Policy Brief:

Reducing Lifetime Building Emissions by Design Through Life Cycle Assessment

Buildings account for approximately 40% of global greenhouse gas (GHG) emissions. Choices at the design stage can significantly reduce their total lifetime emissions. Enabling policies and tools will help the building industry make the required substantial contribution to meeting Australia's net zero carbon emissions by 2050 target.

Assessing only operational emissions underestimates the full carbon impact of buildings. Embodied carbon made up 16% of Australia's built environment emissions in 2019. With increasing energy efficiency in buildings, the relevance of embodied GHG emissions is growing globally in both relative and absolute terms as shown in Figure 1.

Life cycle assessment (LCA) is a tool that allows architects and building professionals to quantify the environmental impacts, including carbon, associated with all phases of a building's life cycle: procurement, construction, operation, and decommissioning. This enables them to make decisions that will reduce emissions at the crucial design stage.

Policymakers can help the building industry transition to more sustainable practices by implementing LCA regulations, fostering the development of assessment tools, and setting robust environmental benchmarks. Adopting these measures will guide the buildings sector towards substantially reducing its emissions, helping to meet national and global climate targets.

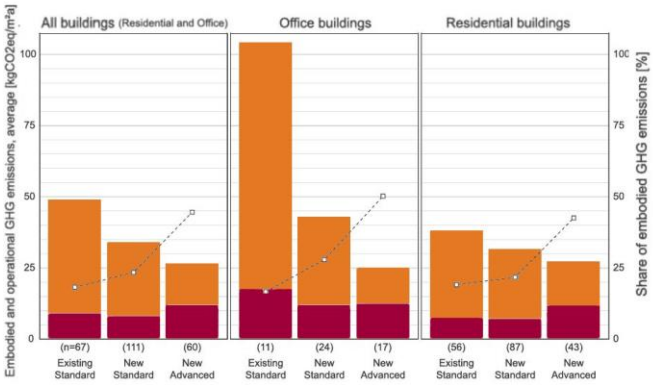

Figure 1 Global trends in embodied and operational, lifecycle GHG emissions. Roeck et al 2020 Embodied GHG emissions of buildings – The hidden challenge for effective climate change mitigation. Red = EC, Orange = OC

Recommendations for policymakers

With the right policy framework, design tools, and benchmarks, the construction industry can contribute significantly to global efforts to mitigate climate change.

- **Focus on embodied greenhouse gas emissions**: Construction-related emissions, especially from building materials and product manufacturing, need to be urgently addressed. These embodied GHG emissions, most of which are realised upfront, contribute to approximately 10% of global emissions and must be reduced.
- **Implement life cycle assessment legislation**: By 2028, there should be legally binding requirements for limiting life cycle-related GHG emissions for new constructions and refurbishments and a roadmap to achieve net-zero life cycle-related GHG emissions by 2050 (Australia's current target). Many scientists believe this should be by 2035.
- **Develop environmental benchmarks**: Clear benchmarks and target values for GHG emissions throughout a building's life cycle are crucial. These should be aligned with global emissions budgets and planetary boundaries. Net-zero GHG emissions should be the universal benchmark for all building types, with intermediate benchmarks guiding the path toward this goal.
- **Establish national LCA databases**: Nationally consistent LCA databases need to be urgently developed. They must include data on construction materials, technical systems, energy supply, transport, and waste management, helping to standardize emissions accounting.
- **Prioritize data quality and transparency**: LCA data must be consistent, fully transparent, independently reviewed, and well-documented to ensure reliability. High-quality data helps in making informed decisions that reduce the environmental impacts of buildings.

Background and context

The potential of life cycle assessment

Investment decisions made today largely determine the environmental impacts of buildings over many future decades due to their long lifetimes. Such decisions involve economic, emissions and environmental trade-offs between additional investments today and potential savings during use and at end of life. Since the cost of construction does not fully account for external environmental effects, environmental resources are used inefficiently.

LCA can be used to integrate economic considerations and environmental impacts when planning and designing buildings before concrete is poured and resources are committed. LCA helps to identify measures to increase the resource efficiency of buildings and construction.

International progress

Many countries, including Denmark, Switzerland, Finland, Belgium, Sweden and Austria, are developing LCA standards, methods and tools to assess environmental impacts in building design. These have enabled the development of legally binding requirements for limiting life cycle-related GHG emissions for new construction and refurbishment and a roadmap to achieve net-zero life cycle related emissions.

In 2023, Denmark set a requirement in their building code to measure the entire lifecycle environmental impact of new buildings at the design stage.

Environmental legislation has previously targeted the energy consumed in a building during operation.

Construction companies must conduct LCAs estimating the impact of a proposed new building over 50 years. New buildings above 1,000 m^2 must also comply with a carbon emissions limit of 12 kg CO_2/m^2/year. That limit will reduce in 2025. Figure 2 shows examples of new and retrofitted buildings that comply with this limit.

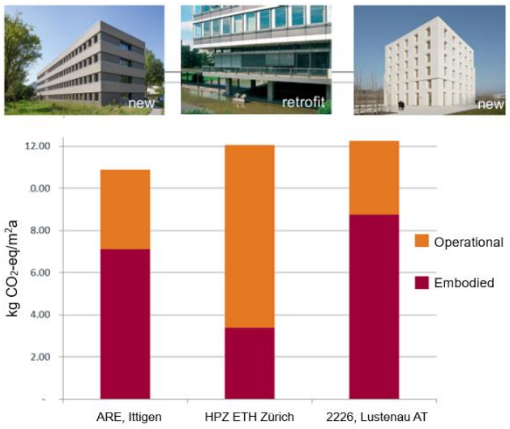

Figure 2: Embodied and operational greenhouse gas emissions (kg CO2-eqper m2 and year) of three office buildings in Switzerland and Austria (two new and one retrofit building); lifetime: 60 years. Source: Tschümperlin et al. 2016

Currently, Australia lacks the ability to similarly measure and manage embodied emissions from new construction.

LCA and embodied carbon in Australia

Developing a consistent method for measuring, benchmarking and verifying embodied carbon is a critical step towards enabling Australia to achieve its emissions targets. The National Australian Building Energy Rating Scheme (NABERS) is following the European approach and has developed a tool to measure embodied carbon. As Australia is already advanced in measuring operational emissions through tools such as NABERS/Mandatory Commercial Building Disclosure, it is the right time to combine these and focus on lifetime building emissions.

Further reading

Project Summary Report, Feb 2023.

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IEA EBC Annex 72 publications.

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