



ATSE

EXPLAINER

Embodied carbon emissions in detached housing



More than 119,000 detached houses were built in Australia in 2025.

Alongside the rising cost of building these homes is another often overlooked cost: the carbon emissions generated before anyone moves in.

With the Australian Government aiming to deliver 800,000 new detached homes over the next five years, these emissions are set to increase significantly.

Known as embodied carbon, these emissions remain largely unaddressed in policy, building practices and regulation. The good news is that practical, cost-effective solutions already exist.

This explainer comes at a time when governments across the country are implementing policy towards expanding housing construction. Now is the time to consider the associated carbon emissions and the ways to reduce them.

Recommendations



Recommendation 1

In setting greenhouse gas reduction targets, Australia has to recognise the impact of embodied energy in new detachable housing.

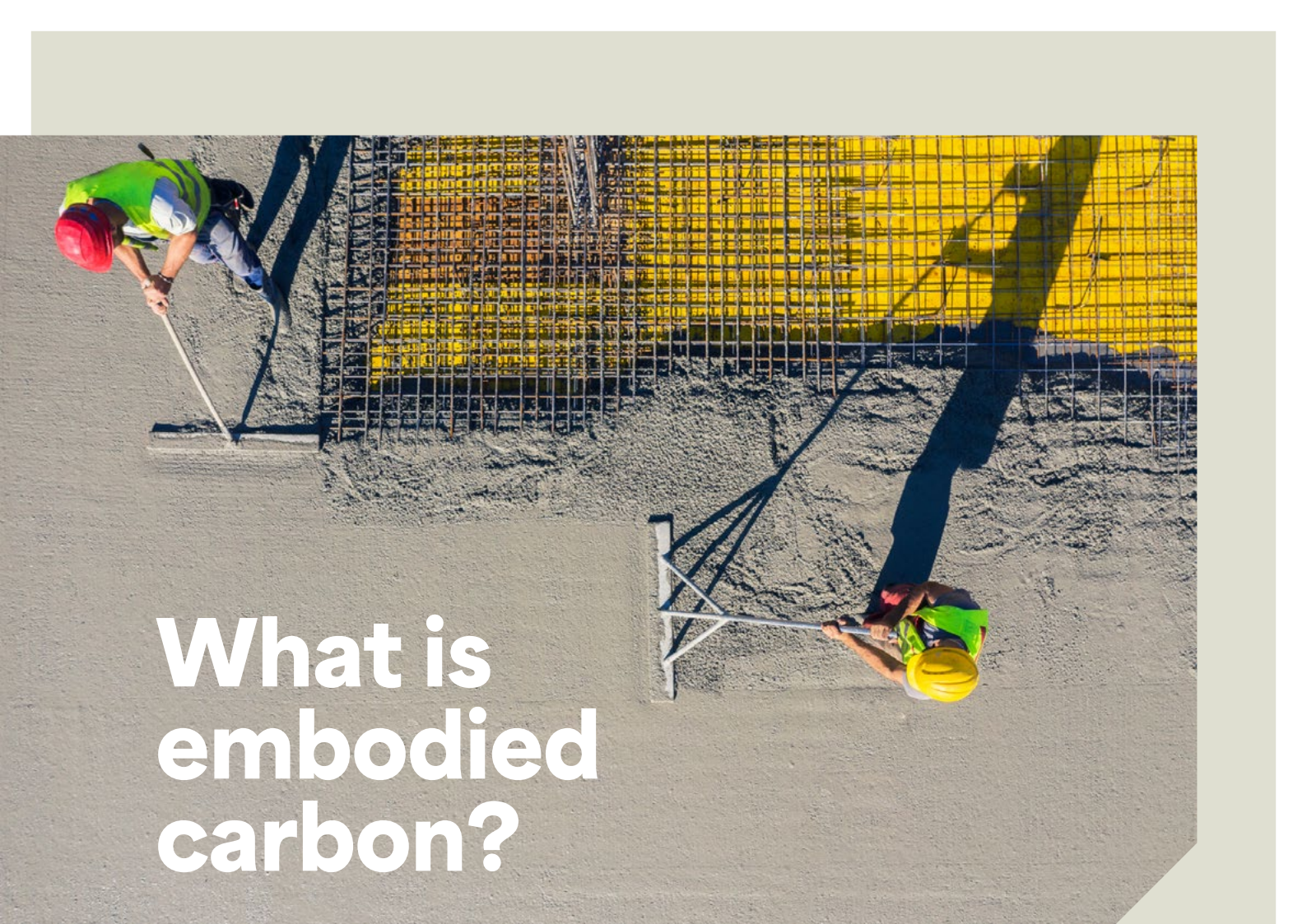
If state governments are going to provide methodologies for estimating embodied energy, they must also provide incentives for designs that have a reduction in embodied energy. Such designs are likely to be more expensive than conventional practice for now.



Recommendation 2

Australia should work to increase awareness of this source of emissions, and the alternatives, among the general public and the construction industry.

The Australian public has recognised the need for the reduction of emissions and should be challenged to depart from the conventional forms of dwelling construction. Simply allowing the status quo to remain will impact greenhouse gas reduction targets and perpetuate more wasteful construction practices.



What is embodied carbon?

Building construction consumes around 50% of raw materials worldwide.

The carbon emissions generated during the mining, processing, manufacturing, and transport of those materials – before a building is even occupied – are known as embodied carbon. Embodied carbon also covers emissions from building practices, maintenance, repair, renovation, replacement and eventual demolition over a building's lifecycle, but excludes the energy used to operate the building while occupied.

The embodied carbon of building products varies dramatically. New aluminium window frames require up to six times more embodied energy to produce than equivalent timber frames (Ref.1). Globally, embodied carbon from buildings accounts for around 11% of all greenhouse gas emissions – a share that is growing as operational emissions fall with grid decarbonisation. One analysis found that an average all-electric Australian home will emit seven times more carbon during its construction than across its entire 60-year operational life (Ref.2).



Why it matters

Scale and the Australian housing pipeline

While the Federal Government has proposed to build 1.2 million homes (two-thirds detached, one-third multistorey apartments) over a five-year period, there appears to be little recognition that – with current building materials and practices – this will significantly increase greenhouse gas emissions. The embodied energy in a multistorey unit is comparable to that of a detached house given the high embodied energy materials used in the construction and fit out.

According to the Green Building Council of Australia (GBCA), upfront carbon emissions in houses have been estimated to range from 1.20 to 1.29 tonnes of carbon dioxide per square metre of the conditioned floor plan or around 185 tonnes per dwelling (Ref.2). Consequently, to meet the Government's construction target, 220 million tonnes of carbon dioxide equivalents will be emitted. In comparison, the Government has indicated that in 2024-25, total greenhouse emissions from domestic road vehicles reached a record of 108 million tonnes of carbon dioxide equivalent. In the same single-year period, embodied carbon emissions from set housing development targets would be 44 million tonnes or just over 40 per cent of the emissions from domestic road vehicles.

The conventional materials used in detached housing are concrete, steel, aluminium, timber, plasterboard, and plastic.

The conventional materials used in detached housing are concrete (foundations, slabs), steel (framing and reinforcement), aluminium (window frames and cladding), timber (rafters, framing and skirting), plasterboard (panelling), and plastic products (piping etc). The carbon footprint of these materials is well recognised and lower footprint materials such as green concrete and steel, and the increased use of timber and engineered wood products, are seen as an opportunity to lower the embodied carbon footprint.

The Australian regulatory landscape

In Australia, embodied emissions remain unaddressed in current policy, building practices and in the regulatory environment.

The National Construction Code does not yet include mandatory embodied energy requirements for detached housing. However, in March 2026, the NSW Department of Planning, Housing and Infrastructure issued an Embodied Emissions Technical Note (Ref.3) in which it stated that all new residential and non-residential developments must report on embodied emissions under the 2022 Sustainable Buildings policy. The GBCA has stated that embodied emissions made up 16% of the Australian built environment's emissions footprint, and that without deliberate action this could increase to 85% by 2050 as buildings became more efficient and the power grid decarbonises. "To achieve Australia's net zero emission target by 2050, we must begin measuring and managing emissions in buildings."



The National Construction Code does not yet include mandatory embodied energy requirements for detached housing.

The NSW Government's Technical Note identifies a methodology for measuring the embodied emissions in residential buildings. The ensuing issue is that once measured, there is no course of action in terms of compliance with the requirement to reduce embodied emissions.

Given current challenges with meeting the Commonwealth's housing construction targets (in NSW, the target is 77,000 in the first year of the five-year housing Accord, but just 42,000 new homes were built in 2025), the implementation of additional restrictions flowing from compliance would be challenging.

Further, the Urban Development Institute of Australia estimated in a recent report that 115,300 new homes will be built across Australian capital cities in 2026, a drop of 4% on the 2025 number and the lowest level since 2014 (Ref.3). With respect to the federal government's Housing Accord target, the report suggested that the actual build could be 380,000 less than the 1.2 million target nationwide.

The concept of modular construction offers potentials for reduced cost and construction waste.



Financing

In 2025, the Commonwealth Bank undertook an initiative to provide financing for prefabricated housing and National Australia Bank has indicated they also will enter into this market.

Prefabricated and modular housing is currently regulated by the Australian Building Code, but there is still some concern with respect to the overall responsibility for the manufacture, transport and erection of the house.

New and recycled materials

While conventional cement manufacture has introduced measures to decrease the amount of carbon dioxide produced per tonne of cement, it is still significant; green cement solutions provide a better option. However green cement can cost 75% more than conventional cement and is impacted by economies of scale. As a consequence, green cement is rarely specified for use in construction because of the recognition of higher cost.

Solid timber and engineered timber components offer lower embodied energy than conventional concrete for floors, but are generally more expensive. Timber can be factory made, which offers some cost reduction potential. Extensive research is currently being directed to achieve low embodied energy in house floors, which can be a significant embodied energy source.

The concept of recycled building materials has attracted some interest in recent times due to the benefits in reducing embodied energy. Recycled timber has been used in new flooring and decking, and crushed concrete and bricks have replaced conventional aggregate in some applications.

Other strategies

Apart from material selection, there are other strategies that can be employed to reduce the embodied energy footprint. Detached housing sizes in Australia are generally large and are among the highest in the world. The average floor area of new houses has remained within 230-245m² over the past two decades, while more recent data indicates an average of approximately 250m² for new detached houses (Ref.5, Ref.6). Reducing unnecessary floor area therefore represents one potential strategy for lowering material use and associated embodied energy. While the housing industry attempts to provide standardisation within the housing footprint, personal variations are reasonably common. The concept of modular construction offers potentials for reduced cost (and construction waste) but has not had strong support in the private sector market.

Things we can do

In reviewing conventional detached housing, the methods of construction and the materials used, there are many options to reduce embodied energy. There is considerable research being undertaken to identify materials and design systems that will achieve this.

Modern methods of construction

The Housing Accord program provides a provision of \$54 million to promote the use of modular and prefabricated housing. As a consequence, there has been considerable stimulus to what has been referred to as modern methods of construction (MMC), essentially prefabricated and modular construction. This type of housing has not been successful in the past as it requires considerable investment in infrastructure (buildings and equipment) and training of the workforce. Such investments require continuity of production. This did not previously occur due to poor uptake by the private sector and little or no social housing investment, but in recent years this situation has been reversed with both federal and state governments announcing considerable investments in both social and affordable housing. A specific focus for MMC has been the reduction of embodied carbon through the use of timber and light gauge steel cladding. In addition, because the components are built in a factory, there is far less waste, the modular units are typically lighter, there is less fuel used in transporting the units to site, and there is an opportunity to reuse some of the components as many of them are bolted together.





Conclusions

Demand for new detached housing in Australia is expected to remain strong, while builders continue to face challenges including rising costs, labour shortages, regulatory complexity and limited land supply. At the same time, population growth is increasing competition for housing and placing further upward pressure on prices.

Reducing the embodied carbon of new homes presents an additional challenge for a sector under pressure to deliver housing quickly and at scale. However, it is not an insurmountable one. Modern methods of construction, lower-carbon materials, innovative financing models and targeted policy reforms can all help reduce emissions while supporting the delivery of more affordable homes. As Australia expands its housing supply, addressing embodied carbon should be part of the solution, not an afterthought.

References

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