2020 levels and align with other international standards like the Science-based Targets Initiative and Green Star.

Our recommendations for governments are simple and clear, and reflect the industry-agreed policy roadmap published by the Australian Sustainable Built Environment Council (ASBEC), Our Upfront Opportunity[1]:

Implement low-cost upfront carbon disclosure for all homes in Australia. Fund the NatHERS embodied carbon module to include a low-cost tool to calculate upfront carbon of homes at the design stage and make it easy to disclose upfront carbon in the NatHERS certificate[2]. NatHERS should use the NABERS emissions factors, to allow for consistency between homes.

Commit to upfront carbon reduction benchmarks. By investing in NatHERS we can have upfront carbon disclosure with minimal cost, while growing the available data to inform benchmarks for upfront carbon reduction. The update to the Trajectory for Low Energy Buildings should include a forward schedule of upfront carbon measurement and reporting standards. This will support a nationally consistent, staged approach for including reduction targets in planning policies and the updates to the National Construction Code (NCC). A cost-effective minimum standard in 2028 and a 20% reduction by 2031[3] should be introduced with further reductions in the future. Upfront carbon reductions should be considered on a per m^2 basis, or on a total carbon budget basis.

Build on what we know to further develop benchmarks. As part of our technical report, we have published all assumptions, from bills of quantities to emissions factors. This work, together with what we can learn from NatHERS embodied carbon disclosure, applying the NABERS Embodied Carbon rating tool and other local and state government initiatives will be a rich source of data to inform benchmarks for all types of homes and buildings.

Fund NABERS permanently to run the national emissions factors database, and their continued upfront carbon work. The NABERS work for the commercial sector has set the baseline for action, and this paper would not exist without their emissions factors. The NABERS program must be funded securely to continue doing this valuable and economically critical work.

Back innovation. Governments should incentivise and provide support for innovative, low-carbon and circular materials and products. This will create better choices for industry while creating opportunities for innovative Australian businesses. Support should also be provided to these manufacturers to disclose the embodied carbon of their products through a verified process.

Lead by example to accelerate momentum. Government procurement and funding for housing should set clear embodied carbon reduction targets and reward decarbonisation on projects.

Planning systems can drive change at scale. By championing medium density where appropriate, state and local government can reduce upfront carbon through smaller homes while also delivering other benefits for liveability, housing choice and affordability. Planning mechanisms can also encourage 'no-build' and 'reuse' options in brownfield developments and encourage modern methods of construction.

For further, detailed recommended government actions to reduce upfront embodied carbon, see ASBEC's Our Upfront Opportunity.

Taking industry action

Industry can take the lead on reducing upfront carbon in homes with three key actions.

Reduce new home sizes now. Australian homes are large. The quickest way to reduce upfront carbon in homes is to reduce their overall size - fewer m^2 means less upfront carbon. Carefully considering how much space we really need can also mean lower construction costs and reduced ongoing costs for heating and cooling our homes. State-based planning has a big part to play in reducing home sizes and driving more density in our cities, reducing our upfront carbon.

Simplify home design. Every corner is lost energy, and every corner is additional embodied carbon. The more complex in shape and geometry our homes are, the more difficult they are to build, and the more materials they require. By reducing design complexity, we can reduce upfront carbon.

Build innovation. Including modular elements, designing to material sizes, reducing waste from construction, choosing low-carbon and circular products, and bringing in equipment that can be powered by renewables are some of the strategies we can use to reduce carbon. Digitisation and automation will further assist in driving innovation.

Integration into Green Star

We will be playing our part.

Green Star Communities v2 includes upfront carbon emission reduction targets for homes. We consider a reduction on each home, or at a total precinct scale carbon budget so that in total, all developments have an average upfront carbon of less than 185 tonnes per home.

Green Star Homes v1.1, expected in 2026, will include a requirement for all homes to reduce their upfront carbon. This will be calculated either on a per m^2 basis, or as a reduction of total carbon budget for the home.

Appendix A: Valuable terminology

Conditioned floor area (CFA): The measure of the total floor area of the dwelling, excluding floor area that is not enclosed, bathrooms (but not ensuites) and laundries, with a ventilation opening; and voids, storerooms, garages and carparks. This definition is used by BASIX and NatHERS.

Carbon dioxide equivalent (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.

Upfront carbon: The emissions caused in the materials production and construction phases (Modules A1 to A5 as defined in EN 15978) of the lifecycle before the building begins to be used. Also used interchangeably with 'upfront carbon emissions' or 'upfront emissions'.

In-use emissions: 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).

End-of-life emissions: The emissions that occur at the end of life of a building. This includes demolition, deconstruction, transportation and waste management after the building is no longer in use.

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.

Operational emissions: The emissions associated with energy used to operate the building. This together with embodied emissions makes up 'whole-life carbon'.

Note: The word 'carbon' and 'emissions' is used throughout this paper as shorthand for all greenhouse gas emissions as per the GHG Protocol Corporate Accounting and Reporting Standard.

Appendix B: Detailed methodology

03 The emissions profile of a single-family dwelling

The operational emissions

Daily electricity use for a family of four[1] = 20 kWh
Annual electricity use for a family of four = 20 kWh x 365 days = 7311 kWh/year

Operational emissions

= Projected grid emissions intensity[2] x Annual electricity use for a family of four

For example:
Projected grid emissions intensity for 2025 = 0.53 $kgCO_2e/kWh$
Operational emissions = 0.53 $kgCO_2e/kWh$ x 7311 kWh/year / 1000 = 3.9 tCO_2e

To calculate the total operational emissions of a single-family dwelling over its lifetime, the operational emissions was calculated each year based on a projected grid emissions intensity and summed. The calculated figures are below:

	Projected grid emissions intensity ($kgCO_2e/kWh$)	Operational emissions (tCO_2e)
2025	0.53	3.9
2026	0.47	3.4
2027	0.39	2.8
2028	0.33	2.4
2029	0.26	1.9
2030	0.17	1.2
2031	0.14	1.0
2032	0.11	0.82
2033	0.11	0.77
2034	0.057	0.42
2035	0.031	0.23
2036	0.029	0.21
2037	0.026	0.19
2038	0.013	0.10
2039	0.012	0.09
2040	0.020	0.14
2041	0.024	0.18
2042	0.021	0.15
2043	0.025	0.18
2044	0.026	0.19

	Projected grid emissions intensity ($kgCO_2e/kWh$)	Operational emissions (tCO_2e)
2045	0.021	0.15
2046	0.013	0.10
2047	0.015	0.11
2048	0.015	0.11
2049	0.011	0.08
2050	0.009	0.06
2051	0.015	0.11
2052	0.009	0.06
2053	0.009	0.07
2054	0.010	0.07
2055	0.013	0.10
2056	0.013	0.10
2057	0.013	0.10
2058	0.013	0.10
2059	0.013	0.10
2060	0.013	0.10
2061	0.013	0.10
2062	0.013	0.10
2063	0.013	0.10
2064	0.013	0.10

1. Simple electricity and gas benchmarks, AER, 2021
2. The emissions intensity of the grid is based on the predicted scope 2 in AEMO's Step Change scenario from Integrated System Plan, AEMO, 2024, sourced from Open Electricity. A 10% increase has been included to account for scope 3 electricity losses.

	Projected grid emissions intensity ($kgCO_2e/kWh$)	Operational emissions (tCO_2e)
2065	0.013	0.10
2066	0.013	0.10
2067	0.013	0.10
2068	0.013	0.10
2069	0.013	0.10
2070	0.013	0.10
2071	0.013	0.10
2072	0.013	0.10
2073	0.013	0.10
2074	0.013	0.10
2075	0.013	0.10

	Projected grid emissions intensity ($kgCO_2e/kWh$)	Operational emissions (tCO_2e)
2076	0.013	0.10
2077	0.013	0.10
2078	0.013	0.10
2079	0.013	0.10
2080	0.013	0.10
2081	0.013	0.10
2082	0.013	0.10
2083	0.013	0.10
2084	0.013	0.10
2085	0.013	0.10

Total operational emissions between 2025 to 2085 = 24 tCO_2e

The upfront carbon emissions of a house

Upfront carbon of a typical home = 185 tCO_2e

Refer to our technical report, Our homes weigh a tonne – Technical report.

04 What does this mean for Australia's carbon budget?

The total upfront carbon associated with the construction of new homes from 2025 to 2050

Average home of new homes constructed annually[2] = 111,496 homes
Upfront carbon of a typical home = 185 tCO_2e
Total upfront carbon from new homes per year
= 111,496 homes x 185 tCO_2e
= 20.6 $MtCO_2e$

The proportion of upfront carbon related to electricity in 2019[1] = 24%
Upfront carbon emissions associated with electricity in 2019
= 20.6 $MtCO_2e$ x 24%
= 4.9 $MtCO_2e$

Upfront carbon emissions associated with other processes and materials in 2019
= 20.6 $MtCO_2e$ x 76%
= 15.7 $MtCO_2e$

To determine the total upfront carbon from new homes whilst accounting for the decarbonisation of the grid, the upfront carbon emissions associated with electricity was reduced proportionally to the decreasing grid emissions intensity as per section 03.

Projected total upfront carbon emissions associated with electricity

$$= \frac{\text{Projected grid emissions intensity}}{\text{Grid emissions intensity in 2019}} \times \text{Upfront carbon emissions associated with electricity in 2019}$$

The upfront carbon emissions associated with other processes and materials was assumed to remain the same from 2019. These were summed to determine the projected total upfront carbon from new homes each year. The calculated figures are below:

	Projected grid emissions intensity ($kgCO_2e/kWh$)	Projected electricity emissions ($MtCO_2e$)	Projected other upfront emissions ($MtCO_2e$)	Total upfront carbon ($MtCO_2e$)	Cumulative total upfront carbon ($MtCO_2e$)
2025	0.53	3.2	15.7	19.0	19
2026	0.47	2.9	15.7	18.6	38
2027	0.39	2.4	15.7	18.1	56
2028	0.33	2.0	15.7	17.8	73
2029	0.26	1.6	15.7	17.3	91
2030	0.17	1.0	15.7	16.7	107
2031	0.14	0.84	15.7	16.6	124
2032	0.11	0.69	15.7	16.4	140
2033	0.11	0.65	15.7	16.4	157
2034	0.057	0.35	15.7	16.1	173
2035	0.031	0.19	15.7	15.9	189
2036	0.029	0.18	15.7	15.9	205
2037	0.026	0.16	15.7	15.9	221
2038	0.013	0.08	15.7	15.8	236
2039	0.012	0.07	15.7	15.8	252
2040	0.020	0.12	15.7	15.8	268
2041	0.024	0.15	15.7	15.9	284
2042	0.021	0.13	15.7	15.8	300

1. Embodied carbon & embodied energy in Australia's buildings, GBCA and thinkstep-anz, 2021
2. Refer to figures on page 7

	Projected grid emissions intensity ($kgCO_2e/kWh$)	Projected electricity emissions ($MtCO_2e$)	Projected other upfront emissions ($MtCO_2e$)	Total upfront carbon ($MtCO_2e$)	Cumulative total upfront carbon ($MtCO_2e$)
2043	0.025	0.16	15.7	15.9	316
2044	0.026	0.16	15.7	15.9	331
2045	0.021	0.13	15.7	15.8	347
2046	0.013	0.081	15.7	15.8	363
2047	0.015	0.095	15.7	15.8	379
2048	0.015	0.095	15.7	15.8	395
2049	0.011	0.068	15.7	15.8	410
2050	0.0088	0.054	15.7	15.8	426