

Embodied Opportunity

How companies in the building and construction sector can benefit from addressing embodied carbon

In the building and construction sector, sustainability has traditionally focused on operational efficiency and reducing energy use. But with more and more companies, governments and institutions pledging to reach net-zero, the sector is facing pressure to minimize carbon emissions throughout all life cycle stages of a building project. This carbon is referred to as embodied carbon.

The good news is that the actions you take to reduce embodied carbon can translate into business opportunity. Let's find out how.

Meet embodied carbon

The building and construction sector emitted 39% of global carbon emissions in 2018, surpassing emissions from transportation (23%) and industry (32%).

Of that 39%, 28% is attributed to **operational carbon** and 11% to **embodied carbon**, although **in some cases embodied carbon represents up to half of a building's carbon footprint**. As well, the **relative embodied carbon associated with building materials is increasing** while operational carbon is decreasing.

What is net-zero, anyway?

Net-zero means that, over a defined time period, the amount of greenhouse gas (GHG) emissions emitted minus the GHG emissions removed from the atmosphere equals zero. GHG emissions are normally expressed as a carbon equivalent (CO₂e), which is what we mean when we refer to carbon emissions throughout this guide.

So, what's the difference between operational and embodied carbon?

Operational carbon includes emissions associated with the day-to-day operations of a building—think heating, cooling and lighting. Energy efficiency measures and building electrification minimize energy consumption and eventually, if buildings are drawing on clean electricity, this results in zero operational carbon.

Embodied carbon, on the other hand, considers emissions associated with the full life cycle of all building materials, from raw material extraction to demolition.

Embodied carbon is expected to be responsible for **72% of the global emissions** associated with new construction between now and 2030, and unlike operational carbon, it can't be reduced after a building is constructed. With the timeline for meaningful climate action shrinking, it's imperative to address embodied carbon as soon as possible.

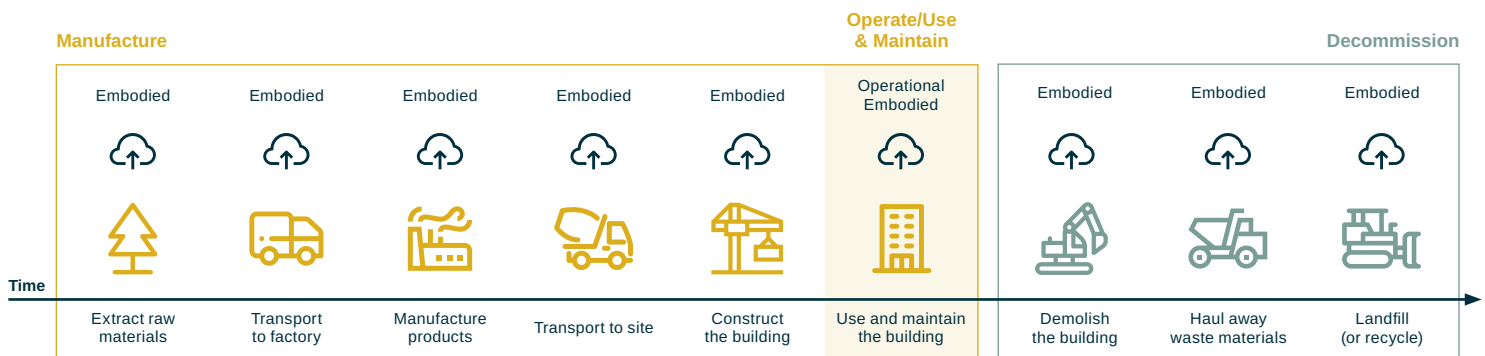


Figure 1: Embodied and operational carbon emissions from building life cycle stages. Source: [The Atmospheric Fund \(TAF\)](#).

Addressing embodied carbon is good for business

Addressing embodied carbon can provide three main advantages to your business:

- 1** **It can provide cost savings.** Embodied carbon reduction is centred around optimizing building design and its associated processes to ensure the efficient transportation, construction, and use of resources and materials. Put simply, efficiency translates into cost savings. Anglian Water demonstrated that by tracking embodied carbon, they have **reduced the cost of their infrastructure projects by 30-50%**.
- 2** **It can foster resilience.** With extreme events expected to increase in the coming years, volatile markets and rising material costs are expected. By ensuring that materials and processes are designed for efficiency, you can mitigate your risk. As an added bonus, embodied carbon encourages long-term thinking, which means that you can deliver projects that are designed for longevity.
- 3** **It can boost your reputation.** Embodied carbon is quickly becoming best practice, with many green building certifications already including embodied carbon elements. As the sector increasingly seeks to mitigate embodied carbon, position yourself at the forefront and welcome new opportunities for collaboration and innovation.

Accounting for embodied carbon will fundamentally transform the way we design, build and construct. With the Government of Canada's recent commitment to **net-zero carbon emissions by 2050**, it's only a matter of time before embodied carbon becomes mainstream. Expect consideration of embodied carbon in upcoming building codes, regulations and even carbon tax discussions.

Green building certifications

Here are some of the green building certifications available in Canada that account for embodied carbon:

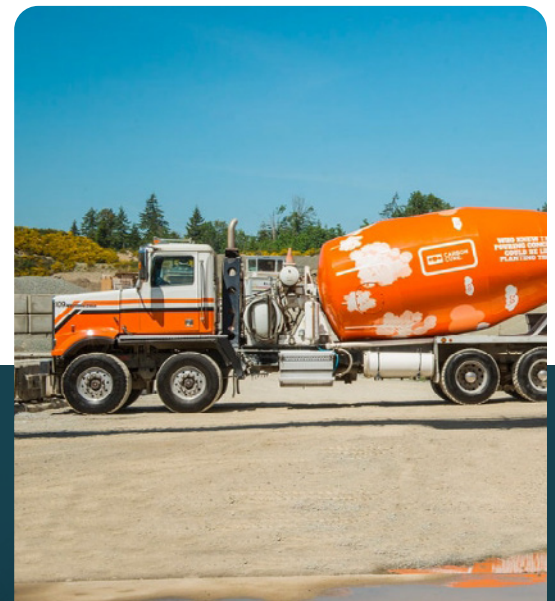
Leadership in Energy and Environmental Design (LEED) is the most widely used green building rating system in the world.

Building Research Establishment Environmental Assessment Methodology (BREEAM) is an international environmental assessment method and rating system for buildings.

Building Owners and Managers Association's Building Environmental Standards (BOMA BEST) is the Canadian industry standard for commercial building sustainability certification.

Zero Carbon Building Standard, from Canada's Green Building Council (CaGBC), provides two certification pathways for new and existing buildings to reach zero carbon.

PHIUS+ Certification program is North America's leading passive building certification program.



Case Study

CarbonCure

CarbonCure, located in Dartmouth, Nova Scotia, is rocking the concrete industry. Using their innovative technology, they inject carbon dioxide (CO₂) into wet concrete mixes, which reacts to create a mineral that locks in CO₂ emissions and creates a stronger concrete product. In addition to lots of recent media attention, they've received financial backing and a **special shoutout from Bill Gates**.

Ways to reduce embodied carbon

Now that we've explored the business case for addressing embodied carbon, let's discuss strategies you can use to reduce it.



Measure it

To understand where to focus your efforts, it's imperative to measure the carbon footprint of your build or retrofit project. Use whole building life cycle assessment (WBLC) tools to calculate your project's carbon footprint and make informed, low-carbon build decisions. Be on the lookout for the areas where your actions will have the biggest carbon reductions.



Re-develop an existing building

Whenever feasible, building structures should be maintained to conserve the carbon that has already been invested. This can be achieved with building retrofits or adaptive re-use, where a building structure is maintained but used for a different purpose. As an added bonus, this option often preserves historical value.



Use innovative material and design strategies

Material choices greatly influence the amount of embodied carbon in your build. Concrete and steel, heavily relied upon in the building and construction sector, **represent 5% and 6.6% of global greenhouse gas emissions**. Make low-carbon material choices and consider using reclaimed or recycled materials. Even more important is your build design: Can you use carbon-intensive materials more efficiently? Can you innovate to use less materials overall? Does the size of the design meet or overshoot the needs of your client?



See waste as a resource with circular design

Demolition currently represents a **significant waste stream in many countries** and a **noteworthy portion of a building's end of life carbon**. In the United Kingdom, the draft London Plan outlines a spatial development strategy that embodies circular design principles. This approach should be carefully studied and used to inspire North American action. If you'd like to learn more about the circular economy, check out our **Insights Guide—Growing in Circles**.

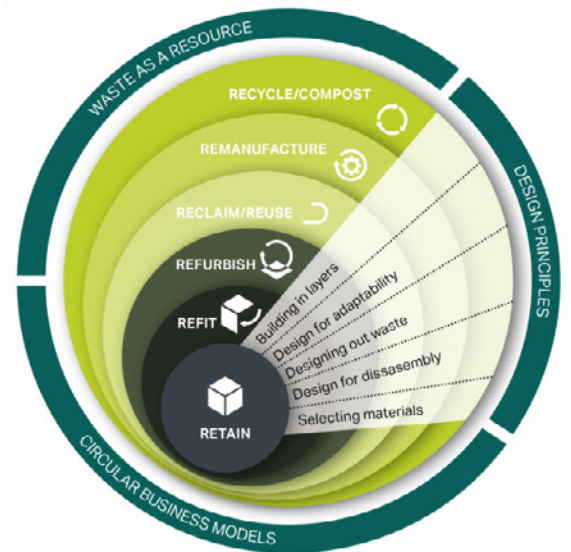


Figure 2: Circular economy design principles for buildings. Source: [AECOM](#).



Designing Differently

Off-site modular construction

Off-site modular construction flips convention on its head. Typically, a building is assembled piece by piece on-site, but modular construction delivers a building in pre-assembled segments. Factory assembly eliminates the challenges of unpredictable weather, means shorter construction times, and reduces waste and emissions. Off-site construction is an **established market in Europe that's beginning to emerge in North America**.

Many of these methods, such as whole building life cycle assessment (WBLC) and choosing **low embodied carbon building materials**, are well within our current abilities. In Canada, the application of **circular design principles in the building and construction sector** is in the early stages of development.

Your role in addressing embodied carbon

To get started, talk to your stakeholders about embodied carbon and understand how you can address it in your own operations. From there, you could form coalitions in your industry to address embodied carbon together, or join an existing one such as the [Canada Green Building Council](#). The knowledge that you acquire and relationships that you build can help future-proof your operations and simultaneously appeal to increasingly climate-conscious clients and investors.

Reaching net-zero by 2050 requires collaboration and action from business stakeholders across the sector, such as investors, developers and designers. To better understand the role you can play in addressing embodied carbon, check out the [World Green Building Council](#) calls to action:

Business Stakeholder	Call to Action
Investors	Scale up investments in support of net-zero embodied carbon and trigger market demand
Asset owners and occupiers	Pursue circularity by extending the life of infrastructure through regular maintenance and reuse and recycling of building material
Developers	Influence and accelerate supply chain action by embracing the business opportunity of net-zero embodied carbon
Contractors	Act as a central knowledge hub for embodied carbon data (e.g. through environmental product declarations) and source equipment that runs on renewable energy or biofuels
Designers	Unleash design that incorporates life cycle thinking and reduces embodied carbon from the outset
Manufacturers	As a central driver, deliver products that support the vision of net-zero carbon emissions

Additional Resources



Best practices and standards:

[Circular Economy Global Sector Best Practices—Construction Zero Carbon Certification](#)



Whole building life cycle assessment tools:

[Tally](#)
[Athena Impact Estimator](#)
[Bionova's One Click LCA](#)



Low carbon material information:

[Carbon Smart Materials Palette](#)
[Inventory of Carbon & Energy database](#)



Membership and industry organizations:

[Urban Land Institute](#)
[Canada Green Building Council](#)
[Carbon Leadership Forum](#)
[BuildingGreen Peer Networks](#)



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