CareEdge-ESG's insights

LC3: Cementing a Greener Future

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Cement's Carbon Footprint

Cement is one of the most widely used construction materials in the world — and also one of the most carbon-intensive. Its environmental impact is significant, especially in terms of greenhouse gas (GHG) emissions. ~7-8% of global CO_2 emissions come from cement production, making it the third-largest industrial emitter after steel and chemicals. For every tonne of cement produced, approximately 0.8 to 0.9 tonnes of CO_2 are emitted. The major sources of emission in the cement production process are:

- **Clinker production (calcination):** Limestone ($CaCO_3$) is heated to produce lime (CaO), releasing CO_2 — this process alone accounts for ~60% of emissions.
- **Combustion of fossil fuels:** High temperatures (around 1450°C) are required in kilns, typically achieved by burning coal or petcoke — contributing to ~30-35% of emissions.
- **Electricity use & transport:** Remaining emissions stem from energy use for grinding, mixing, and transporting raw materials and final product.

Cement is indispensable to infrastructure but comes with a heavy environmental cost. Addressing its carbon footprint is critical for meeting global climate goals. Solutions exist — but require policy support, industry innovation, and large-scale adoption to shift toward a greener, more sustainable cement industry.

What is the cement type – LC3?

JK Cement has achieved a major milestone in becoming the first company in the Indian subcontinent to launch the commercial production of LC3 or Limestone Calcined Clay Cement[1]. This is a major stride towards sustainable infrastructure and the global transition to low-carbon construction materials.

Cement's environmental impact stems largely from clinker, its most carbon-intensive component. This is why the PPC (Portland Pozzolana Cement) type of cement is more environmentally friendly than OPC (Ordinary Portland Cement), since the former replaces a part of the clinker with fly ash, which is a byproduct of coal power plants. LC3 further reduces the use of clinker in its production with its typical composition comprising ~50% clinker, 30% calcined clay, 15% limestone and 5% gypsum[2].

OPC, PPC, LC3: A Comparative Analysis

Feature	OPC	PPC	LC3
Clinker Content[3]	90–95%	~65–75%	~50%
Additives	Gypsum only	Fly ash or volcanic ash	Calcined clay + Limestone
CO_2 Emissions[4]	High	Moderate (15–20% lower)	Low (up to 40% lower)

[1] The Economic Times. (2025, August 7). JK Cement becomes first Indian subcontinent company to commercially produce LC3 cement. The Economic Times. Retrieved from https://economictimes.indiatimes.com
[2] Scrivener, K. L., Martirena, F., Bishnoi, S., & Maity, S. (2018). Eco-efficient cements: Potential economically viable solutions for a low-CO_2 cement-based materials industry. United Nations Environment Programme. Retrieved from https://www.researchgate.net/publication/327655392
[3] Cement Manufacturers Association. (2022). Annual cement industry emissions report. New Delhi: CMA Publications.; Central Pollution Control Board. (2020). Environmental standards and emissions data for the cement sector in India. Ministry of Environment, Forest and Climate Change, Government of India.
[4] Danjaji, M. B., Bishnoi, S., & Maity, S. (2021). Life cycle assessment of the production of LC3 in India and Cuba: Comparison to OPC and blended cements. Resources, Conservation and Recycling, 172, 105812. https://doi.org/10.1016/j.resconrec.2021.105812

Strength & Durability	High early strength	Higher long-term strength	Comparable to OPC, sometimes better
Cost	High	Slightly cheaper than OPC	Cheaper or similar to OPC
Supply Chain Issues	Stable	Fly ash scarcity is emerging	Clay & limestone are widely available
Scalability	Already dominant	Widespread	Scalable, under expansion

Key strengths of LC3

LC3's key strengths also include that it requires no change in on-site handling or application. From mixing to curing, it behaves almost identically to OPC, working seamlessly with existing equipment, standard water ratios, and construction practices[5]. It also offers comparable strength and durability to OPC. It is expected to be more cost-effective than OPC since LC3 relies on less energy-intensive materials, reducing both raw material and production costs over time. For cement companies, this means they can significantly reduce their carbon footprint without compromising on performance or cost, thus making it especially attractive for commercial-scale adoption.

Barriers to large-scale production of LC3

However, commercialising LC3 is not straightforward. It demands:

- Specialized calcination units since clay is calcined at ~700–800 °C, much lower than clinker which calcines at ~1450 °C[6].
- A continuous supply of calcined clay that has a specific clay-limestone ratio. Any change in the composition of the calcined clay won't produce strong cement.
- Fine-tuned grinding and hydration processes since LC3 utilises a blend of different materials of different hardness and particle sizes. Improper grinding or hydration leads to reduced performance.
- Regulatory approvals for this new cement to be sold and used in large-scale projects. The Bureau of Indian Standards (BIS) formally recognised LC3 in June 2023, setting protocols and benchmarks.[7]

Being one of the world's largest cement producers and consumers, a successful LC3 rollout could help steer market demand and policy shifts towards green construction norms, which would significantly reduce emissions and reduce reliance on clinker imports. Globally, pioneers from Ghana, other parts of Africa, Cuba, and Colombia have also begun commercial LC3 production, with many more companies from various other countries like Switzerland, Germany and Spain expected to follow suit.

[5] LC3 Project. (n.d.). Limestone Calcined Clay Cement – A low-carbon cement innovation. École Polytechnique Fédérale de Lausanne (EPFL), IIT Delhi, IIT Madras, and TARA. Retrieved August 7, 2025, from https://www.lc3.ch

[6] Scrivener, K. L., Martirena, F., Bishnoi, S., & Maity, S. (2018). Eco-efficient cements: Potential economically viable solutions for a low-CO_2 cement-based materials industry. United Nations Environment Programme. Retrieved from https://www.researchgate.net/publication/327655392

[7] Bureau of Indian Standards. (2023). IS 18189:2023 – Limestone Calcined Clay Cement – Specification. New Delhi: Bureau of Indian Standards.

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