The Green Premium in Construction

Prepared by: Ruta Ozolina, Caitlin Fuge

Many of the most commonly used construction materials today rely on energy-intensive, mineral-based extractive processes, and their emissions are set to increase. The figure 1 on the right visualises the predicted emission increase per material in a business-as-usual scenario (Zhong et al., 2021).

The transition to environmentally friendly construction materials often comes at a financial cost known as the "green premium." This report explores the comparative cost and environmental impact of conventional versus sustainable alternatives for six key building materials: cement, concrete, steel, aluminum and glass. The stacked bar graph below shows the embodied carbon percentage breakdown by traditional material across five key building types.

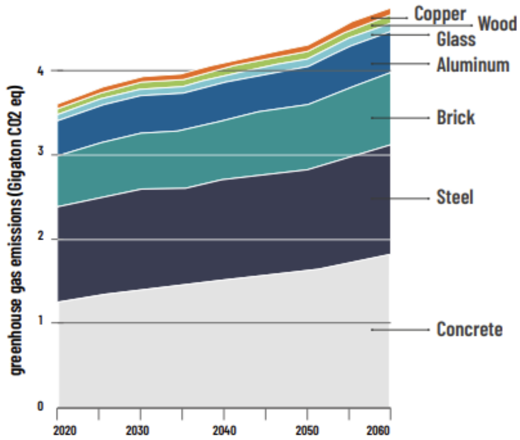
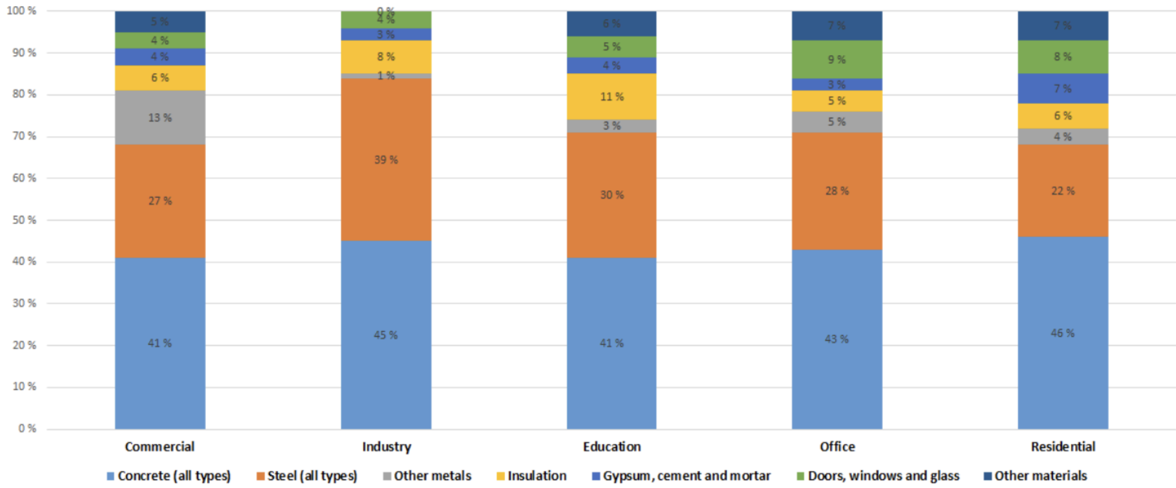


Figure 1: Predicted emission increase per material in a business-as-usual scenario (Zhong et al., 2021)



material for five building types (One Click LCA, 2021)

Cement and Concrete

Cement production is one of the most carbon-intensive industrial processes, accounting for roughly 7% of global CO_2 emissions. Furthermore, 88% of the total emissions of concrete are coming from cement manufacturing (Nisbet et al. 2002). This further divides into emissions from chemical calcination of limestone into clinker (53%) and fossil fuels being burned to heat cement kilns (35%) (Energy Monitor, 2023). As shown

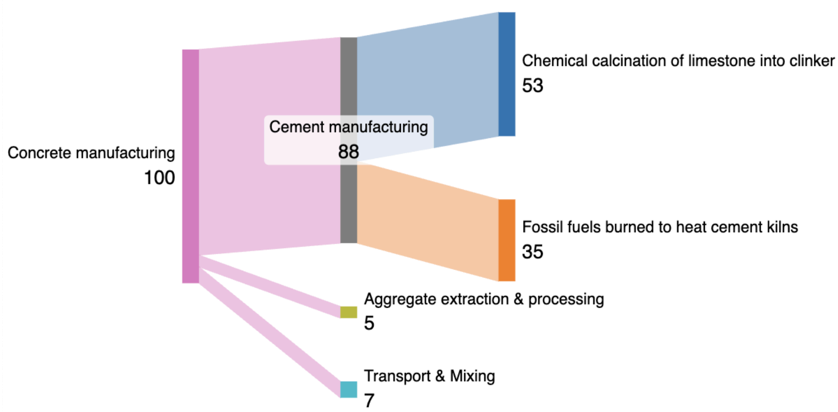


Figure 3: Emission breakdown of concrete (Nisbet et al. 2002; Energy Monitor, 2023)

in Figure 3, the largest reductions in emissions for concrete can be achieved when changing cement manufacturing methods.

In the GCC, traditional cement costs range from AED 250–350 per ton (Dubai Statistics Center, 2019). Sustainable alternatives like geopolymer cement and blends using Ground Granulated Blast Furnace Slag (GGBS) can reduce carbon emissions significantly. GGBS, priced around AED 220/ton, may actually reduce overall costs when blended with Portland cement. More experimental alternatives such as Ashcrete can lower environmental impact but may carry a moderate premium due to limited production and application knowledge (Re-thinking The Future, 2023). Further strategies for decarbonising concrete production can be found in the appendix.

Steel

Conventional steel produced via blast furnaces emits high levels of CO_2. In contrast, Electric Arc Furnace (EAF) steel, often made with recycled scrap, reduces emissions by up to 80%. Advanced sustainable variants like hydrogen-based Direct Reduced Iron (H_2-DRI) or molten oxide electrolysis (MOE) steel are not yet widely adopted in the GCC and would likely involve significant cost premiums due to new infrastructure requirements. Global research on the green premium of H_2-DRI shows up to a 10% premium in comparison to steel produced in regular blast furnaces (Global Efficiency Intelligence, 2021). Research in Europe estimates this premium to reach 20-40% (Breakthrough Energy, 2025). The recycled steel prices (AED 2,350–2,600/ton) however are roughly on par with traditional steel, implying a negligible green premium (Dubai Statistics Center, 2019).

Aluminum

Global best practices show that producing aluminum from recycled scrap can cut energy demand by 70–90%, only about 34% of global aluminum in 2019 came from scrap (UN Environment Programme and Yale Center for Ecosystems + Architecture, 2023). Sustainable alternatives are limited, as aluminum's unique properties (lightweight, corrosion-resistant, and strong) make it difficult to substitute in many applications. Reports on the green premium on aluminum vary significantly depending on the region, due to accessibility of aluminum scrap as well as energy costs. In Europe the premiums reach around 10% (McKinsey & Company, 2023) while in other parts of the world it has been proven to reach 40% (Kajrolkar, 2024). Considering the low availability of aluminum scrap and comparably cheap cost of non-renewable energy sources, the most viable long-term solution is to decarbonize the regional energy grid, leveraging the GCC’s abundant solar resources.

Glass

Traditional glass production is highly energy-intensive. Sustainable alternatives include recycled glass and low-carbon glass, which use higher percentages of recycled content (up to 70%) and renewable energy sources in production (Saint-Gobain, 2023). Recycled glass use in the UAE is still limited due to technical and awareness barriers, low-carbon glass, though more expensive, offers better thermal performance and sustainability credentials (Saint-Gobain, 2023). The green premium for these products can range from 5–20% (PW Consulting Chemical & Energy Research Center, 2025).

Conclusion

In cases like GGBS concrete and recycled steel, the green premium is negligible or even cost-saving. For advanced technologies like H_2-DRI steel and low-carbon glass, higher initial costs may be offset by long-term performance and regulatory benefits. Increased local production capacity, incentives, and regulatory support will be key to narrowing the green premium and achieving sustainable construction goals across the region. An overview of the green premium per material type is summarized in Table 1.

High-level recommendation for what should be prioritized for each material:

- Cement & Concrete - Cement can be decarbonized by reducing the clinker-to-cement ratio, increasing the share of cement alternatives, and shifting towards renewable energy-powered kilns. Policy is also a top enabler, as mandates can force industry-wide shifts.
- Steel - In primary steel production, a shift away from blast furnace production and towards reduced iron technology, renewable energy-powered furnaces, and necessary infrastructure, such as hydrogen pipelines or scrap hubs, should be constructed.
- Aluminum - As production is highly energy-intensive, decarbonizing the energy grid has the highest potential, including grid modernization and utility-scale renewables.
- Glass - Decarbonize production and boost window glass recycling should be prioritized.

Table 1: Green premium expressed as a percentage per material type

Material	**Green Premium**
Cement & Concrete	0-120%
Steel	10-40%
Aluminum	10-40%
Glass	5-20%

Appendix

Table 2: Chemical calcination of limestone into clinker

Technology	Details	Emissions saved	Green premium
Supplementary cementitious materials	Fly-ash or slag replaces 30-50% of clinker	↓ 10-20% CO_2	0%
Limestone Calcined Clay Cement (LC^3)	Blends clay and limestone to replace 50% clinker	↓ 40% CO_2	0%
Electrochemical cement	No high-tempterature limestone calcination	↓ 100% CO_2	+135%

Table 3: Fossil fuels burned to heat cement kilns

Technology	Details	Emissions saved	Green premium
Green hydrogen fuel	Hydrogen burnt in cement kilns	↓ 30-40%	+20%
Electrification of kiln heating	Electric heaters	↓ 35-40%	+27-45%
Waste derived fuels	E.g. shredded tires, non-recycled plastics, etc.	↓ 40%	0%

Sources

Breakthrough Energy (2025) *Carbon removal costs and climate impact: Steel sector analysis*. [pdf] Available at: https://www.breakthroughenergy.org/wp-content/uploads/2025/02/CRC3-STEEL.pdf [Accessed 8 June 2025]

Dubai Statistics Center (DSC) (2019) *Average prices of building materials - 2019*. [pdf] Dubai Statistics Center. Available at: https://www.dsc.gov.ae/Report/202019%-20%متوسط20%أسعار20%مواد20%البناء.pdf [Accessed 30 May 2025]

Energy Monitor (2023) *Decarbonising Cement: Why the hold up?* Energy Monitor. Available at: https://www.energymonitor.ai/sectors/industry/decarbonising-cement-why-the-hold-up/ [Accessed 30 May 2025]

Global Efficiency Intelligence (2021) *Green Steel: Economics*. [online] Available at: https://www.globalefficiencyintel.com/green-steel-economics [Accessed 30 May 2025]

Kajrolkar, O. (2024) *The green premium explained*. *Illuminem Voices*, 26 November. Available at: https://illuminem.com/illuminemvoices/the-green-premium-explained [Accessed 8 June 2025]

Kondolf, G.M., Podolak, K. and Walker, R.F. (2022) 'The environmental impacts of river sand mining', *Science of The Total Environment*, 829, p.154924. Available at: https://www.sciencedirect.com/science/article/pii/S0048969722029746 [Accessed 23 May 2025]

McKinsey & Company (2023) *Aluminum decarbonization at a cost that makes sense*. [online] Published 20 April. Available at: https://www.mckinsey.com/industries/metals-and-mining/our-insights/aluminum-decarbonization-at-a-cost-that-makes-sense [Accessed 8 June 2025]

Nisbet, M., Marceau, M., and VanGeem, M. (2002) *Environmental Life Cycle Inventory of Portland Cement Concrete*. Portland Cement Association. Available at: https://web.archive.org/web/20170516142547/https://www.nrmca.org/taskforce/item_2_talkingpoints/sustainability/sustainability/sn2137a.pdf [Accessed 8 June 2025]

One Click LCA (2021) *Embodied carbon benchmarks for European buildings*. [pdf] Available at: https://143253260.fs1.hubspotusercontent-eu1.net/hubfs/143253260/Ebooks/Embodied-Carbon-Benchmarks-for-European-Buildings-10-June-2021-FINAL.pdf [Accessed 8 June 2025]

PW Consulting Chemical & Energy Research Center (2025) *Decorative Glass for Construction Market*. [online] PW Consulting. Available at: https://pmarketresearch.com/chemi/decorative-glass-for-construction-market/ [Accessed 30 May 2025]

Re-thinking The Future (2023) *Alternative Material: Ashcrete*. [online] Available at: https://www.re-thinkingthefuture.com/materials-construction/a4497-alternative-material-ashcrete/ [Accessed 23 May 2025]

United Nations Environment Programme and Yale Center for Ecosystems + Architecture (2023) *Building materials and the climate: Constructing a new future*. [online] United Nations Environment Programme. Available at: https://wedocs.unep.org/20.500.11822/43293 [Accessed 8 June 2025]

Zhong, X., Hu, M., Deetman, S., Steubing, B., Lin, H.X., Hernandez, G.A., Harpprecht, C., Zhang, C., Tukker, A. and Behrens, P. (2021) 'Global greenhouse gas emissions from residential and commercial building materials and mitigation strategies to 2060', *Nature Communications*, 12, Article number: 6126. Available at: https://doi.org/10.1038/s41467-021-26212-z [Accessed 8 June 2025]